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Title:

Spreadsheet Packages for Microcomputer Users

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Synopsis

Spreadsheet packages are now available for virtually all microcomputers and present the user with a screen which is set up like a large sheet of squared paper. The spreadsheet is used by moving the cursor to any particular location and entering there a piece of text, a numeric value, or a formula linking numeric values on the spreadsheet. The equations are then calculated by the spreadsheet program so that only the answers appear on the screen; the final sheet can be printed on paper. The more sophisticated spreadsheets can express selected rows or columns as line graphs, pie charts or histograms. Potential uses of spreadsheets range from self-contained models such as cashflows to matrix manipulations, graphical presentations of results or carrying out simple summary statistics. Data held by a spreadsheet package may be used as input to other packages.

Keywords

cashflows, histograms, line graphs, pie charts, spreadsheets, statistics

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SPREADSHEETS

Spreadsheet packages are now available for virtually all microcomputers. This Note explains what a spreadsheet is, suggests different ways of using spreadsheets, and gives some yardsticks by which to assess the different spreadsheets on offer.

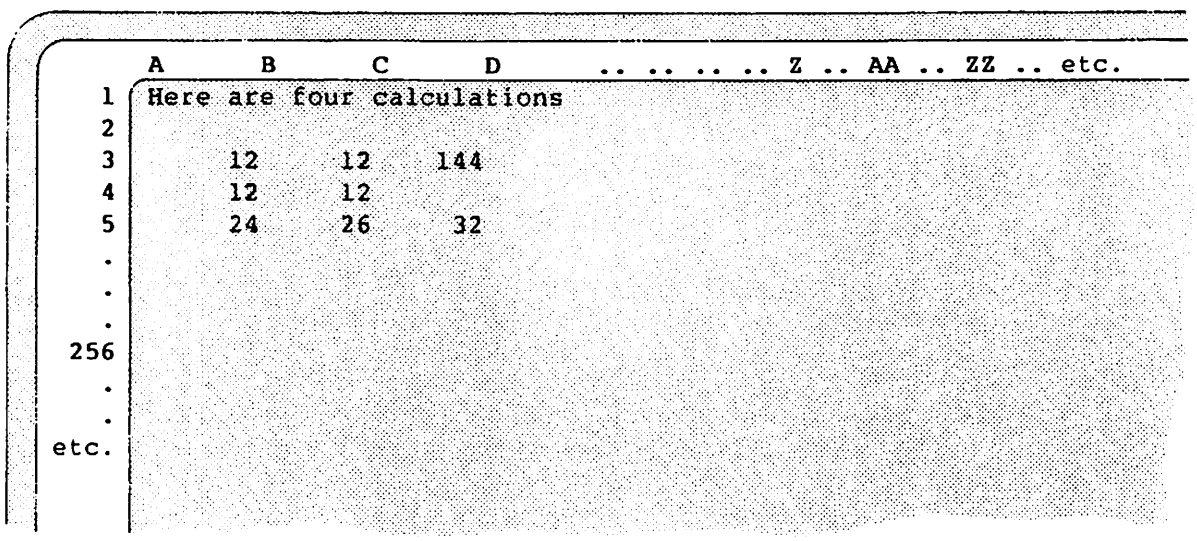
DESCRIPTION OF SPREADSHEETS

All spreadsheets present the user with a screen which is set up like a large sheet of squared paper, with columns across the top usually labelled A to Z, followed by AA to AZ etc., and rows down the side labelled 1 to 256 or more. The spreadsheet is used by moving the cursor to any particular location (from A1 to ZZ256) and entering there some text, a numeric value, or an equation linking numeric values on the spreadsheet (for example A1*B10+2). The equations are then calculated by the spreadsheet program so that only the answers appear on the screen; the final sheet can be printed on paper.

The same spreadsheet package can be used over and over again, starting each time with a blank sheet and filling in different numeric values, formulae and text. I will call the whole package a 'spreadsheet', and any particular set of data a 'worksheet'. Each worksheet can be saved to disc and recalled individually at any time.

The more sophisticated spreadsheets can express selected rows or columns as line graphs, pie charts or histograms.

Fig 1. Diagram of a small worksheet:
the cell references are shown underneath with their worksheet contents in brackets. Each column is 7 characters across.

