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Part 3
Reference

Overview

Now that you have completed the Spencer Ceramics tutorial you should be ready to create your own spreadsheets. To do so you will find the material in Part 3 to be helpful. Part 3 contains some advanced operating information and it describes all commands, functions, and messages completely.

Part 3 has the following seven chapters:

Chapter 12 — Operating Information
Chapter 13 — Glossary
Chapter 14 — Useful Excerpts
Chapter 15 — Elements of Multiplan
Chapter 16 — Command Directory
Chapter 17 — Function Directory
Chapter 18 — Message Directory

In Chapter 16 you will find descriptions of some commands not covered in Spencer Ceramics. These commands which should be particularly useful to you include:

```
Delete    Move    Sort
```

That Chapter also goes into more detail about some commands that were covered, such as:

```
Copy      GoTo    Options    Transfer
Format    Lock    Print      eXternal
```

In addition, Chapter 17 describes Multiplan's numerous mathematical, financial, and statistical functions. So far you've only seen SUM.

Chapter 18 lists messages alphabetically and describes them in detail.

Chapter 12
Operating Information

Overview

You will find the information in this chapter useful once you have familiarized yourself with Multiplan. It covers the following topics:

Memory Requirements

Memory available for Multiplan worksheets is about 53Kb in an HP 150 microcomputer that has 256Kb of main user memory. You may find the exact amount of memory available on your system immediately upon startup when you have a clear workspace showing 100% free memory. With that setup, take the following steps:

1. Press "*O*" (for options)
2. Press Return.

The screen message line should then be:

```
Microsoft Multiplan Version 1.NN  Total Bytes Available:nnnnn
```

Then, as you create your worksheets, record the ending percentage-free figure as you complete each worksheet. That figure multiplied by the beginning bytes available should show the amount of memory needed for your particular kind of worksheets.

The Startup Drive

The startup drive simply is the drive you start Multiplan from. You designate the startup drive in similar ways when using either a flexible drive or a fixed drive.

If you are using a flexible drive: the startup drive is the flexible drive in which you have inserted the program disc when you startup the program.

If you have installed Multiplan on a fixed drive: the startup drive is that logical drive which you designated when you installed Multiplan on the fixed drive.

Multiplan always looks for the Multiplan programs and Help file on the startup drive. It also will use the startup disc for worksheet data storage unless you direct it to use a different drive. (Using a data drive other than the startup drive is described in the next section.)

If you are using Multiplan on a flexible disc drive, you may remove the Multiplan program disc from its startup drive. You can then put a data disc in the startup drive. If Multiplan needs a portion of the program or Help file not in memory, it displays this message:

```
Enter Y to retry access to <filename>
```

Then do the following:

1. Remove the data disc from the startup drive.
2. Put in the Multiplan program disc.
3. Press Return.

You can now go on with your work. When you want to save your worksheet, put the data disc in the startup drive before you choose the Transfer Save command.

Designating Drives for Data Files

Multiplan saves or looks for worksheets as data on either the startup drive or on some other drive that you designate. This drive that you specifically designate as the data drive is called the "setup drive."

Unless you specify a particular setup drive, Multiplan assumes that any filename you use refers to a file on a disc in the startup drive. You may designate the setup drive in two ways.

You of course may want to save your file to a disc other than the startup file. You have two ways to do so.

First, you may specify a different setup drive each time that you save or load a file. You do this by including the drive letter and a colon before the filename. For example, B:BUDGET refers to the file BUDGET on the disc in drive B.

Alternatively, you can instruct Multiplan always to save and look for your worksheets in a drive other than the startup drive. To accomplish that, you should:

1. Press *T*, then *O*. You are now in the Transfer Options command.
2. Press Tab. You are now in the setup field.
3. Type the drive designation. For example, if you want to switch to drive B, type *B:*.
4. Press Return.

Multiplan will now look on drive B for worksheets. It will still look on the startup drive for Multiplan programs.

Summary: Ways to Designate Data Drives

In summary, there are several ways to tell Multiplan the location of files that you want it to use:

1. If you specify a drive letter when you type a filename (B:SPENCER or C:MYBUDGET) in any of the Print or Transfer commands, Multiplan will look for the file or save it on the disc in that drive.

2. If you don't specify a drive letter, Multiplan checks the setup field of the Transfer Options command to see if you have specified a data drive. If you have, Multiplan looks for or saves the file on the disc in that drive. (See the Transfer Options command in Chapter 15, Elements of Multiplan.)

3. If you don't specify a drive letter with the filename and haven't specified a data drive with the Transfer Options command, Multiplan will look for or save the file on the startup drive.

See the "Files" section of Chapter 8, Elements of Multiplan, for more information on how Multiplan accesses disc drives to find files.

When to Change Discs

In general, two rules apply to changing discs. Always be sure the drive is turned ON when inserting or removing a disc. Never change discs when the disc access light is illuminated. Other cautions apply when using Multiplan.

When you work with MS-DOS such as Multiplan uses, it is safe to change discs in any drive when you see the MS-DOS prompt (such as "A>").

It is also safe to change discs when MS-DOS displays a message on the screen asking you to. In this case, follow the directions on the screen exactly.

When you work with Multiplan, it is safe to change discs in the data drives when you can see the main command menu on the screen, or when you see either of these Multiplan messages:

```
Disc full

Enter Y to retry access to <filename>
```

If you change discs when you see either of these messages, after you change the discs, press Return. Otherwise Multiplan will not be able to save worksheets on the disc.

Warning Do not try to change discs when Multiplan is executing a command. You may destroy the information on the discs — and you may even lose the information you have in the computer's memory. Never remove any disc while Multiplan is showing you Help text on the screen (see the Help command in Chapter 16).

Print Option Setup Responses

General Procedures

Multiplan works well with a variety of printers. It can send any special characters the printer needs to set print modes, such as boldface or 160-character width.

Your printer manual manual will tell you what print modes are possible. It will also tell you what special characters to include in the Print Option setup field in order to set those modes.

Multiplan/HP 150 has one requirement in addition to the printer manual instructions. It has a general requirement to send two ampersand characters when the printer manual instructions call for one ampersand. This requirement is described in the illustration below.

An illustration of having Multiplan instruct the printer to use compressed print follows:

1. From the main command menu, Press *P*, then *O*.
2. Press [Tab]. This puts you in the Setup field.
3. Type the special characters. One example involves using an HP 82905B printer. The printer manual tells you the message to send the printer is the escape control string of characters:

   ```
   &k2S
   ```

   In Multiplan/HP 150 the characters that are equivalent to "Escape" are "^[". And, complying with the Multiplan requirement for an extra ampersand, you would type:

   ```
   ^[&&k2S
   ```

4. Press [Return]. You are now back at the Print command.

Multiplan sends the setup characters to the printer each time you use the Print Printer command.

Multiplan saves the setup field of the Print Options command when you save the worksheet. This means you won't have to re-enter the special characters each time you want to print the worksheet.

You can change the setup field any time you want to change the print modes for the worksheet. If you select the Print File command instead of Print Printer, Multiplan includes the special characters in the printable file.

Print Option Setup Response Using an Arbitrary Byte

Some users may want to send an arbitrary byte to the printer or to a file if printing to a file. To do so, send the following character string (where "c" is any character):

```
&Hcc
```

Two examples follow. To have the printer receive the arbitrary byte for "Escape sequence" (ASCII character 1B hex), the Print Option setup response would be:

```
&H1B
```

To have the printer receive the arbitrary byte for "form feed" (ASCII character 0C hex), the Print Option setup response would be:

```
&H0C
```

Note In this setup response for sending an arbitrary byte, and only in this setup response, just one ampersand is used.

File Format Conversion

Multiplan may store files in two formats: normal and SYLK (Symbolic Link). Normal format is that mode used as long as you do not need to send or receive worksheet data outside the Multiplan applications program that you are working in.

On the other hand, Multiplan files need to be in SYLK format if you want to send or receive worksheet data outside the applications program you are working in. See Appendix C, SYLK (Symbolic Link) File Format.

If you should want to change from Normal to SYLK file format, take the following steps:

1. Press *T* (for Transfer).
2. Press *O* (for Options). This puts you at the Transfer Option command.
3. Press *S* (for SYLK). Multiplan will now save files in SYLK format. You are now able to load files that are in SYLK format.

To change back to Normal format, simply press *N* (for Normal) after selecting the Transfer Options command.

Multiplan will not permit you to load a file that is incompatible with the Transfer Options Mode that you have selected. If you attempt to do so, Multiplan will send you a message that the format mode setting is incorrect.

Reference Toggle for Copying Formulas

One use for Reference Toggle arises when formulas in cells are copied. Multiplan normally will give a relative reference to cells to be copied. Multiplan does this unless you instruct it to give the copied cells an absolute value.

You will sometimes want Multiplan to give cells an absolute value. Such situations occur when you want part of a formula always to refer to the contents of a specific cell, perhaps in a table separate from the worksheet itself. Such a situation is illustrated in the following example:

Use the *SPENCER* worksheet.

1. Move the cell pointer to February Sales, R3C3.
2. Blank cell R3C3, copy R3C3 10 cells right.
3. Move the cell pointer to R17C1.
4. Enter "Sales Incr.%", then press [►].
5. Type "101%", press [Return].
6. Format for % and 2 decimals.
7. Goto R3C3.
8. Press =, then [◄].
9. Type *.
10. Move the cell pointer to R17C2, press [Return]. Notice the appearance of "$20200" in R3C3 and of the formula RC[-1]*R[+14]C[-1] as the cell contents.
11. Copy right 10 cells. Notice the appearance of "$0.00" in the monthly sales cells to the right of R3C3. That is because copying the sales increase formula introduced a zero in the calculation.
12. Move the cell pointer through several of the monthly sales cells to the right of R3C3. Notice that the intended reference to "Sales Inc.%" is always relative. The intended reference thus does not refer to R17C2 but to cells with a zero value.

This problem is corrected by using Refernce Toggle. Its use is illustrated by redoing the above example as follows:

1. Goto R3C3.

2. Press =, then ◄.

3. Type *.

4. Move the cell pointer to R17C2.

5. Press Refernce Toggle, As you do, note that the cell contents change from RC[-1]*R[+14]C[-1] to RC[-1]*R17C2. The second cell reference has changed from relative to absolute.

6. Press Return.

7. Copy Right 10 cells. Notice that the monthly sales cells to the right of R3C3 now change to show increasing sales. Move the cell pointer through several months of sales figures. Notice that R17C2 remains absolute or constant, and so the formula always refers to "101%".

8. Change R17C2 to 102.5% and notice the change in monthly sales.

Reference Toggle for Copying Named Cells

A second use of Refernce Toggle is for the Copy command. In this function it takes advantage of the shortcuts possible by naming cells. The procedures outlined below illustrate one of several ways to use Refernce Toggle for copying named cells.

Use the *SPENCER* worksheet.

1. Move the cell pointer to the cell(s) from which you want to move contents, for example, R17C2.

2. Press *C* (Copy), then *F* (From). You are now in the "COPY FROM cells:" field, and "R17C2" appears as the field response.

3. Press Refernce Toggle, then ►. Notice that the name of the first cell that you named now appears as the response in the "COPY FROM cell(s):" field. To display the next cell(s) that you named, press ►. Press ◄ to list the named cell(s) in reverse order.

   To list the first cell(s) named, press ▲.
   To list the last cell(s) named, press ▼.

4. Press Tab to move into the "COPY to" field. You now have two possibilities for the destination of the cell's contents. In the case where the destination is to be to specific unnamed cells, you would follow normal "COPY to" procedures.

   If the destination is to be named cells, you follow procedures as outlined for the COPY FROM command in step 3 above.

5. When you have determined the "COPY to" response, press Return.

To get out of this mode of copying, press Cancel.

Note It is possible using Refernce Toggle to move contents to and from named cells without using the cell pointer at all to define the source or destination.

To get out of this mode of copying, press Cancel.

Note It is possible using Reference Toggle to move contents to and from named cells without using the cell pointer at all to define the source or destination.

Summary of Copying Combinations

You may copy from:

- cells to either named cells or unnamed cells,

  or from

- unnamed cells either to named cells or unnamed cells.

Multiplan MS-DOS Control Characters

Multiplan/HP 150 was developed from the generic MS-DOS version of Multiplan. Because of this the control characters listed below are functional for Multiplan/HP 150.

Moving the Cell Pointer

Up	CTRL E
Down	CTRL X
Left	CTRL S
Right	CTRL D
Home	CTRL Q
End	CTRL Z
Next Window	CTRL W
Next Unlocked Cell	CTRL F

Select and Execute Commands

Cancel	CTRL C
Do this command	Return
Select next item on menu	Space bar
Select previous item on menu	Back space or CTRL H
Tab to next field in command	Tab or CTRL I
Help	?
Recalculate	!

Edit Cells and Commands

Delete character to left of cursor	Back space or CTRL H
Delete character(s) highlighted	CTRL Y
Character left	CTRL K
Character right	CTRL L
Word left	CTRL O
Word right	CTRL P
Reference	@

Note When using the control sequences, do not put a space between CTRL and the letter.

Chapter 13
Glossary

Note You may also wish to look over the Glossary in *HP 150 Owner's Guide.*

Absolute reference A reference to a cell that uses specific row and column numbers; for instance, R17C12. Opposed to relative reference, as R[+1] C[−2].

Action keys Keys that cause Multiplan to carry out an action at once. The action keys include the Cancel, Next Window, and Return. See also Direction keys, Edit keys.

Active Something in use right now and immediately accessible, such as the active window, active cell, or active field of a command.

Active cell The cell indicated by the cell pointer. The contents of the active cell can be seen on the status line and may be edited with the Edit command.

Active window The window containing the active cell, marked on the screen by a highlighted window number.

Alignment The rule for the horizontal positioning of the display of a cell's value. Values may be left justified or right justified or centered.

Cancel Action key that causes Multiplan to abandon the current command and return to command choice.

Cell — One position on the worksheet, a place where data or a formula may be stored. A cell has a location and may be referred to by one or more names. The contents of a cell determine its value; the cell's format determines how its value is displayed.