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A1 (Here ar)      B1 (e four )      C1 (calcula)      D1 (tions  )
A2 (Blank  )      B2 (Blank  )      C2 (Blank  )      D2 (Blank  )
A3 (      12)     B3 (      12)     C3 (A3*B3  )      D3 (Blank  )
A4 (      12)     B4 (      12)     C4 (Blank  )      D4 (Blank  )
A5 (A3+A4  )      B5 (B3+B4+2)      C5 ((C3/A5)+B5+(A3*B3)) D5 (Blank  )
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Note that even though the column width in this example was 7, the formulae are allowed to be much longer than this.

USE OF SPREADSHEETS

The simplest way to use spreadsheets is to build self-contained models such as cashflows and budgets which carry out simple totalling of columns of figures. Any of the spreadsheets on the market could do this. Once a cashflow has been typed in, the user can alter selected values, when the results will be recalculated automatically. This is called a 'what-if' investigation. In effect you have an intelligent typewriter which will total your figures automatically.

Going to the other extreme, spreadsheets can be used to demonstrate algebraic problems (such as linear, quadratic and general polynomial functions), matrix manipulations and simultaneous equations, and can be used in the study of calculus.

Another practical application is to send the results from an "ordinary" program (for example a program written in FORTRAN or BASIC) to a spreadsheet in order to carry out further analysis of the results. Most spreadsheets can accept data from a computer file (ASCII or other format). Since the better spreadsheet packages are able to present any row or column in the form of a line graph, pie chart or histogram, results from "ordinary" programs could be presented on screen as graphs or histograms, and printed out graphically on to paper. This could be done by users with little computing experience.

More complex models can be built if it is possible to exchange values between separate worksheets. The limitation with a single worksheet is that values must be changed one by one; the user has to search about on screen to find the particular value to be changed. Where several worksheets all use the same value (for example the price of barley) this value needs to be changed separately on each sheet, which is boring, time-consuming and carries the possibility of typing errors. If a master worksheet can hold certain values, and slave worksheets automatically pick them up, much time can be saved and larger models become feasible. A database of prices can be typed in to one worksheet, and costings based on these prices produced on slave worksheets.

Spreadsheets are also useful tools to complement word processing packages in the preparation of tables or columns of figures. Figures in different columns can be either left or right justified, and on most spreadsheets the width of the columns can be varied independently and changed at any time. Blocks of figures and/or text can be moved around the sheet as you improve the layout of your document. Some spreadsheets allow you to type text across several columns; none however will perform automatic 'wrap' onto the next line as a word processing package will do.

Each spreadsheet package has a theoretical maximum size of worksheet; however the size of worksheet that can actually be constructed depends on the size of memory in the computer. The spreadsheet program and the worksheet are both held in memory as long as the program is being used, although afterwards the particular worksheet can be saved on to disc. If you find that you run out of space on your worksheets, buying more memory will give you more room, up to the maximum size permitted by the spreadsheet package. However, size limitations are unlikely to occur using modern microcomputers with 256K or more memory unless you are producing exceptionally complex worksheets.

SPREADSHEET FEATURES WHICH VARY FROM PACKAGE TO PACKAGE

Link worksheets together

This feature is lacking in some spreadsheets, and not very flexible in others.

Some packages allow worksheets to be linked at load time, so that at the start of the spreadsheet session a master sheet can provide information to be used in a

slave sheet.

Yet others allow worksheets to be linked together during a work session; master and slave sheets are loaded into different computer buffers, and the user can switch back and forth between slave and master sheets. The user can create a chain of several successive slaves to one master sheet, or can have just one master with any number of slave sheets dependent on the master but independent of each other.

Some packages allow consolidation between cells at the same relative position on different sheets (for example cell B3 on one sheet copied to cell B3 on another). Others allow free exchange of data (for example cell B3 on one sheet copied to cell D5 on another).

Some packages allow different areas of the sheet to be named, and later referred to by name, and if the sheet is large this can work in a similar way to linked sheets.

Linked worksheets allow the development of simple database type applications, and since spreadsheets are conceptually simple, with all the data easy to inspect all the time, inexperienced users can develop their own applications after a couple of hours training. If any application becomes complex, a computer specialist can take it and develop a database system from it. The spreadsheet has allowed the problem to be defined and clarified by the user so that it is now in a form to be developed further.

Exchange data with other programs

Spreadsheets may have several formats to choose from in receiving data from an external file, or sending data to file. If other programs send results to a file which can be read by the spreadsheet, the results can be expressed on the worksheet in the form of line graphs, pie charts, or histograms by users with little computer expertise. 'What-if' investigations could also be carried out.