Cell pointer — A highlighted pointer that selects one cell from all the cells in the worksheet. That cell becomes the active cell. The cell pointer is moved from cell to cell with the direction keys, or directly with the Goto command.

Character — A symbol that can be displayed on the screen; includes letters, digits, punctuation, and special characters like $, +, and %.

Column — A vertical line of cells down the worksheet. There are 63 columns, designated by the numbers 1 through 63.

Command — An instruction to Multiplan to do something. A command may have one or more fields in which to specify how the command should be carried out.

Command line — The screen lines just under the worksheet area, beginning with the word COMMAND:, and showing the main command menu. Here is where commands are built.

Contents (of a cell) — That which has been put into a cell. If nothing has been put in, the cell is empty and its contents are blank. Otherwise the cell contains either data (text or a number) or a formula. If a cell contains a formula, the cell's value, which is the result of the formula, is usually displayed.

Cursor — See Edit cursor.

Dependent sheet — A sheet that uses values from another sheet. The dependent sheet depends on information calculated on another, saved, sheet to which it is linked by the eXternal Copy command. See also Link.

Direction keys Keys that move the cell pointer. The ▲, ▼, ◄, and ► keys move the pointer one cell at a time. The ▼ key moves it to the cell in the upper left corner of the active window.

Directory The table of file names kept on each diskette by the operating system. The directory lists each file on the diskette.

Edit Altering a response in a field of a command. The edit keys are used to move the edit cursor over the response, and the character keys are used to replace or insert characters.

Edit cursor The highlighted part of a command on the command line, which may be as small as one character or as large as an entire field. The edit cursor is moved with edit keys. It shows where alterations can be made to the command.

Edit keys Keys that move the edit cursor within the command line. Includes, for example, Word Right and Word Left and Character Right and Character Left keys.

Field A portion of a command in which you type a response to instruct Multiplan in some detail of the command's work. When Multiplan first shows a field, it fills it with a proposed response; you can replace or edit that response if it isn't what you want.

File A named unit of data stored on disk or diskette. When a worksheet is saved it is written into a file. Not all files are saved worksheets, but those that are can be loaded or linked to other worksheets.

Filename The name used to refer to a worksheet when it is saved, loaded, or linked to another sheet.

Format How a cell's value is displayed. The format controls numeric punctuation and the alignment of the displayed value. A format can be specified for a cell or cells with the Format Cells command; cells without a specific format are displayed according to a default format set with the Format Default command.

Formula A recipe for how a value is to be calculated. Whenever the contents of a cell are changed, Multiplan recalculates all the formulas on the worksheet (unless automatic recalculation is turned off).

Function A built-in mathematical or statistical operation that Multiplan can perform on one or more values; e.g., SUM or AVERAGE.

Group of cells A collection of one or more cells on the worksheet that may be named; e.g., Sales.

Highlight An area on the display that appears emphasized. Highlights are used to indicate the edit cursor, active cell, active window number, and current menu item.

Link In Multiplan, the use of data from an inactive sheet in calculations on the active sheet. The inactive sheet is called the supporting sheet. The data to be copied must have been marked with the Name command or must be specified by an absolute reference. Then data from the supporting sheet may be used in formulas on the active sheet. Link is also used to express connection between windows for synchronized scrolling.

Load To make a saved sheet active again. The sheet to be loaded must have been saved. The Transfer Load command is used to copy the saved sheet from its file to working storage, where it becomes the active sheet.

Lock Protection of cells that contain formulas or text from inadvertent alteration.

Menu

A list of alternatives. A choice from a menu is selected in one of two ways: by moving through the list with the space bar (a highlight will move along the menu indicating the current selection) and selecting the highlighted choice with the Return key, or by typing the initial letter of the desired item.

Message

A notice posted by Multiplan on the message line to explain a problem or suggest what kind of input the system is waiting for.

Message line

The next to the last line on the display.

Mode

A field in the Transfer Options command. It enables you to designate the mode or format for your worksheet data. Normal mode is used when working within Multiplan. SYLK format is used when transferring data to or from other applications programs.

Name
(of a cell or group of cells)

A tag associated with a group of cells by the Name command. The name can be used to refer to the cell or cells in formulas.

Nxt Unlk Cell

Action key that moves the cell pointer to the next cell that is not blank and is not locked. Used to find cells that contain numbers (rather than a formula or text) so you can perform "what if" experiments.

Proposed response

Response supplied by Multiplan. It is usually based on the most recent responses by the user or on the current status of Multiplan.

Range

The smallest rectangle of cells containing two references. A range is designated by the colon (:). The range R3:R8 defines the rectangular area containing all of rows 3 and 8, namely rows 3, 4, 5, 6, 7, and 8. See also Reference.

Reference The designation of a cell or an area of cells. The simplest reference is to a single cell: R9C2. A reference may be relative to the cell containing the reference, as in R[−1]C. A reference may be to a single cell, as the prior two, or to an area of cells: R6 refers to all of row 6. A reference may be composed of intersections of references, ranges of references, or unions of references. A reference may be a name defined to refer to one or more cells. See also Range and Name.

Relative reference A reference to a cell relative to the cell containing the reference, as R[−1]C meaning "the row above, in this column." Opposed to absolute reference, in which the actual column and row numbers are stated.

Response What the user types in a field of command. May be a row or column number, a count, a name, or the contents to be put in a cell. When Multiplan displays a command on the command line, it usually supplies a proposed response in every field of the command; the user may replace the proposed response, edit it, or leave it as proposed.

Row A horizontal line of cells across the worksheet. There are 255 possible rows, designated by the numbers 1 through 255.

Save The operation of making a permanent copy of the active worksheet in a file.

Scroll To move one or more windows across the worksheet one row or column at a time. Scrolling is done with the direction keys. For example, if the → key is pressed until the cell pointer reaches the right edge of the screen, and then pressed again, Multiplan scrolls the worksheet display one column to the left.

Setup (in Print command) A field in the Print command. It permits you to send special instructions to your printer, for example, for compressed formatting.

Setup (in Transfer command)
A field in the Transfer command. It permits you to instruct Multiplan to save or look for files in a drive other than your startup drive. If you leave this field empty, Multiplan will look for or save files in your startup drive.

Status line
Bottom line of the screen, where Multiplan presents status information such as the location of the active cell and its contents.

Supporting sheet
A sheet providing values to another sheet. The sheet supports the other sheet (the dependent sheet) with data that has been designated with the eXternal Copy command. Data on the supporting sheet must have been named with the Name command. See also Link.

Text
String of characters that may be used for titles in the worksheet. Multiplan formulas can perform operations on text also.

Value
The information content of a cell: its numeric value if it contains a number; its text if it contains text; or, if it contains a formula, the result of calculating that formula.

Window
A rectangular portion of the display area within which Multiplan displays a part of the worksheet. As many as eight windows may be open at once; they are opened or closed with the Window command. Each window has a window number from 1 through 8 shown in its upper left corner. The window number of the active window is highlighted; that window contains the active cell, which is highlighted by the cell pointer.

Worksheet
A grid of cells displayed by Multiplan to store formulas and values.

Chapter 14
Useful Excerpts

These sections are taken from other chapters in this manual. The sections contain the type of information that you may want to refer to often when you are beginning to learn Multiplan.

Alignment

The following is an excerpt from "Alignment" in Chapter 6, Building a Worksheet:

Alignment means where text and numbers are placed in a cell; flush with the left edge, flush with the right edge, centered, or a mix of right and left (called General).

The "alignment" field offers you these choices:

Settings	Examples	Effect
Ctr centered	Sales $1000.25 $50.25	text and numbers
Gen	Sales $1000.25 $50.25	text flush left numbers flush right
Left flush left	Sales $1000.25 $50.25	text and numbers
Right flush right	Sales $1000.25 $50.25	text and numbers

Dissolving Connections between Worksheets

The following is adapted from the steps described in "Dissolving Connections between Worksheets" in Chapter 11, Using Multiple Worksheets:

To dissolve the connections between worksheets, take the following procedures:

1. Select the eXternal Copy command; press X, (for eXternal), then C (for Copy). The "from sheet" field should show the name of the worksheet last copied; in this case, SPENCOST, the supporting worksheet.

2. Press Tab to move to the "name" field.

3. Type the name of the group of cells you want to delete. In this example, the connection with *Materialcosts* was deleted. Type *Materialcosts*.

4. Press Tab to move to the "to" field. The entire proposed response is highlighted.

5. Press Delete; the response disappears.

6. Now, press Return, and watch the values disappear from the row for *Material* costs on the SPENCER worksheet.

Error Values

The following is taken from "Error Values" in Chapter 15, Elements of Multiplan:

The error values and their causes are:

Value	Cause
#DIV/0!	result of an attempt to divide by 0.
#NAME?	result of an undefined label reference.
#N/A	result when the value is not available. Also, #NA is a special value that may be created using the NA() function and which will be propagated by arithmetic.
#NULL!	result of specifying an intersection of disjoint areas; e.g., R1 R2 (use union instead, R1,R2).
#NUM!	result of overflow (number is too large or too small) or of an illegal use of an arithmetic function; e.g., SQRT(-1).
#REF!	result of a relative reference reaching outside the sheet or of a reference to a deleted area.
#VALUE!	result of using text where a number is needed or vice versa. or of using references when a value is needed.
#######	cell width is too narrow for the number entered or calculated.

Format Codes

The following is taken from "Formats" in Chapter 6, Building a Worksheet. The chart below gives a brief summary of the Multiplan formats; they are thoroughly explained in Chapter 16, Command Directory.

Settings	Meanings	Examples
Cont	Continuous	Spencer Ceramics
Exp	Scientific	1.4301E-23 4.67E5
Fix	Fixed Point	4.513
Gen	General	text and numbers shown in standard format
Int	Integer	3.1416 shown as 3
$	Dollars	$20000.00 ($150.00)
*	Bar Graph	3 shown as ***
%	Percent	.0513 shown as 5.13%
—	(Do not change format	

Keyboard and Touchscreen

Cell Pointer Control	Keyboard	Touch
Move cell pointer		Touch
one cell up		. .
one cell down		. .desired
one cell to right		. .
one cell to the left		. .cell
continue moving pointer to scroll window		Screen
to R1C1		
to the lower right cell in the worksheet		
to the next window		
to next unlocked cell		

Command Operations	Keyboard	Touch
Carry out a command or instruction	Return	Command
Cancel present operation, return to main command menu	f8	Cancel or ESC
Command Selection		
(Move to next) field		Tab
(Move to previous) field		Shift Tab
(Select next) item on menu		Spacebar
(Select previous) item on menu		Back space
(Select) Edit Cursor keys		Edit Cursor
(Request) Help text for overall Help or for a specific command	f7	Help
(Select) Main keys	f8	Main
(Select) Page Control keys	f5	Page Control
Recalculate worksheet	f2	Recalc
(Change) relative reference to absolute reference	f1	Refernce Toggle

Edit	Keyboard	Touch
Delete character(s) highlighted	f1	Delete
Delete character left of edit cursor		Back space
(Move) edit cursor one word left	f3	Word Left
(Move) edit cursor one word right	f4	Word Right
(Move) edit cursor one character left	f5	Char Left
(Move) edit cursor one character right	f6	Char Right
Edit: Alternate Keys		
move edit cursor one character left	CTRL ◄	
move edit cursor one character right	CTRL ►	
move edit cursor one word left	CTRL ◄	
move edit cursor one word right	CTRL ►	
(List) named cells in order named when in Name command	◄	
(List) named cells in reverse order named when in Name command	►	
(Change "Copy from:" field from cells to) names	f1	Refernce Toggle

Scrolling	Keyboard	Touch
Scroll Window		
one page left	f3	Page Left
one page right	f4	Page Right
one page up	f5	Page Up
one page up	f6	Page Down
Alternate Keys: scroil		
one page left	Shift ◄	
one page right	Shift ►	
one page up	Prev	
one page down	Next	
Scroll Globally		Scroll bars

Printer Instructions

This is taken from "Special Instructions for Printers" in Chapter 12, Operating Instructions.

To send special characters from Multiplan to the printer:

1. From the main command menu, press *P* (for Print), then *O* (for Options). This puts you in the Print Options command.

2. Press Tab. This puts you in the setup field.

3. Type the special characters. For example, if you have an HP 82905B printer, the characters you send the printer to instruct it to use compressed print would be:

   ^[&&2S

4. Press Return. You are now back at the Print command.

5. Select the Printer command and press Return

Multiplan sends those characters to the printer when it begins printing a worksheet.

Print Margins Command

The following is taken from "The Print Command" in Chapter 10, Printing a Worksheet.

Multiplan has set margins that it uses unless you specify different ones.

These margins are:

left	5 characters
top	6 lines
print width	70 characters
print length	54 lines
page length	66 lines

Multiplan will print as many columns across the page as will fit within these margins. Any columns left over will be printed on a second page, with row and column numbers continued.

Screen Label Menus

Main Menu

Refernce Toggle	Recalc	Next Window	Nxt Unlk Cell		Page Control	Edit Cursor	Help	Cancel

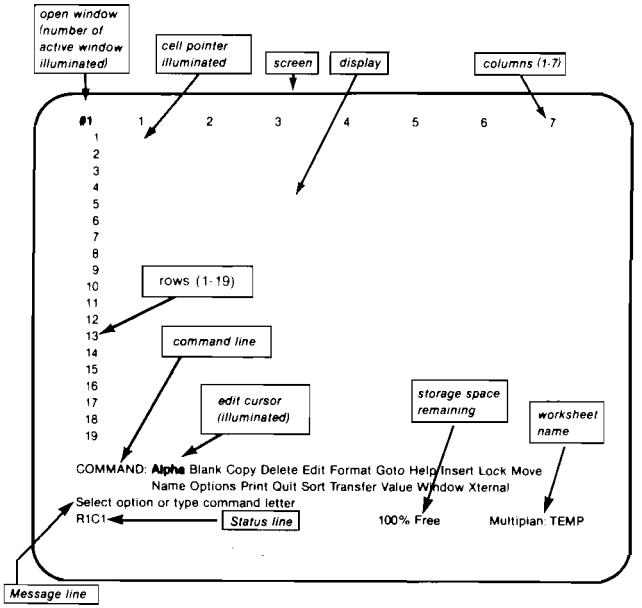
Page Control Menu

		Page Left	Page Right		Page Up	Page Down	Help	Main

Edit Cursor Menu

Delete		Word Left	Word Right		Char Left	Char Right	Help	Main

Screen for Multiplan/HP 150



SUM Function

This is taken from "Calculating Functions: SUM" in Chapter 8, Naming Cells and Copying.