Some spreadsheets are designed to integrate with particular database, statistical or word processing packages.

Graphics

The more sophisticated spreadsheets can present any part of a row or column graphically on screen and on paper; this is both impressive and useful and can be done by users with little computing experience.

Macro commands

Some spreadsheets allow command sequences to be "embedded" in the worksheet, so that the structure and working of the sheet becomes invisible to the user. Prompts can be built into the worksheet so that a user is led through it step by step; these prompts need not appear on a final print out of the results. This means that less expertise is needed to operate the system (although more was used to develop it!). This can be carried to the extent that the user may be unaware that a spreadsheet has been used, since in operation it looks so much like a FORTRAN or BASIC program.

Help messages

Most spreadsheets have a series of "Help" screens which can be called at any time if the user has forgotten the meaning of any command or is unsure of the spreadsheet operation at any point. The quality of the help screens varies from package to package.

Checking the contents of the worksheet

Most spreadsheet packages can produce a listing on paper which shows the contents of each cell on the sheet, listed in order and numbered A1 to ZZ256 or more. This is very useful where equations have been used and need to be checked.

Entering formulae

Some spreadsheets allow the user to

1 - move to the position which is to receive the equation

2 - indicate that an equation is to be entered

3 - move the cursor around the spreadsheet until it arrives at a cell containing a value (which may itself be the result of a formula), then press +, -, /, or * to indicate how the value is to be used; the program takes a note of the coordinates of that value (for example B16, or AZ67) and includes them in the equation, then returns the user to the location of the equation, and waits for the user to

4 - indicate that the equation has ended, or else move off in search of another value.

This feature can save quite a bit of time during development of the worksheet. Equations such as AZ267*BQ173+ZP24 can be a nuisance to work out if the user has to select the coordinates beforehand and then type them in letter by letter.

Some spreadsheets allow cells to be referenced by name, for example 'Jan Sales', rather than by coordinates.

Statistics

Not all spreadsheet packages offer statistics, and in at least one package one statistical calculation is wrong. It is therefore worth checking statistical calculations before using them on real data.

However, if the functions are there this can be a convenient way of carrying out simple summary statistics.

Other functions

Functions such as Sine, Cosine, Net Present Value, Log etc. are available on most spreadsheet packages. The collection of functions available will vary between different spreadsheets.

ADDITIONAL FEATURES

The user may be able to

- include program branching in the worksheet, so that operation of the sheet is different depending on whether certain values are positive or negative, or greater than some number, etc.

- "Lock" the contents of important cells so that inexperienced users cannot delete or change formulae

- change individual column widths (useful when entering long labels, although it is also useful for the package to allow the user to print across more than one column)

- insert or delete rows and columns into a finished worksheet, when the formulae affected by the change will be adjusted automatically

- replicate the contents of series of cells (for example A1,A2,A3,A4) in another series of cells (for example B1,B2,B3,B4). This can be done so that the receiving cells contain an exact copy of the sending cells, or can be done so that any formulae in the sending cells are translated to the new locations (for example A1+A2 becomes B1+B2); this type of copy is called a 'relative replication'

- print the worksheet either with or without the co-ordinates showing

- print part of the worksheet only; "hide" individual cells so that they are not printed out

- Sort columns or rows so that simple database applications become possible

- Search tables for a range of values, or for dates, and present the results of the Search in a separate table

- Order of calculation is normally from top to bottom of each column in the worksheet, starting with the leftmost column, then the next to the right, and so on. This order can be changed so that the entire top row is calculated (from left to right), then the next row down and so on.

Spreadsheet equations must usually not refer to cells which have not yet been resolved by the time the equation is being calculated ('forward' references). However, some spreadsheets do allow 'forward' or 'circular' references, which makes large worksheets easier to design.

Some spreadsheets offer 'natural' order calculation where the order in which formulae are resolved depends on the contents of the formulae themselves.

Printing the finished worksheet

The final worksheets can be printed out on to any matrix or daisy wheel printer connected to the microcomputer. Spreadsheet graphics can be printed out if the matrix printer is capable of it, or if a plotter is available. Selected parts of a worksheet can be printed out, and if a worksheet is too wide for the printer then some spreadsheets will automatically print adjacent areas one underneath the other. Other packages have a 'sideways print' option (i.e. producing 'landscape' output), to be used if the worksheet is very wide but not very deep.