A summary of procedures for setting up the SUM function follows:

1. Begin by moving the cell pointer to the cell where the result will appear.

2. Press =.

3. Type SUM (name or cells to be added), for example, SUM(*Sales*).

Note Do not leave a space between the function name and the opening parenthesis, (. Be sure to have a closing parenthesis,).

4. Press Return.

Unlocking Cells

To unlock cells, press *L* (for Lock), then *C* (for Cells). In the "cells" field, specify the whole active area of the worksheet, as follows:

1. Press ↖ (for the upper left corner of the worksheet).
2. Press: (colon, to create a range).
3. Press Shift ↖ (for the most lower left cell that contains data or has been formatted).
4. Press Return. All cells should now be unlocked.
5. Press Nxt Unlk Cell several times; the cell pointer should move from one cell to the next, just as if you were pressing →, except that blank cells are still skipped.

Chapter 15
Elements of Multiplan

The Microsoft Multiplan Worksheet

The worksheet is a rectangle with an arrangement of intersecting rows and columns. The sheet may be up to 63 columns wide and 255 rows long. An area one column wide by one row high is called a cell.

Each cell possesses both a value that may be displayed on the Multiplan screen and a formula for computing that value. This formula may be as simple as the number 19.95, or it may be more complex, containing functions and references to other cells; for example, "previous cell times growth rate."

The potential dependence of the value of one cell on the values in other cells is the key idea behind the worksheet. When cells have been connected by references among them, a change in one cell (for example, changing 19.95 to 18.50), causes Multiplan to calculate the effect of the change on all other cells. This process is called "recalculating the worksheet." Recalculation may be automatic after every change, or it may be turned off (see Options command, Chapter 16). When automatic recalculation is turned off, one-time recalculation may be caused by pressing Recalc.

The order of calculating the cells is automatically chosen by Multiplan so that the calculation of each cell precedes the calculation of other cells that depend on it. If such an order is impossible, the "Circular references unresolved" error message is displayed.

The Multiplan screen is a movable "window" through which to view part of the worksheet. When Multiplan starts, only one window is open. You may open up to eight windows to the worksheet. Each window opened is given a consecutive window number. For the following discussion, assume that only one window is open, just as when you start a Multiplan session.

Across the top of the window are column numbers. Down the left edge of the window are row numbers. The row and column numbers tell you what area of the worksheet you are viewing.

Somewhere within the window is a highlighted cell. The highlight is called the cell pointer, and it points to the "active cell." Many operations do something with the active cell.

Across the bottom of the screen are four lines of text. The top two lines are called the command line. The actions you want Multiplan to perform are selected from these commands. The command line is discussed more in the "Entering Commands" section. The commands are described in Chapter 16, Command Directory.

Just below the command line is the message line. The message line shows either an error message or a prompt message. An error message indicates what the problem is. A prompt message indicates in general terms your next step in entering a command. The prompt message changes as you work your way through a command. See the "Entering Commands" section for more information about command entry and Chapter 18, Message Directory, for explanations of message line messages.

The bottom line on the screen is called the status line. Here, Multiplan displays the position of the cell pointer, the current contents of the active cell, the percent of free memory, and the name of the active sheet.

The position (row number and column number) of the active cell is shown first on the status line. The formula used for calculating the value of the active cell is shown next to the coordinates. When the contents of the active cell are text or numbers, the status line shows the text in double quotes or the number itself.

The cell pointer can be moved around by using the direction keys.

[▲] moves the cell pointer towards the top of the window.

[▼] moves the cell pointer towards the bottom of the window.

◄ moves the cell pointer towards the left edge of the window.

► moves the cell pointer towards the right edge of the window.

When the cell pointer reaches the edge of the window, the window begins to move across the worksheet one cell at a time. This is called scrolling. When the cell pointer reaches the edge of the worksheet, the cell pointer stops, and the Multiplan alarm sounds.

The page keys scroll across the worksheet a whole windowful at a time in the direction selected.

↖ may be used to go to row 1 column 1 quickly. Shift ↖ may be used to go to the last row and last column of the active area of the worksheet. The active area is the smallest rectangle that encompasses the cell in the upper left corner of the worksheet (row 1 column 1, referred to as R1C1) and the last cell to the right and down that has been given contents or formatting.

Entering Commands

You direct Multiplan to perform the tasks you want done by entering commands. The commands are described individually in Chapter 16, Command Directory. This section describes the methods of command entry.

You select a command when the main command menu is on the screen. The main command menu shows the choice of commands:

Alpha Blank Copy Delete Edit Format Goto Help Insert Lock Move Name Options Print Quit Sort Transfer Value Window Xternal

When this menu is on display, Multiplan is waiting for you to select a command. When Multiplan is computing, the main command menu is not visible and no message appears on the message line. When the main command menu reappears, Multiplan is ready for more commands.

Some of the main commands have subcommands. In these cases, when the main command has been chosen, the main command menu is replaced with a subcommand menu.

Remember: the message line shows a prompt message that indicates your next step in entering the command. See Chapter 18, Message Directory, for descriptions of these messages.

To enter a command:

1. Select an active cell (move the cell pointer to the appropriate cell), if required by the command to be selected.

2. Select a command.

3. Select responses for the command fields. The responses are used to specify where to Goto, what to Format, where and how to split windows, and so forth.

4. Press Return or Enter to carry out the command. Or, press Cancel, f8, or ESC during the first three steps to cancel the command.

Selecting the active cell is described in the section entitled "The Microsoft Multiplan Worksheet." Steps 2 and 3 are described below.

Select a Command

When you are prompted to select an option from a menu, select in one of two ways:

1. Type the first letter of the option you want.

or

2. Use SPACE and BACKSPACE to move the highlight to the appropriate command word. SPACE moves the highlight to the right, BACKSPACE to the left. Press Return.

When you have selected a command, Multiplan displays the main command name followed by either a subcommand menu or one or more command fields. Typically, a new subcommand menu will follow selection of a main command. Select a subcommand as you would a main command.

The command line will show the command and subcommands you have already selected in capital letters. For example:

```
WINDOW: Split Border Close Link
```

Now if "Split" is selected, the command line changes to:

```
WINDOW SPLIT: Horizontal Vertical Titles
```

Continue selecting subcommands until the command fields are displayed. The names of command fields are shown in lowercase letters followed by a colon. For example:

```
WINDOW SPLIT HORIZONTAL at row: 7      linked: Yes(No)
```

This command line has two fields: the "at row" field and the "linked" field. Note that the "linked" field contains a small menu.

Select Responses for the Command Fields

The next step is to enter responses for the command field or fields. There may already be responses in the fields. These are responses proposed by Multiplan. If a proposed response suits your purpose, you need not enter a response in that field. In fact, if the proposed responses in all the fields are suitable, you can just press Return to carry out the command.

Entering responses proceeds field by field starting at the first one. A highlight indicates the "active" field (the field in which a response is being entered). Other fields will not contain a highlight.

To move the highlight from field to field, press Tab. Pressing Tab when the highlight is in the last field returns it to the first field.

The message line gives you messages prompting entries in the command fields. Whenever the message line starts with "Enter...," the field must be filled in. To "fill in" the field, either accept the proposed response or simply type the characters. For example:

TRANSFER LOAD filename: *INCOME*

Enter filename

where *INCOME* was typed. In this case, there is only one field, and Tab is not needed. Simply press Return to carry out the command.

In certain fields, the direction keys may be used to view and select from a list of possible responses. The message line will indicate when the direction keys may be used. → will propose the next response on the list; ←, the previous response. ↑ will propose the first response on the list; ↓, the last response.

When the message line shows "Select option," the field contains a menu of options. Select the option you want by either of the two methods used for selecting commands: either type the initial letter or use the space bar and Back space to move the highlight to your choice. Note that when a command field with a menu is not active, the current option is shown enclosed in parentheses, as in the "linked" field in the example above.

Proposed Responses

The proposed response depends on the specific command; thus proposed responses are described with the commands in Chapter 16, "Command Directory." However, proposed responses follow a few general principles:

1. When a command field contains a menu, the "proposed" response is the current setting. For example, the Options command initially appears as:

   OPTIONS recalc:(Yes)No mute: Yes(No)

   with the highlight on Yes showing the current setting in the "recalc" field and the parentheses showing the current setting in the "mute" field. Thus, the same menu may be used to inspect as well as select options in command fields.

2. In other fields, the proposed response will be the one entered the last time the command was used. This simplifies entering a series of related commands.

3. Yet other fields reflect the position or contents of the active cell. For this reason, positioning the cell pointer before selecting a command may be helpful.

All proposed responses may be edited by using Multiplan editing keys, described in the "Editing" section below.

Editing

Microsoft Multiplan provides editing keys to edit responses in command fields. Multiplan editing can be used any time you are entering responses in command fields. To edit the contents of cells, move the cell pointer to the cell, then use the Alpha command for cells with text or the Edit command for cells with formulas, and edit the proposed responses in the command line.

Either just after a command is selected or just after pressing Tab, the whole field containing a proposed response is highlighted.

To *replace* the proposed response: Type the replacement. Multiplan automatically deletes the proposed response as you type the new one.

To *delete* the proposed response and leave the field empty: Press Delete (after pressing Edit Cursor). All text that is highlighted is deleted.

To *append* to the proposed response: For cell references (when the message line shows "Enter reference to cell or group of cells"), type a colon (:) or other operator. For other responses, press either Char Right or Word Right (after pressing Edit Cursor) then type the additional text.

Once the proposed response is altered, one character or word in the field is highlighted. This highlight is the edit cursor. The edit cursor may be moved to designate where or what to edit.

Use Char Left, Char Right, Word Left, and Word Right keys to move the edit cursor.

The Char Left and Char Right keys move the edit cursor left or right one character.

The Word Left and Word Right keys move the edit cursor left or right highlighting words or the space or punctuation between words. In formulas, the values and the operators are highlighted alternately.

To *insert* new text: Type the text. It will be inserted in front of the edit cursor.

To *delete* text: Use Back space to delete characters on the left side of the cursor. Use Delete to delete what is highlighted by the cursor.

To *replace* text: Delete the old text and type the new.

The following formula editing keys simplify the typing of formulas. These keys all insert text in front of the edit cursor:

1. As you begin to enter a formula or just after you enter an operator, the direction keys (as well as ↘) can be used to enter a relative cell reference of the form:

   R[±n]C[±m]

   in the field by pointing to the cell you want (see the "Formulas" section for an explanation of cell references, relative references, absolute references, and Names). As you move the cell pointer, the reference will change accordingly. The cell pointer will return to its original position as soon as any key other than a direction key is pressed.

2. Similarly, the direction keys can be used to enter absolute references of the form:

   RnCm

   in fields that accept a cell reference (when the message line shows "Enter reference to cell or group of cells").

3. Relative references created with direction keys (described under item 1 above) may be changed to absolute references by pressing Refernce Toggle immediately after the direction keys.

4. Names may be entered easily by pressing the REFERENCE key first, then using the direction keys to step through the list of defined names.

5. Finally, a formula may be replaced with its resulting value by pressing Recalc after the formula is entered.

Formulas

Formulas are "recipes" for calculating values. When these values are displayed on the computer screen or printed on a printer, they compose the results of a Multiplan worksheet.

Multiplan works with different types of values, which are appropriate in different circumstances:

Value	Use
numbers	used for financial, statistical, scientific, and other calculations.
text	characters treated as words, including numbers in special displays, such as $10.00 or 6/14/81. Text is always shown in double quotes ("text") in the status line.
references to cells	used to express dependency of a value in one cell on values in other cells on the worksheet. Groups of cells can be specified by "intersection," "range," and "union" operators.
logical values (*true* and *false*)	used in making conditional, "either-or" decisions.
error values	used as substitutes for values that cannot be calculated because of a mistake in a formula. For example, the "result" of division by 0 is an error value.

New values may be calculated by combining other values with the operators, described below under the topics "Numbers," "Text," and "References to Cells"; or by using functions, such as MIN or MAX, described in Chapter 17.

The following sections describe each type of value.

Numbers

Numbers may be written as integers (123), as decimal fractions (123.45), or in scientific notation. In the last case, an integer or decimal fraction (mantissa) is followed by the letter *E* and a positive or negative integer exponent. This notation multiplies the mantissa of the number by 10 raised to the given power. For example:

12.1E2 means 1,210 (12.1×10^2)
(note: + sign may be omitted)

1E−5 means .00001 (1×10^{-5})

1.5E+6 means 1,500,000

Percentages may be written as numbers followed by % (the same as division by 100):

15% means .15 (15/100)

Numbers are calculated with 14 digits of precision and a decimal exponent ranging from −63 to +63. This means that the smallest positive nonzero number is:

$.1 \times 10^{-63}$

and the largest one is:

$9.9999999999999 \times 10^{+62}$

Mathematical operators are the following:

Operator	Meaning
^	exponentiation. Calculated by the rule: a^b = exp(ln(a)*b).
*	multiplication.
/	division.

%	percent. Written after the value and has the same meaning as /100.
+	arithmetic addition.
—	subtraction. May also be used in front of a value to denote "negative."

Operator precedence is: — (negative value) is evaluated first, then %, then ^, followed by * and /, then + and — (subtraction), and finally the logical operators described under "Logical Values" below. Parentheses may be used to alter the order in which Multiplan performs the calculation when more than one operator appears in a formula.

Chapter 10 describes Multiplan functions for performing mathematical, statistical, and financial calculations.

Text

A text value may contain up to 255 characters. Text is written enclosed with double quotes ("). Text may not include double quotes as a character. For example:

"salary =" is 8 characters of text

"1.0" is also text, not a number

Two text values may be concatenated using the & operator. The result is a text value that consists of the left text immediately followed by the right. For example:

" $ " & "1.00" concatenates the text value "$1.00"

Chapter 10 describes functions that operate on or return text values. In particular:

LEN(*T*) returns the number of characters in a text value.

MID(*T*,s,c) returns a specified part of a text value.

Functions are also provided for converting numbers into text and vice versa. For example:

FIXED(1,2) returns the text "1.00"

VALUE("0.1") returns the number .1

All the functions are described in detail in Chapter 10.

References to Cells

References to cells describe the location of one or more cells on the worksheet. References are the means of access to the values in cells.

A cell reference consists of a row reference and of a column reference, in that order. (You can give cell references by entering the column reference followed by the row reference, but Multiplan stores the reference in row-column order.)

A cell reference indicates the place where a specific row and a specific column intersect.

For example, R4C3 is a reference to the cell at row 4, column 3. Assuming that that cell has the value 5, the result of the formula R4C3+1 is 6.

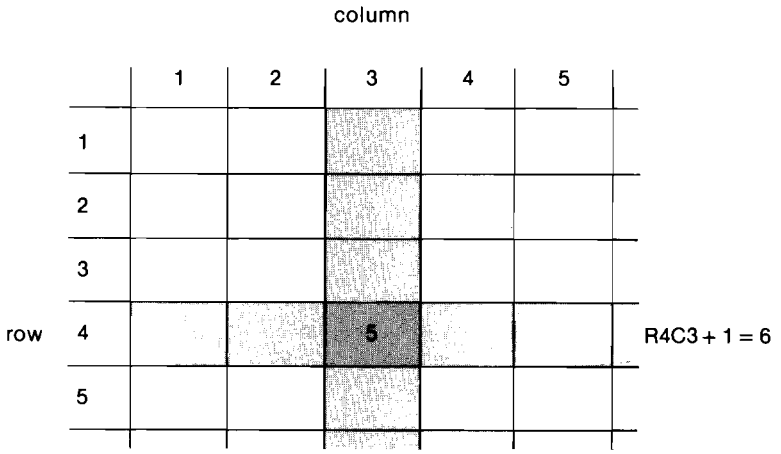


Figure 15.1. Cell Reference Gives Access to a Value

References may be written three ways:

as an absolute reference

as a relative reference

as a name reference

Absolute References

An absolute reference consists of the letters *R* and *C* and the actual row number and column number (as illustrated above).

The forms are:

Form	Meaning
Rn	row number n (1—255)
Cn	column number n (1—63)
Rn:m	all rows from n through m
Cn:m	all columns from n through m

Placing an R form and a C form together denotes the rectangle formed by the intersection of the rows and columns:

Form	Meaning
RnCm	single cell at row n, column m
Rn:mCp:q	a rectangle of cells

Relative References

A relative reference describes the location of another cell in terms of the location of the current cell. ("Current" means the cell that contains the cell reference.) A relative reference gives a direction by "+" for right or down or "—" for left or up and a number indicating how many rows or columns away from the current cell.

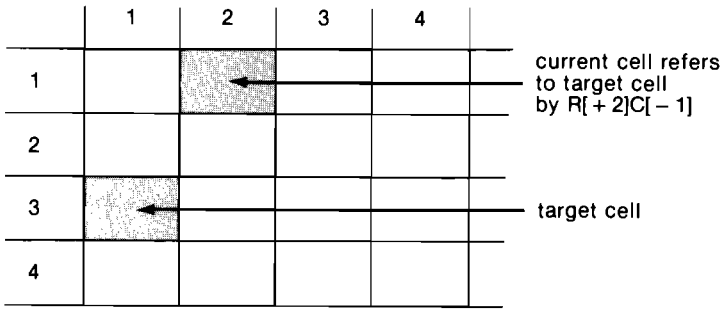


Figure 15.2. Relative Cell Reference

The "target" cell is 2 rows down from the current cell (+2) and 1 column left of the current cell (−1).

The forms of relative references are:

Form	Meaning
R	current row
C	current column
R[+n]	the row that is n rows below R (the + may be omitted)
C[+n]	the column that is n columns to the right of C (the + may be omitted)
R[−n]	the row that is n rows above R
C[−n]	the column that is n columns to the left of C

As for absolute references, placing a relative R form and C form together denotes the rectangle formed by the intersection of the rows and columns. For example:

Form	Meaning
RC[−1]	the single cell just to the left of the current cell

The difference between absolute and relative references becomes apparent only when a reference is copied (see Copy command, Chapter 9). Absolute references will refer to exactly the same cell or cells in all of the copies. The cells referred to by relative references, however, are different for each copy (see Figure 8.3):

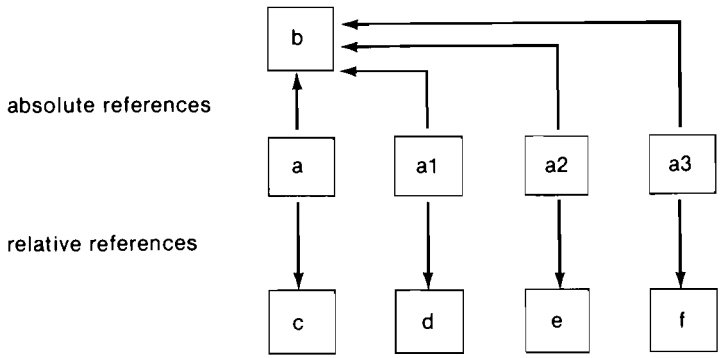


Figure 15.3. Comparison of Absolute and Relative References

If a reference in cell *a* is absolute and refers to cell *b*, the copied references in cells *a*1, *a*2, and *a*3 will all refer to cell *b*.

If a reference in cell *a* is relative and refers to cell *c* as 3 rows down [+3], cell *a*1 will refer to cell *d* (not cell *c*), cell *a*2 will refer to cell *e*, and cell *a*3 will refer to cell *f*.

Names

Names are words used to identify a cell or group of cells. A Name may be defined as an absolute reference with the Name command (see Chapter 16). The spelling rules for names are:

Names must start with a letter,

followed by letters, digits, periods, and underline (_) characters,

up to 31 characters maximum.

Words that are the same as absolute or relative references (for instance, R1C1 or R) must not be used for names.

Once defined, a Name may be used as you would use any absolute reference. For example, you might define the name *Sales* to refer to R3C2:8. The name of the reference suggests that the calculation involves sales figures. The absolute form, R3C2:8, is not mnemonically suggestive of sales figures. However, to the Multiplan program, the meanings are identical.

The name in the example above may be illustrated as:

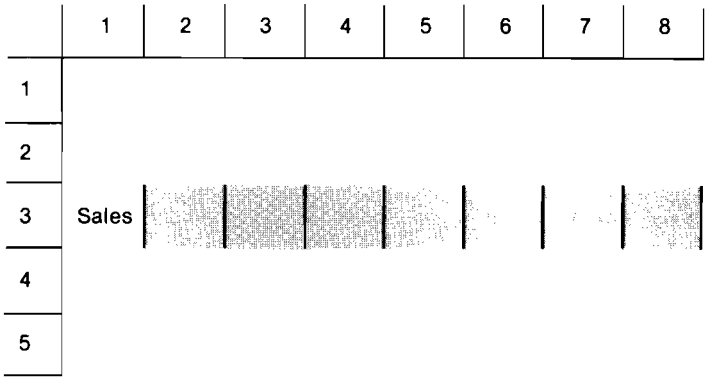


Figure 15.4. Names as Cell References

Three operators may be used to combine references: intersection, range, and union.

Intersection Operator (Space)

The intersection operator is used to combine two references to refer to all the cells that belong to both references.

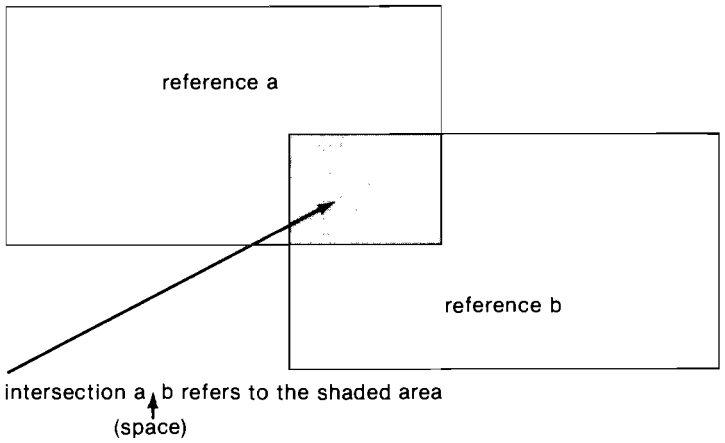


Figure 15.5. Intersection Reference

As a specific example,

```
R C3
  ↑
(space)
```

refers to the cell where the current row and column 3 intersect.

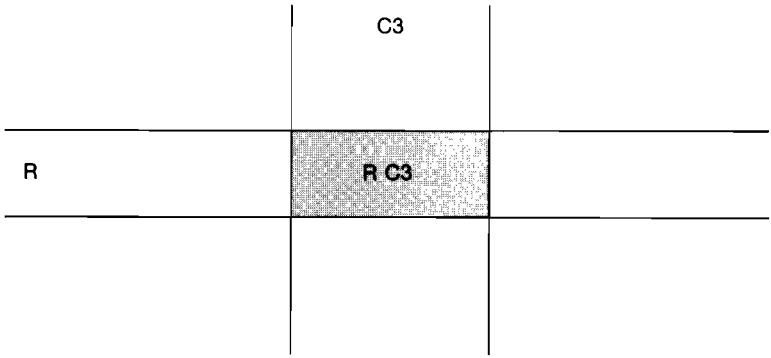


Figure 15.6. Relative-Absolute Intersection Reference

When reference forms are combined (that is, an absolute with a relative, an absolute with a name, a relative with a name, or a name with a name), the intersection operator must separate them to indicate access to the value or values where the two references intersect.

For example: RC3 is not permitted, write R C3 instead.

If the two references do not intersect, Multiplan returns a #NULL! error value.

Range Operator (Colon) (:)

The range operator is used to combine two references so that the values in a group of contiguous cells may be used.

The area of a range is the smallest rectangle that includes both references.

Typically, in a reference written as a:b, the *a* reference is in the upper left corner and the *b* reference is in the lower right. For example:

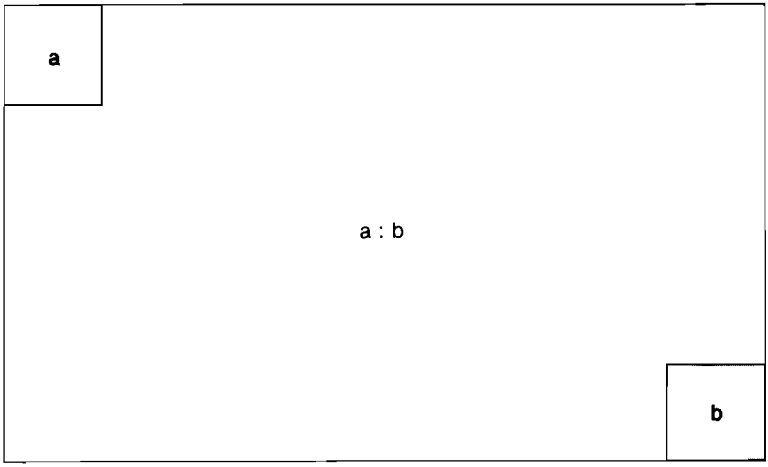
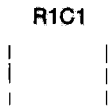


Figure 15.7. Range Reference

The range operator may be used to combine any of the reference forms (absolute, relative, or name) in any order.

Union Operator (Comma) (,)

The union operator is used to combine references to refer to all cells that belong to either reference. For example:



R1C1,R3C1

Figure 15.8.

Each reference in a union may be any form (absolute, relative, or name), an intersection, or a range.

A union usually refers to cells that are not contiguous. Where a union describes contiguous cells, it describes a rectangle as a range reference would. For example:

R1C1,R1C2 equals R1C1:2

Figure 15.9.

but R1C1,R3C1 does not equal R1:3C1

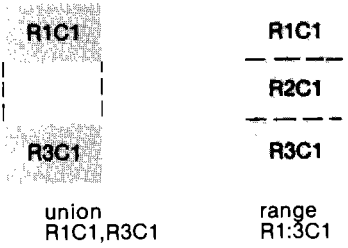


Figure 15.10.

The range reference in the second example includes cells not specified by the union reference.

References may be used in formulas that require the value of a single cell. When the reference describes a single cell and a single value is required (for example, R1C1+1), the value meant is the value of the cell described plus the value 1. (Note that this value may be a number, text, logical, or error value, depending on the value in the cell referred to.)

When the reference describes a group of cells but a single value is required, Multiplan chooses the value to be used from the cell where the current row or column intersects the group of cells. In particular, for groups that are parts of rows, Multiplan chooses the value in the current column. Similarly, from parts of columns, the value in the current row is chosen. Figure 8.11 illustrates a use for this feature. Using a group of cells that is not either a row or a column (or a part of one of these) does not yield useful results.

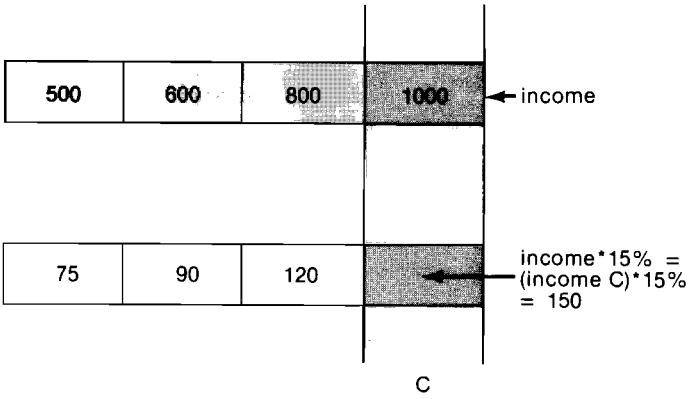


Figure 15.11. Single Value from a Reference to a Group of Cells

Chapter 10 contains descriptions of the functions that can process a collection of values (SUM(...) for instance). Any type of reference may be given as an argument to such a function. The value of all the cells that are described, whether one or many, will be processed.

Logical Values

The logical values true and false are returned by the comparison operators that compare two numbers:

Operator	Meaning
<	less than
<=	less than or equal
=	equal
>=	greater than or equal
>	greater than
<>	not equal

The functions AND(...), OR(...), NOT(...), TRUE(), and FALSE() also perform logical operations.

The purpose of logical values is to make "either-or" decisions using the IF(...) function. All of these functions are explained in Chapter 10.

Note that text values cannot be compared, except by the Sort command.

Error Values

When a Multiplan function, operation, or reference is used incorrectly, an error value will result. There are different error values for different error conditions, as described below. Error values "propagate," meaning that operations or functions that result in error values in one cell cause the same error values in all the cells that refer to the first cell. This also means that when one notices an error value in a cell, the propagation has to be unraveled step-by-step until the source of the error is found.

For example, we notice that cell R1C1 displays the #NAME? (undefined name) error value. The formula in R1C1 is $a+1$. We

check the definition of *a* using the Name command. We find that the name *a* is defined to refer to R1C2. That cell is the next step in the search. When we look in cell R1C2, we may find the cause there, but we may also find references to other quantities which will have to be inspected. We may have to look at more than one cell to find the source of the error.

The error values and their causes are:

Value	Cause
#DIV/0!	result of an attempt to divide by 0.
#NAME?	result of an undefined label reference.
#N/A	result when the value is not available. Also, #N/A is a special value that may be created using the NA() function and which will be propagated by arithmetic.
#NULL!	result of specifying an intersection of disjoint areas; e.g., R1 R2 (use union instead, R1,R2).
#NUM!	result of an overflow (number is too large or too small) or of an illegal use of an arithmetic function; e.g., SQRT(−1).
#REF!	result of a relative reference reaching outside the sheet or of a reference to a deleted area.
#VALUE!	result of using text where a number is needed or vice versa or of using references when a value is needed.
#####	cell width is too narrow for the number entered or calculated.

Files

This section describes how Multiplan uses files, when it reads and writes files and how links between files are handled.

This information will help better plan your use of Multiplan files.

File Handling

Files are permanent repositories of information kept on diskettes. Files are identified by filenames, which are kept in a directory. Multiplan uses files mainly to store worksheets. For more information on diskettes, see the section entitled "Operating Information."

Multiplan can read files, and it can write them. For both operations, Multiplan requires access to the file.

However, the machine may have more than one disk drive and different files may reside on different diskettes. It is important, then, to make sure that the proper diskette is mounted in the proper drive.

If the filename includes a drive specification, then that drive is the proper one. Otherwise, the "default" drive (assigned through the Transfer Options command and the setup field) is used.

See also "Designating Drives for Data Files" in Chapter 12, 12, Operating Information, and the Transfer commands sections in Chapter 16, Command Directory.

Efficient operations with multiple diskettes may require some advance planning. Should the planning fail, however, Multiplan will simply display the message:

Enter Y to retry access to *filename*

When you see this message, check that you used the correct filename and that you have the correct disc loaded.

The following lists describe when Multiplan reads files, when it writes files, and what problems Multiplan may have with reading and writing files. This information may help you anticipate file access by Multiplan.

Multiplan reads files:

1. When a sheet is loaded (Transfer Load command) in any mode (Normal, Symbolic, Other).

2. When a sheet is loaded that has supporting sheets, the supporting sheets are read one by one.

3. When the eXternal Copy command is executed, the source sheet is read.

4. When the eXternal Use command is executed, the affected copies are redone, and the source sheets are read. (See the eXternal Use command in Chapter 16.)

5. The Multiplan system disc will be read for parts of the Multiplan program when commands are executed and for the Help file when Help is requested.

Multiplan writes the file to the diskette:

1. When a sheet is saved (Transfer Save command) in any mode.

2. When a sheet is renamed or deleted, the file directory is read or written. The file directory, by definition, shares the diskette with the worksheet files.

3. When the Print File command is executed.

4. When sheet linking relationships change, a Transfer Save or Transfer Rename command, in addition to normal duties, gains access to all supporting sheets to issue or to revoke receipts.

Problems with File Access

You should be aware of problems to consider when trying to read or write a file. If problems with file access persist, check for possible causes from the following lists.

Problems When Reading

1. The information may not be on the disc. Use the Transfer Load command and the direction keys to display the directory of files on the disc.

2. The information is not reliably readable or is unreadable. You should maintain backup copies of important files.

3. The information is not in the expected format. Check the "mode" setting of the Transfer Options command. Remember that the eXternal Copy command requires that sheets be saved in Normal mode.

4. The information is not up to date. This may happen if incorrect procedures are used for updating a collection of externally linked sheets. See the section, "External Relationships," in this chapter for details.

Problems When Writing

1. The disc may become filled. Discs can store only a limited amount of information. As more files are stored on them, they may fill up. See the "Memory Requirements" section in Chapter 12, Operating Information, for procedures for determining the amount of storage used on a disc.

2. Previous information stored in a file may be valuable. Multiplan will ask you:

   Overwrite existing file?

   Pause and reflect if this is what you want.

3. The disc may be write-protected by a small piece of foil covering an indentation on the sleeve of the diskette. Consider the reason for write-protection before removing the foil.

4. Errors during writing, such as an interruption, may leave incorrect information on the diskette. Make sure that write operations are allowed to complete.

External Relationships

The information in this section applies to the eXternal group of commands. Refer to the discussion of these commands in Chapter 9 for additional information.

External relationships between worksheets may be illustrated as follows:

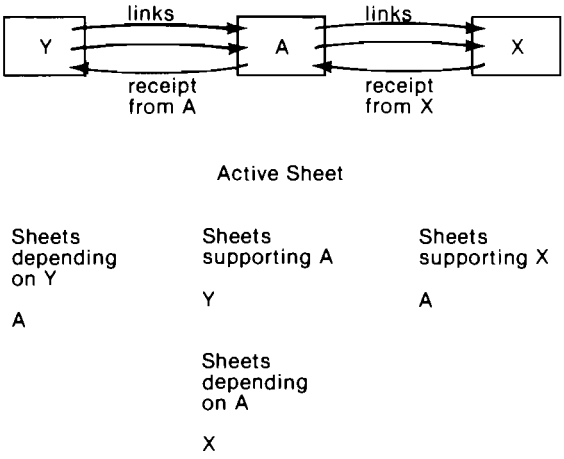


Figure 15.12. External Relationships between Worksheets

The set of external links can be reviewed by stepping through the supporting sheet names and the source and target areas in the eXternal Copy command.

Changing data on a supporting sheet has no immediate effect on its dependent sheets. Only when a dependent sheet is loaded is

the current information read from its supporting sheet. Thus, when changes are made to sheet Y, nothing changes on sheet A until sheet A is loaded. When sheet A is loaded, then sheet Y is read, and its data is copied to sheet A.

Similarly, when sheet A is changed (including changes from sheet Y), sheet X does not change until it is loaded. When sheet X is loaded, then sheet A is read, and its data is copied to sheet X. Note that for the information read from A to X to be current with the information on Y, A must have been loaded *and saved* at least once before X was loaded. Information is copied only one link at a time.

In a more complex set of worksheets, the relationships between the worksheets may be unraveled using the eXternal List command on each sheet and creating a dependency diagram similar to the one below.

Consistency of all data can be assured by starting with a set of sheets that are not supported by any sheets. Load and save a second set of sheets that depend on the set of unsupported sheets, then load and save sheets that depend on the second set of sheets, and so on until all sheets have been loaded and saved.

This process is illustrated in the following diagram:

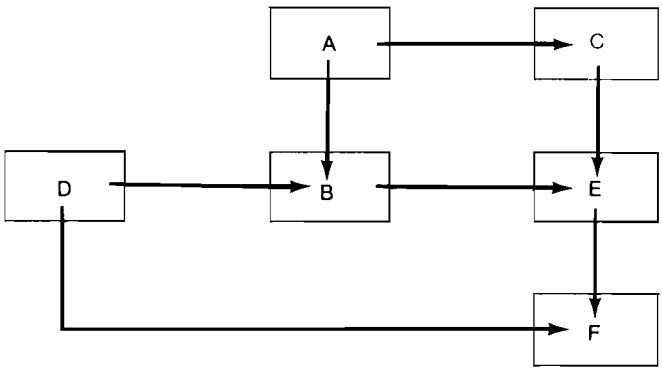


Figure 15.13. Dependency Diagram

Sheets A and D are not supported by any other sheets. If the information on them is current, then:

1. Load and save sheets C and B.

2. Load and save sheet E.

3. Load and save sheet F.

When preparing the dependency diagram, remember that the list of "depending sheets" on each sheet is not necessarily complete. For example, the listing of sheets depending on A is contingent on a "receipt" being issued when the link was established by B.

A "receipt" is an entry in the supporting file that says sheet B receives data from this sheet. When you give the eXternal List command, Multiplan looks at the receipts to build the list of "Sheets depending on." The "receipt" must have been written correctly onto A just after B was saved. If, for any reason, Multiplan cannot enter the receipt onto sheet A, the "depending" list on A is not current. Even so, the data from the supporting sheets can be copied as specified by the eXternal Copy command.

The list of "supporting" sheets will always be correct.

Transforming the Worksheet

The information in this section applies to the Delete, Insert, Move, and Sort commands. Refer to the discussions of these commands in Chapter 16 for additional information.

When rows or columns are inserted, deleted, moved, or sorted, sections of the worksheet may be displaced. For example:

1. One column is inserted before column 2. This moves the part of the worksheet that is to the right of column 2 one column farther to the right.

2. Row 2 is moved to before row 10. Besides moving the contents of row 2 to row 9, the former rows 3-9 are displaced one row toward the top of the sheet.

Because these commands may change the location of cells, Multiplan also automatically adjusts any references to the cells, whether they occur in formulas or in the definition of names. However, the adjustments to some references after the worksheet has been transformed may cause problems. The problems fall into the following general categories:

1. References to cells which have been deleted from the sheet are replaced by #REF! error values. All formulas that contained the references must be edited. These formulas are found by inspecting the cells that display the #REF! error value.

2. If the reference is to a group of cells and the transformation would distort a rectangular part of the group into a more complex shape (for example, if a corner cell is deleted from a rectangular area), the name definition is not changed.

3. If cells are inserted adjacent to a group of cells, references to the group are not updated to include the new cells. If the enlargement of the group is desired, the insertion must be made in the interior of the group rather than at the boundary. If necessary, the new cells may be inserted at an unambiguous place (e.g., in the interior of the group), then the cell contents copied as required.

4. Related problems may occur when rows or columns containing a boundary of a group are moved. Such moves will "drag" the boundary line of the definition of the group along. If this is not desired, the move can still be accomplished by an insert, copy, delete sequence.

5. If a formula is copied into a number of cells using the Copy Down, Copy Right, or Copy From commands, the relative references in all of the formulas are adjusted equally. The model formula for the adjustment is the first one encountered on the sheet. This means, for example, if the formula

   ```
   RC[-1]*1.05
   ```

   is copied from R1C2 to R1C14, and if column 5 is deleted, all formulas will be adjusted according to R1C2; no change in this case. However, if column 1 is deleted, the reference in R1C2 will become #REF! (see rule 1 above), and the other formulas will follow accordingly. To fix undesirable results, edit the model formula and recopy it.

Note that the Sort command may move many rows and, therefore, may cause any of these problems.

Chapter 16
Command Directory

The following directory explains each Multiplan command.

At the beginning of each command description, the complete menu for the command or subcommand is shown with proposed responses. In most cases, the proposed response is derived from the position and contents of the active cell. For consistency of reference, a general notation is used for proposed responses, as follows:

RC indicates the active cell

R indicates the row number of the active cell

C indicates the column number of the active cell

W indicates the active window

( ) indicates a description of proposed response; for example, (contents of RC)

Other proposed responses, usually numbers, are shown as they appear when the command is used.

The examples provided are intended to give you a sample of the uses for the command. A short description of the action to be performed precedes a command format with proposed responses in the fields. To recreate the example yourself, use any of the methods for entering responses until your command line looks like the example.

All commands are terminated (carried out) by pressing Return

Related and similar commands are listed under the heading "See Also" in each listing in this chapter. Commands that offer subcommands are described only generally under the main command heading. Refer to the subcommand descriptions for the details of performing a particular action.

Alpha

ALPHA: (contents of RC)

Enter text (no double quotes)

Description

Places text in the active cell. If the active cell already contains text, that text is the proposed response to the Alpha prompt.

The proposed response may be edited, but if you simply begin typing, the proposed response is replaced entirely.

The Alpha command is terminated by press Return or any action key that moves the cell pointer, such as the direction keys.

The contents of a cell containing text are displayed in double quotes in the status line. Multiplan supplies these double quotes automatically.

Alpha may not be used to blank a cell. Use the Blank command for this.

The Alpha command is highlighted in the command menu when Multiplan is idle. This means that (1) Alpha can be selected by pressing Return; and (2) if Return is pressed inadvertently, you may find yourself in the Alpha command.

Entering text or values in a sequence of cells is made easier because of the following feature:

> If either the Alpha or Value command is terminated by an action key that moves the cell pointer, the cell pointer is moved appropriately, and Multiplan displays on the command line:
>
> ALPHA/VALUE:
>
> Enter text or value
>
> The first character entered selects the standard Alpha or Value command. The Value command is selected if you press

one of the digits 0-9 or one of the characters = (equals), + (plus), − (minus), . (period), ((left parenthesis), or " (quotation mark). The characters selecting the Value command have the same effect as when selecting from the main command menu. This effect is described under the Value command in this chapter. All other characters select the Alpha command.

This process can be repeated for entering text, numbers, and formulas in successive cells until Return or Cancel is pressed.

Example

To enter the text *Net Profit* into the active cell:

ALPHA: Net Profit

To enter the text *Spencer,* the text *Sales* and the number *1000* in adjacent cells, press *A* (for Alpha), type *Spencer,* press ►, type *Sales,* press ►, type *1000,* and press Return.

See Also

Format Cells to permit the display of cell contents to cross a cell boundary.

Format Width to accommodate text within a column.

Name to create names for cells.

Value to enter numbers or formulas.

Blank

BLANK cells: RC

Enter reference to cell or group of cells

Description

Replaces contents of specified cells with blanks. The proposed response permits quick blanking of the active cell.

The format of the cell is not changed. The cell is still available for storing values.

Names are not affected. If a cell was named before the Blank command was used, that name will still apply.

When a formula refers to a blank cell, its number value is taken as zero, or its text value is a blank.

Examples

To blank the cell in row 3 column 2:

```
BLANK cells: R3C2
```

To blank all cells in the area named *Sales*:

```
BLANK cells: Sales
```

To blank an irregular area:

```
BLANK cells: R1:6C1,R7:8
```

See Also

Delete to remove cells from the sheet entirely.

Transfer Clear to clear the entire sheet.

Copy

COPY: Right Down From

Select option or type command letter

Description

Presents a choice of ways to copy some cells into other cells. Both the contents and the formats of the source cells are copied. Source cells are not altered.

Copy Right copies one cell or a column of cells into cells to its right.

Copy Down copies one cell or a row of cells into cells below it.

Copy From is the general form and can be used for all copying on the active worksheet. Copy Right and Copy Down are included because they make a common copying task easier.

The subcommands are explained individually on the following pages.

See Also

Insert to add new cells between existing ones.

Move to move cells to other locations.

eXternal Copy to copy cells from an inactive worksheet.

Copy Down

```
COPY DOWN number of cells: 1      starting at: RC

Enter a number
```

Description

Copies the specified cell the number of times specified in the "number of cells" field into the cells below it.

The proposed response for the "number of cells" field is the number used in the last Copy Down or Copy Right command. The total number of identical cells will be number specified plus one (for the original).

The command can also copy down a row of cells by specifying a row or part of a row in the "starting at" field.

Examples

To copy the value and format of R1C1 into the 10 cells below it:

```
COPY DOWN number of cells: 10      starting at: R1C1
```

To copy the first five cells in row 1 into the next four rows below:

```
COPY DOWN number of cells: 4      starting at: R1C1:5
```

Copy From

COPY FROM cells: RC to cells: RC

Enter reference to cell or group of cells

Description

Copies the contents of a cell or group of cells to another location on the sheet. Copy From is used, for example, when the source cells and the destination cells are not in the same row or column.

When there is only one source cell, the cell contents are copied into each destination cell.

When the source is a group of cells, the entire group is copied. When only one destination cell is given but the source is a group of cells, the destination cell marks the upper left corner of the destination area.

In general, either the source or the destination should consist of a single cell.

In special circumstances, copying vectors can be accomplished. (A vector is a line of two or more cells, either in a row or in a column.) Copying from a row to a row or from a column to a column is allowed if the source and the destination are the same size. If copying is done from a row vector to a column vector, or from a column to a row, the resulting copy is a rectangle in which the source vector is copied starting at each cell of the target vector.

The following diagrams illustrate the results of copying vectors, as described above:

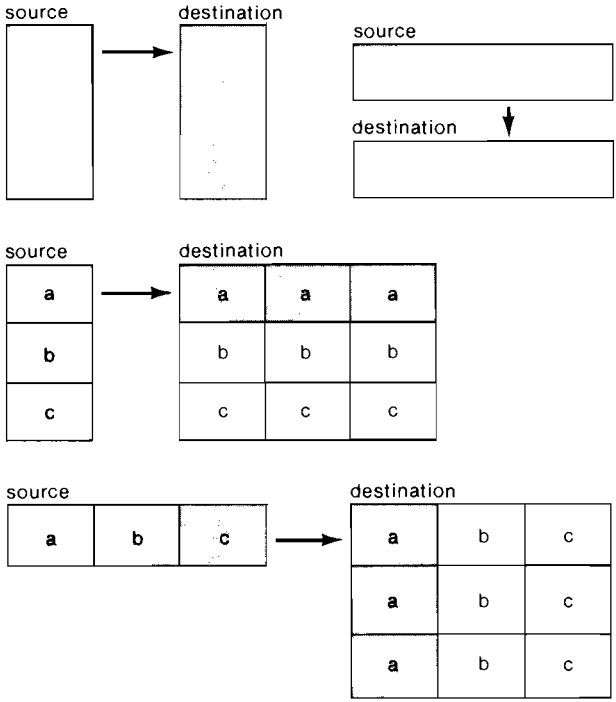


Figure 16.1. Results of Copying Vectors

If other forms of copies are attempted, the system cancels the Copy command and displays the "Illegal parameter" message.

Examples

To copy the contents of cell R1C1 into cell R5C3:

```
COPY FROM cells: R1C1      to cells: R5C3
```

To copy the contents of cell R1C1 into all cells in column 8:

```
COPY FROM cells: R1C1      to cells: C8
```

To copy a square patch of cells in the upper left corner of the worksheet into a square patch beginning at R8C1:

```
COPY FROM cells: R1:4C1:4      to cells: R8C1
```

The upper left cell of the new patch is R8C1. After the copying, R8C1 is a copy of R1C1, R8C2 is a copy of R1C2, and so on to R11C4, which is a copy of R4C4.

Likewise, the same copy can be made by also specifying a destination area that matches the source area:

```
COPY FROM cells: R1:4C1:4      to cells: R8:11C1:4
```

To copy the first four cells in column three into column six:

```
COPY FROM cells: R1:4C3      to cells: R1C6
                                       (upper left of area)

COPY FROM cells: R1:4C3      to cells: R1:4C6
                                       (matching area)
```

To copy the first four cells in column six three times:

```
COPY FROM cells: R1:4C6      to cells: R1C6:8
```

The source cells are part of a column while the destination area is part of a row. The source column is copied down beginning at each cell of the destination.

Copy Right

```
COPY RIGHT number of cells: 1      starting at: RC

Enter a number
```

Description

Copies the specified cell the specified number of times into the cells to the right of the specified cell.

The proposed response for the "number of cells" field is the number used in the last Copy Down or Copy Right command. The total number of identical cells will be the number specified plus one (for the original).

The command can also copy right a column of cells by specifying a column or part of a column in the "starting at" field.

Examples

To copy the contents of the active cell (R1C1) into the 8 cells to the right of it:

```
COPY RIGHT number of cells: 8      starting at: R1C1
```

To copy the contents of the 5 cells in column 1 (R1:5C1) into column 2, giving two side by side columns with the same contents:

```
COPY RIGHT number of cells: 1      starting at: R1:5C1
```

Delete

DELETE: Row Column

Select option or type command letter

Description

Presents choices for deleting cells from the worksheet and closing up the space.

Delete Row deletes a row or rows and moves the rest up.

Delete Column deletes a column or columns and moves the rest to the left.

Multiplan adjusts all references affected by any deletion. See "Transforming the Worksheet" in Chapter 15 for the description of how the Delete command affects references.

The subcommands are explained individually on the following pages.

See Also

Blank to make cells empty.

Delete Column

```
DELETE COLUMN # of columns: 1          starting at: C
                between rows: 1        and: 255
```

Enter a number

Description

Deletes all or part of a column or columns. The proposed response for the starting column is the column of the active cell. This command is most commonly used to delete complete columns by accepting the proposed responses of rows 1 and 255.

Columns to the right of the deleted columns move left, and new columns of blank cells are added at the right edge of the sheet.

Parts of columns can be deleted. The deletion takes place between the specified rows; other rows are not affected.

Examples

To delete the entire column 4:

```
DELETE COLUMN # of columns: 1          starting at: 4
                between rows: 1        and: 255
```

To delete a rectangular area in columns 3 and 4, between rows 3 and 8:

```
DELETE COLUMN # of columns: 2          starting at: 3
                between rows: 3        and: 8
```

The portion of the worksheet in rows 3 through 8 which was to the right of column 4 will move two columns to the left.

Delete Row

```
DELETE ROW # of rows: 1                starting at: R
           between columns: 1          and: 63

Enter a number
```

Description

Deletes all or part of a row or rows. This command is most commonly used to delete complete rows by accepting the proposed responses of columns 1 and 63.

Rows below those deleted move up, and new rows of blank cells are added at the bottom of the sheet.

The proposed response for the starting row is the row of the active cell.

Parts of rows can be deleted. The deletion takes place between the specified columns; other columns are not affected.

Examples

To delete the active row (R1):

```
DELETE ROW # of rows: 1                starting at: 1
           between columns: 1          and: 63
```

To delete a rectangular area in rows 6 and 7 between columns 1 and 8:

```
DELETE ROW # of rows: 2                starting at: 6
           between columns: 1          and: 8
```

The portion of the worksheet in columns 1 through 8 which was below row 7 moves up two rows.

Edit

EDIT: (contents of RC)

Enter a formula

Description

Used to edit a formula or value in the active cell. If you edit text with the Edit command, remember to enclose the text in double quotes.

The current contents are shown in the command line. The edit cursor is placed at the end of the current contents.

After you have edited the cell's contents, press RETURN or one of the cursor movement keys, such as the direction keys, to put the contents into the cell. If you use a cursor movement key to place the contents in the cell, Multiplan changes to the ALPHA/VALUE: command rather than returning to the main command menu. Refer to the description under the Alpha command.

Press CANCEL before pressing either RETURN or one of the cursor movement keys to cancel your changes and to return to the main command menu.

If the cell contains a formula, Multiplan checks the formula for errors when RETURN is pressed. If the formula contains an error, the erroneous part is highlighted, and the Multiplan Edit command remains active.

See the "Editing" section in Chapter 15 for the description of the editing keys.

Note Locked cells may not be edited.

See Also

Alpha for entering or editing text.

Format

FORMAT: Cells Default Options Width

Select option or type command letter

Description

Presents a choice of various display adjustments.

Format Cells alters the alignment and format of a cell or group of cells.

Format Default sets the default alignment, format, and width for all cells.

Format Options controls the display of formulas and of commas in numbers.

Format Width sets the width of a column or columns.

The display of cell contents is controlled by the settings in the "alignment" and "format" fields of the Format Cells command.

The setting in the "alignment" field controls the placement of the contents within the available spaces of the cell; whether the empty space is placed to the right of the contents, to the left, or on both sides.

The setting in the "format" field, together with the response in the "# of decimals" field, controls how the value is displayed, as a dollar amount, as a percentage, as a decimal value, and so on.

In both the "alignment" and "format" fields, there is a "Default" setting. The "Default" setting is defined by the Format Default Cells command. The settings selected in the "alignment" and "format" fields of the Format Default Cells command define the display of all cells with the "Default" setting.

All cells have the "Default" setting initially. (When Multiplan is first started, the display is controlled by "General" alignment and "General" format.) If you insert new rows or columns, the inserted cells receive the default setting.

The format given to the default settings can be changed at any time by using the Format Default command. This allows you to change easily the format of all cells that have the default code setting, which may be most of the cells.

We recommend that you define the most common format you will be using as the default, and alter a cell or some cells to display their contents differently from the default with the Format Cells command.

The subcommands are explained individually on the following pages.

See Also

Print Margins to set the format of a printed copy of the sheet.

Format Cells

FORMAT cells: RC alignment: Def Ctr Gen Left Right –
format code: Def Cont Exp Fix Gen Int $ * % – # of decimals:

Enter reference to cell or group of cells

Description

Alters the alignment and format codes of one or more cells.

The proposed responses are the format codes of the active cell. This command may be used to review the settings for the active cell. The settings of the active cell may be given to a group of cells by changing the response in the "cells" field.

If you are changing the alignment code of a group of cells but not the format code, you must select the hyphen response in the "format code" field to keep the format codes as they are. Otherwise, all cells in the group will receive the format code of the menu setting.

Similarly, if you want to change the format code but not the alignment code of a group of cells, select the hyphen response in the "alignment field."

The alignment codes are:

Def	Default	Align this cell by the default alignment.
Ctr	Center	Center the cell display in the column.
Gen	General	Align text left, numbers right.
Left	Left	Left-justify the cell display in the column.
Right	Right	Right-justify the cell display in the column.

Leave all alignment codes as they are. Used when changing the format code of a group of cells but not the alignment codes.

Text is displayed only for the width of the cell unless the Continuous format code is selected.

The format codes are:

Def	Default	Display this cell with the default format.
Cont	Continuous	Text longer than the column width is displayed at its full width, crossing into the column on the right if necessary (the cell to the right must be blank and must have the Continuous format also). Numbers are displayed in the General format code. Typically, you will want to format an entire row when using the Continuous format code.
Exp	Scientific	Numbers are displayed as a decimal notation times a power of ten; for instance, 2.1E6 for 2100000. The number of decimal places used is set in the "# of decimals" field of the Format Cells command.
Fix	Fixed Point	Numbers are displayed rounded to a fixed number of digits of decimal fraction. The number of decimal places is set in the "# of decimals" field of the Format Cells command.
Gen	General	Numbers are displayed as precisely as possible in the available width of the cell, with scientific notation used automatically, as needed.

Int	Integer	Numbers with a decimal fraction are rounded to integers.
$	Dollar	Money amounts are displayed with a leading dollar sign and two decimal places. Negative numbers are shown in parentheses.
*	Bar graph	When the cell contains a number, it is rounded to an integer and that many asterisks are displayed. For example, all values between 2.5 and 3.5 are displayed as three asterisks. Use the Bar graph format code to build a bar graph. Negative numbers are shown in parentheses. Only as many asterisks as the width of the cell allows are shown. To see all asterisks, use the Format Width command to widen the cell. See also the REPT function for creating bar graphs composed of other characters.
%	Percent	Numbers are displayed as a percentage. The number of decimals is set in the "# of decimals" field of the Format Cells command. For example, the value .1 will be displayed as 10% if the # of decimals is zero; or as 10.0% if the # of decimals is 1.
		Leave all format codes as they are. Used when changing the alignment code of a group of cells but not the format codes.

The "# of decimals" field is used only for the Fix, Exp, and % format codes. If you enter a response to this prompt for the other format codes, your response is ignored. If you are not specifying one of these three format codes, you can simply press Return after specifying the format code.

Examples

To align the contents of the active cell (R5C15) in the center of the available spaces:

```
FORMAT CELLS: R5C15      alignment: Def (Ctr) Gen Left Right –
format code: (Def) Cont Exp Fix Gen Int $ * % –      # of decimals: 0
```

To display the cells in column 2, rows 3 through 6 as money values preceded with a dollar sign and displayed with two decimal places:

```
FORMAT CELLS: R3:6C2 alignment: (Def) Ctr Gen Left Right –
format code: Def Cont Exp Fix Gen Int ($) * % –      # of decimals: 0
```

Notice that the alignment of all cells in this group is now "Default." If any of the cells had an alignment setting other than "Default" and if you want to preserve the special alignment, select the hyphen response instead of the "Def" response in the "alignment code" field.

To display the values in rows 1 through 12 of column 10 as percentages with four decimal places accuracy:

```
FORMAT CELLS: R1:12C10 alignment: Def Ctr Gen Left Right (–)
format code: Def Cont Exp Fix Gen Int $ * (%) –      # of decimals: 4
```

Any alignment already specified for any of the cells in this group is retained.

See Also

Format Default to set the default format.

Format Width to set the width of specific columns.

Format Default

FORMAT DEFAULT: Cells Width

Description

Presents a choice of two kinds of defaults to be changed.

Format Default Cells sets default alignment and format codes.

Format Default Width sets the default width of all columns.

See Also

Format Cells to alter the format and alignment codes of specific cells.

Format Width to alter column widths of specific columns.

Format Default Cells

```
FORMAT DEFAULT CELLS alignment: Ctr Gen Left Right
format code: Cont Exp Fix Gen Int $ * %      # of decimals: 0
```

Description

Sets the alignment and format for all cells that have the default setting. The initial default alignment and format code is General.

The alignment and format codes are listed and described under the Format Cells command.

Example

To set the default format code to money amounts ($):

```
FORMAT DEFAULT CELLS alignment: Ctr (Gen) Left Right
format code: Cont Exp Fix Gen Int ($) * %      # of decimals: 0
```

Format Default Width

FORMAT DEFAULT column width in chars: 10

Enter a number

Description

Sets the width of all columns that have the "default" width setting. See "Format Width" for an explanation of default width.

The initial default width is 10 characters.

Example

To set the default width to 12:

```
FORMAT DEFAULT column width in chars: 12
```

See Also

Format Width to alter the width of some columns.

Format Options

```
FORMAT OPTIONS commas: Yes No      formulas: Yes No

Select option or type command letter
```

Description

The proposed responses are the current settings of the options.

For cells that have "Fix," "Int," "$," or "%" format settings, the comma option groups a number into thousands and separates the groups with commas. For example, a number such as 12345678 under the comma option would be displayed as 12,345,678.

The formulas option permits you to see what generates the value in every cell. A cell normally displays the value of a formula placed in it. Selecting "Yes" for the formulas option causes cells that contain formulas to display their formulas instead of their values. The width of all columns is doubled. Cells that contain text display their contents in double quotes.

When the "formulas" option is off (No), check the formula in a cell by using the Edit command or by moving the cell pointer to the cell; the formula will appear in the status line.

Example

To display formulas in the cells that contain them:

```
FORMAT OPTIONS commas: Yes(No)      formulas: (Yes)No
```

Format Width

FORMAT WIDTH in chars or d(efault): d column: C through: C

Enter a number or d for default

Description

Alters the width of one or more columns to the number of characters specified.

The proposed response for the "in chars or d(efault)" field is always d. "d" is a special "default" setting, similar to the default setting for format and alignment codes. When the width setting is "d", the column width is controlled by the Format Default Width command.

All columns have the default setting initially. The width of all columns with the default setting can be changed easily using the Format Default Width command. You can set the most convenient width as the default with the Format Default Width command, and alter specific columns to other widths with the Format Width command.

If a cell contains text longer than the column is wide, Multiplan cuts off the display at the right edge of the column. Use this command to widen the column or the "Continuous" cell format.

If a cell contains a number that cannot be displayed in the column width, Multiplan displays a series of number signs (#) instead. This can be fixed by widening the column, or sometimes by using a different format code.

Examples

To change the width of column 1:

FORMAT WIDTH in chars or d(efault): 12 column: 1 through: 1

To change the width of columns 4 through 8 to 20 characters:

```
FORMAT WIDTH in chars or d(efault): 20    column: 4    through: 8
```

See Also

Format Cells to set Continuous format code.

Format Default Width to set the default column width.

Goto

GOTO: Name Row-col Window

Select option or type command letter

Description

Presents a choice of ways to move the cell pointer to a new position.

Goto Name makes the first cell of a named area the active cell.

Goto Row-col makes the specified cell the active cell.

If a requested cell is already visible through the active window, only the cell pointer is moved.

If the requested cell is not visible through the active window, the active window is shifted so that the named area appears in the specified window.

Goto Window makes the specified cell the active cell and places it at the upper left corner of the specified window.

The subcommands are explained individually on the following pages.

Goto Name

GOTO name:

Enter reference to cell or group of cells

Description

Places the cell pointer on the upper left corner cell of the named area, making that cell the active cell.

Use the direction keys to step through the list of names.

Example

To move the cell pointer to the upper left corner of the area named *SumCosts:*

GOTO name: SumCosts

Goto Row-col

GOTO row: R column: C

Enter a number

Description

Places the cell pointer on the specified cell, making that cell the active cell.

Examples

To move to row 25 in the active column (column 1):

GOTO row: 25 column: 1

The proposed response in the "column" field was not changed.

If rows 1 through 20 are visible through the window when you enter this command, the window will be shifted so that cell R25C1 is visible in the upper left quarter of the active window.

To make row 37, column 9 (R37C9) visible:

GOTO row: 37 column: 9

Goto Window

GOTO WINDOW window number: W row: R column: C

Enter a number

Description

Places the specified cell in the upper left corner of the window specified.

If you use this command with the proposed responses, which are the active window and active cell, Multiplan redraws the active window, placing the active cell in the upper left corner.

Examples

To set the active cell as the upper leftmost cell of window number 3:

GOTO WINDOW window number: 3 row: 5 column: 15

To set cell R100C45 as the upper leftmost cell of window number 5:

GOTO WINDOW window number: 5 row: 100 column: 45

See Also

Window Split to open windows.

Help

HELP: Resume Start Next Previous
Applications Commands Editing Formulas Keyboard

Select option or type command letter

Description

Provides helpful information about Multiplan.

Help information is read from a disc file. Information in the Help file is requested two ways: either (1) selecting Help from the main command menu, or (2) pressing Help. When you request Help, the worksheet is replaced by text from the Help file, and the Help menu appears.

The worksheet display resumes when you either select the "Resume" subcommand (press R or Return) or press Cancel or ESC. "Resume" returns to the exact place where Help was requested. Pressing Cancel or ESC returns to the main command menu.

The information displayed depends on when Help is requested. In particular:

If you use the space bar or Back space to highlight a command word in a menu, a description of that command is shown when you request Help.

If the edit cursor is in a command field, a description of that field is shown.

If the message line shows an error message, either a description of the previous command or a description of the error is shown.

Once in the Help command, you can request Help information by selecting one of the following options on the Help menu:

Option	Result
Resume	Return to the menu where you requested Help.
Start or ↖	Show the beginning of the Help file.
Next or Page Down	Show the next screenful of Help information. Typically, not all the relevant information is shown, and Next (press the letter *N*) should be used.
Prev or Page Up	Show the previous screenful of Help information.
Applications	Show a list of common problems paired with the names of the commands that offer solutions.
Commands	Show the description of the first command (Alpha).
Editing	Show the description of Multiplan editing.
Formulas	Show a list of all functions and the rules about formulas.
Keyboard	Show the keytop labels corresponding to Multiplan action keys.

Insert

INSERT: Row Column

Select option or type command letter

Description

Presents a choice of ways to insert new cells into the worksheet.

Insert Row inserts new rows, moving the rest down.

Insert Column inserts new columns, moving the rest to the right.

Multiplan adjusts all references affected by the insertion. See "Transforming the Worksheet" in Chapter 15 for the description of how the Insert command affects references.

The Insert command will not be carried out if the insertion would push data off the edge of the sheet. If, for example, you have data in column 63, an attempt to insert even one column will receive the message "Illegal parameter." Similarly, if you have data in column 50 and attempt to insert 14 columns, you will receive the "Illegal parameter" message.

The subcommands are explained individually on the following pages.

See Also

Move to move rows or columns on the sheet.

Delete to remove rows or columns.

Insert Column

```
INSERT COLUMN # of columns: 1      before column: C
                between rows: 1    and: 255

Enter a number
```

Description

Inserts all or part of a column or columns of blank cells. This command is most commonly used to insert complete new columns by accepting the proposed responses of rows 1 and 255.

Parts of columns can be inserted. Insertion takes place between the specified rows; other rows are not affected.

Cells to the right of the inserted ones move right.

Examples

To add a column just left of the active one (column 3):

```
INSERT COLUMN # of columns: 1      before column: 3
                between rows: 1    and: 255
```

To insert a rectangular area in columns 5 and 6 between rows 3 and 8, causing parts of rows 3-8 to move right to make room:

```
INSERT COLUMN # of columns: 2      before column: 5
                between rows: 3    and: 8
```

Insert Row

```
INSERT ROW # of rows: 1              before row: R
           between columns: 1        and: 63
```

Description

Inserts all or part of a row or rows of blank cells. This command is most commonly used to insert complete rows above the active row by accepting the proposed responses of the active cell and columns 1 and 63.

The command can be used to insert parts of rows. Insertion takes place between the specified columns; other columns are not affected.

Cells below the ones added move down.

Examples

To insert a new row above row 7:

```
INSERT ROW # of rows: 1              before row: 7
           between columns: 1        and: 63
```

To insert a rectangular area in rows 4 and 5 between columns 1 and 8, causing the lower parts of columns 1-8 to move down to make room:

```
INSERT ROW # of rows: 2              before row: 4
           between columns: 1        and: 8
```

Lock

LOCK: Cells Formulas

Select option or type command letter

Description

Provides two ways to lock cells to protect them from accidental change.

Lock Cells locks and unlocks selected cells.

Lock Formulas locks all cells that contain text or formulas.

The values of locked cells cannot be changed by the commands Alpha, Blank, Copy, Edit, Value, or eXternal.

Locked cells are still affected by the commands Delete, Format Cells, Insert, Move, and Sort.

When some cells are locked, pressing Nxt Unlk Cell positions the cell pointer on the next unlocked cell that is not blank. Using Lock and this action key, you can quickly locate variable quantities on a complex worksheet and perform "what if" experiments.

The subcommands are explained individually on the following pages.

Note See the "Unlocking Cells" and "Dissolving Connections between Worksheets" in Chapter 14, Useful Excerpts.

Lock Cells

LOCK cells: RC status: Locked Unlocked

Enter reference to cell or group of cells

Description

Displays and changes the protection status of cells.

The proposed responses show the status of the active cell.

Lock or unlock selected cells by selecting the appropriate response in the "status" field.

Cells locked by eXternal Copy may not be unlocked with this command.

Examples

To lock an unlocked active cell (R1C1):

LOCK cells: R1C1 status: (Locked) Unlocked

To unlock the whole worksheet:

LOCK cells: R1:R255 status: Locked (Unlocked)

Lock Formulas

LOCK FORMULAS:

Enter Y to confirm

Description

Entering Y locks all cells that contain text or formulas. Cells that contain numbers are not affected by the Lock Formulas command.

The Lock Formulas command protects all values generated by formulas. Numbers and any entries made after locking are the exception, and you must decide which unlocked cells you want to lock.

See Also

Lock Cells to lock cells with numbers and to unlock cells.

Move

MOVE: Row Column

Select option or type command letter

Description

Presents a choice of ways to move cells from one place to another on the sheet.

Move Row moves whole rows.

Move Column moves whole columns.

More complex moves can be made by inserting blank cells at the destination, copying the source cells into the destination cells, then deleting the source cells.

The destination of a move is identified by the row or column that will follow the moved cells. That row may or may not be displaced, depending on the direction of the move.

For example:

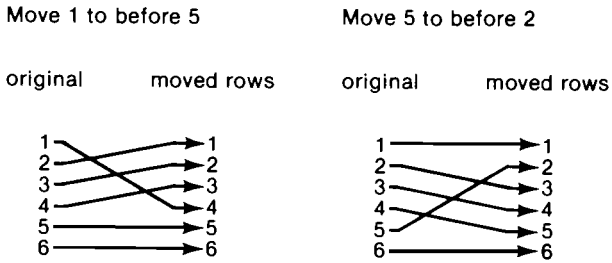


Figure 9.2

Moving cells causes the worksheet arrangement and all references to be adjusted. See "Transforming the Worksheet" in Chapter 15 for the description of how the Move command affects the worksheet.

The subcommands are explained individually on the following pages.

See Also

Copy to duplicate cells.

Delete to delete rows or columns.

Insert to add rows or columns.

Move Column

```
MOVE COLUMN  from column: C      to left of column: C
             # of columns: 1

Enter a number
```

Description

Moves a group of columns to a new position on the worksheet.

Example

To move the active column (column 9) to the left edge of the sheet, moving all columns now between the active column and the leftmost column right one column to make room:

```
MOVE COLUMN  from column: 9      to left of column: 1
             # of columns: 1
```

Move Row

MOVE ROW from row: R to before row: R # of rows: 1

Enter a number

Description

Moves a row or group of rows to a new position on the worksheet.

Example

To move the active row (row 5) to the top of the sheet, moving all rows now between the active row and the top row down one row to make room:

MOVE ROW from row: 5 to before row: 1 # of rows: 1

Name

NAME: define name: to refer to:

Enter name

Description

Assigns a name to a cell or area of cells. The name may then be used to refer to that cell or area in a command or formula.

The proposed response for the "define name" field is either a blank or text. If the active cell contains text, Multiplan proposes that text, with any illegal characters removed, as the name to be defined. This makes it easy to convert a title already given to a row or column into a name.

If cell R5C1 contains the text *Costs* as a title, then the Name command can be used to define the name *Costs* as R5C2:15. Text used as titles and names are very different and should not be confused. However, it will be easier to read your formulas if the names in them correspond to the visible titles on your worksheet.

If you want the name to be something besides the proposed response, simply type the new response.

The proposed response for the "to refer to" field is either the active cell or, if the last name defined was a vector (portion of a row or column), the same vector shifted to the active row or column. This feature makes defining parallel groups a simple task.

If the name you enter is already defined, after you hit TAB the proposed response in the "to refer to" field will show the current definition.

Names must begin with a letter. The rest of the characters of a name may be any combination of letters, numbers, the period (.), and the underscore (_). (These rules are the same ones used in the BASIC programming language.) Proposed responses are automatically made to conform to these rules. Illegal characters are ignored and underscores are substituted for blanks embedded in text strings.

Names may be up to 31 characters long.

Names may not be a combination of characters that could be confused with a reference. See the descriptions of references in the "Formulas" section of Chapter 8.

To see the names that have been defined, select the Name command. Use the direction keys to display each defined name and its definition in the command fields.

To change the definition of a name after viewing it, use the edit keys to alter the response in the "to refer to" field and press RETURN.

Names are deleted by making them refer to no area. Enter the name in the "define name" field, delete the response in the "to refer to" field, and press RETURN.

Example

To define row 10, columns 3 through 15 as Sales:

```
NAME: define name: Sales      to refer to: R10C3:15
```

See Also

eXternal Copy for names associated with external links.

Options

OPTIONS recalc: Yes No mute: Yes No
iteration: Yes No completion test at:

Select option

Description

The proposed responses show the current settings.

The "recalc" option controls when Multiplan performs formula calculations. If the "recalc" option is set to "Yes", Multiplan recalculates all formulas whenever a cell is changed. If the "recalc" option is set to "No," recalculation is done only when Recalc is pressed or during Transfer Save.

The length of time Multiplan takes to recalculate a sheet depends on how many cells are in use, and on the complexity of the formulas in them. When you want to make many entries on a busy worksheet, set the "recalc" option to "No" for quicker response. Set "recalc" to "Yes" again when you want to see the effect of each change.

The "mute" option controls the Multiplan audible alarm. The initial setting is "No," which means the alarm sounds when an error is made. Select "Yes" when you want to mute the alarm.

The "iteration" option, and the accompanying completion test, allows for the use of numerical approximation methods that involve circular dependencies. Such methods are applicable to a wide range of problems, which includes solving simultaneous equations, calculating internal rate of return, and finding roots of equations. Appendix D, "Solving Extended Problems with the Iteration Option," contains a detailed discussion of this powerful feature.

After you press Return, Multiplan will display in the message line its version number and the total bytes of storage (corresponding to 100% Free) that are available to Multiplan.

Print

PRINT: Printer File Margins Options

Select option or type command letter

Description

Presents a choice of four actions related to printing the active worksheet.

Print Printer begins printing.

Print File stores printable output in a disk file.

Print Margins sets the margins for the printed output.

Print Options specifies the part of the worksheet to be printed and controls part of the printed format and printer setup.

The subcommands are explained individually on the following pages.

Print File

PRINT on file:

Enter a filename

Description

Stores printed output in a disk file rather than sending it to the printer. Such files have several uses. The file might be printed at a later time. You might use a text editor to alter the file before printing it, or you could include the file as an illustration in another text file.

If a file of the same name exists, Multiplan will display the message "Overwrite existing file?". Press *Y* to start printing. Pressing any other key cancels the Print File command.

Example

To write a print-formatted version of a worksheet to the file *BUDGET*:

```
PRINT on file: BUDGET
```

Print Margins

```
PRINT MARGINS: left: 5      top: 6      print width: 70
               print length: 54         page length: 66

Enter a number
```

Description

Alters the margins and page length for printed output. The left margin and the print width are given as a number of characters. The top margin, print length, and page length are given as a number of lines.

The "print width" field sets the maximum number of characters to be printed on each line. The "print length" field sets the maximum number of lines of print on each page. The "page length" field sets the length of the paper so that a form feed advances the paper the correct number of lines to begin printing on the next page. The proposed responses are the ones created by the last Print Margins command. In addition, margins are saved with the sheet.

When the Print Margins command is complete, the Print command is displayed again.

Example

A sheet of letter-size paper is 8-1/2″ x 11″. Assuming the printer prints 10 characters per inch across a page and 6 lines per inch down a page, the page length is 66 lines and the page width is 85 characters. To fill these dimensions, you might want a top margin of 3 and a print length of 60 for a bottom margin of 3. A print width of 65 characters leaves 20 characters total for the right and left margins. To center lines on the page, you need a left margin of 10.

```
PRINT MARGINS: left: 10     top: 3      print width: 65
               print length: 60         page length: 66
```

Print Options

PRINT OPTIONS: area: setup:
formulas: Yes No row-col numbers: Yes No

Enter reference to cell or group of cells

Description

Sets four optional features before printing:

printing only part of the sheet,

printing formulas rather than their values,

suppressing row and column numbers from the printed page,

and some set up of printer hardware.

If you want to print only part of the worksheet, specify a reference to a rectangular group of cells, in the "area" field.

Depending on your hardware configuration, the "setup" field may be used to set up the printer hardware (see the "Special Instructions for Printers" section in Chapter 12, Operating Information.)

If you choose to print "formulas," the listing will display the actual formulas that appear in each cell, rather than the calculated values of the formulas, as it normally would. This feature is useful when you want a record of the logic behind a worksheet. Column widths are doubled when "formulas" is set to "Yes."

If you select "Yes" for the "row-col numbers" field, row and column numbers will be printed.

Example

To print only an area named *Factors*, which holds discount percentages:

PRINT OPTIONS: area: Factors setup:
formulas: Yes(No) row-col numbers: Yes(No)

Print Printer

PRINT on printer:

Description

Starts printing the sheet under the conditions set up by the Print Margins and Print Options commands.

The time it takes to print depends on the size of the sheet and the speed of the printer.

Empty columns at the right of, and empty rows at the bottom of the sheet are not printed. Multiplan prints as many columns across the page as will fit in the print margins. If there are rows left over, it prints a second page, repeating the same columns. When all the rows have been displayed, Multiplan starts the next set of columns on a new page. Thus, if the area to be printed is wider than the paper, you can assemble the complete width by cutting and pasting later.

Press Cancel to interrupt printing.

If a printer error occurs during printing, Multiplan will display the "Printer error" message.

See Also

Print File to direct output to a disk file.

Print Margins to set the dimensions of a page.

Print Options to print part of a sheet, to print formulas, or to print row and column numbers.

Quit

QUIT:

Enter Y to confirm

Description

Ends the Multiplan session. The active sheet is not automatically saved. If you wish to save the worksheet, use the Transfer Save command before using the Quit command.

Multiplan will display the message "Enter Y to confirm." If you press *Y*, Multiplan terminates, returning control to the operating system. Pressing any other key cancels the command.

See Also

Transfer Save to save the active sheet.

Sort

SORT by column: C between rows: 1 and: 255 order: (>) <

Enter a number

Description

Reorders the rows on the worksheet within the specified column so that the values will be sorted.

The proposed response for the column field is the active column. The proposed response for the rows is the whole column. The proposed sorting order is ascending order, from least to greatest.

The column to be sorted may contain numbers, text, or other values. Sorting collects the different types into the following groups:

1st	Numbers
2nd	Text
3rd	Logical and error values
4th	Blank cells

Numbers and text are further sorted into either ascending (>) or descending (<) order. Text is arranged according to the ASCII standard character sequence, which is, from "least" to "greatest":

! " # $ % & ' ( ) * + , – . / 0-9 : ;

< = > ? @ A-Z [\] ^ _ ` a-z { | } ~

Within each type, equal values are left in the order Multiplan encounters them.

The worksheet can be sorted on multiple columns. To do this, sort the least significant column first. Then, sort the other columns one at a time, from the least significant to the most significant. The example below illustrates this method.

References on the worksheet are adjusted as described in the "Transforming the Worksheet" section of Chapter 8.

To generate a sorted report without the effects of the adjusted formulas, turn off automatic recalculation. Multiplan then displays the values calculated before the sort was performed. You can print the sorted sheet, but do not save it.

Note also that numbers intermixed with text in a cell or dates represented as text are sorted by the rules of standard alphabetization. For example, "A10" is sorted as *less than* "A9."

Example

To sort a list of checks into categories (in column 1) by amount (in column 2) with the largest amount at the top of each category, first sort all checks by amount in descending order:

SORT by column: 2 between rows: 1 and: 255 order: >(<)

The checks are listed from largest to smallest, but with the categories unsorted. To sort the categories alphabetically:

SORT by column: 1 between rows: 1 and: 255 order: (>)<

The checks are now sorted into categories. The checks within each category are arranged from largest to smallest. Because Multiplan leaves equal items in the order it finds them in the column it is sorting, any previous sorting in other columns is retained.

Transfer

TRANSFER: Load Save Clear Delete Options Rename

Select option or type command letter

Description

Offers a choice of six subcommands which affect an entire sheet.

Transfer Load loads a saved sheet, replacing the active sheet.

Transfer Save saves the active sheet in a disk file.

Transfer Clear clears the active sheet, deleting all its contents.

Transfer Delete deletes a file on the diskette.

Transfer Options specifies which disk drive to use, or which file format.

Transfer Rename saves the active sheet under a new name and updates external links.

The subcommands are explained individually on the following pages.

Transfer Clear

TRANSFER CLEAR:

Enter Y to confirm

Description

Clears the active sheet after you type *Y* to confirm the command. Typing any other key cancels the command.

Using the Transfer Clear command is almost the same as starting up Multiplan; that is, all cells are deleted; all columns are set to the default width; the default alignment and format are set to General; all names and all links to external sheets are cleared; and the sheet name is set to *TEMP*. The exceptions are that options set with the Options, Format Options, Transfer Options, and Print Options commands are preserved.

If a copy of the active sheet has previously been saved with Transfer Save, that copy is not affected.

See Also

Blank to replace the contents of specified cells with blanks.

Delete to delete specified cells.

Transfer Save to save the active sheet as a disk file.

Transfer Delete

TRANSFER DELETE filename:

Enter a filename, or use direction keys to view directory

Description

Deletes a saved worksheet from a diskette.

Pressing one of the direction keys causes Multiplan to display a directory of files on the disc. To use the direction keys, see the directory display explanation under the Transfer Load command. Press Return to select the filename that is highlighted.

When you press Return, Multiplan displays the message "Enter Y to confirm." Press *Y* to delete the file. Pressing any other key cancels the Transfer Delete command.

Use Transfer Delete to clear your disc of unwanted files.

Transfer Load

TRANSFER LOAD filename:

Enter a filename, or use direction keys to view directory

Description

Transfer Load loads a worksheet from a disc file. You may load a file in two ways.

The first way is by typing in the filename and pressing Return. The filename must be spelled and punctuated exactly as it was when the sheet was saved with the Transfer Save command.

The second way is by means of a file directory. You obtain a list of the files on your default drive by pressing any direction key ▼ , ▲ , ► , ▼ , ◄ . This list, or directory, will be displayed whether or not a filename has been entered in the "filename" field. A file selection pointer is also displayed with the directory.

You may obtain a limited directory. For example, your disc may contain groups of files, with some filenames ending with ".TXT" and others ending with ".DOC". To obtain a directory of only the ".TXT" files, you should enter a "*.TXT" as the filename and then press any direction key.

Once the directory is on the screen, use the direction keys or touch screen to move the pointer to the desired file. As you do, each highlighted filename also appears as a proposed response in the "filename" field in the command line. To load the file that is highlighted, press Return.

You also may re-display the worksheet that you previously had on the screen without using the file selector. This is done by pressing Cancel, ESC, or any key except Return or, of course, the direction keys.

In either case, the previous worksheet will be displayed, but with different command lines:

- If you press Cancel or ESC, the screen will display the main command menu.
- If you press any key except Return or the direction keys, the screen will display the Transfer Load command. Also, the character of the key you pressed will be entered as the first character of the filename field.

A full directory will display all files, including Multiplan program and other non-worksheet files. Attempting to call up a non-worksheet file will cause a re-display of the previous worksheet and the command main menu.

When a "Normal" mode Multiplan worksheet is loaded, it replaces the worksheet on display and becomes the active sheet.

As a special feature, the Transfer Load command can also load worksheets from files written by other systems in an acceptable interchange format (described under Transfer Options and Appendix C, the SYLK (Symbolic Link) File Format). Data read from one of these files will be merged with the active worksheet, rather than replacing it. To avoid this merging, first use the Transfer Clear command.

Example

To load a sheet saved in a file named *INCOME*:

```
TRANSFER LOAD filename: INCOME
```

See Also

Transfer Save to save the active sheet as a disk file.

Transfer Options

TRANSFER OPTIONS mode: Normal Symbolic Other setup:

Select option

Description

The "mode" field specifies the file format for all subsequent Transfer Load and Transfer Save commands.

The format choices are:

Normal	Multiplan binary format. External references require that the referenced worksheet be saved in Normal format. This format is also the most efficient use of disk space and requires the least transfer time.
Symbolic	The format for data interchange with other programs. This format is described in Appendix C, The (SYLK) Symbolic Link File Format.
Other	VisiCalc™ file format. Multiplan can load files in this format. The loaded file is merged with the active sheet. See Transfer Load and Appendix B, Notes for the VisiCalc User. Worksheets cannot be saved in Other mode. If you try to do so, Multiplan displays an "Illegal parameter" error message.

The "setup" field changes the default disk drive from the drive currently being used to the drive specified. This affects all subsequent Transfer commands.

The proposed responses show the current settings.

Example

Multiplan was started on drive B:. To simplify use of a data diskette in drive A:

```
TRANSFER OPTIONS mode: (Normal)Symbolic Other
                 setup: A:
```

Transfer Rename

TRANSFER RENAME filename: (name of active sheet)

Enter a filename

Description

Saves the active sheet under a new name and adjusts external links to supporting and dependent sheets. Deletes the file with the previous sheet name. (See the "Files" section of Chapter 8 for a description of external links.)

Example

To rename the active sheet *JUNE82*:

TRANSFER RENAME filename: JUNE82

See Also

Transfer Load to load a saved sheet.

Transfer Save to save the active sheet as a disk file.

Transfer Save

TRANSFER SAVE filename: (name of active sheet)

Enter a filename

Description

Saves the active sheet as a disk file, which can later be loaded with Transfer Load. The proposed name for the disk file is the name last given with Transfer Save or Transfer Rename, or the name last loaded with Transfer Load, or *TEMP* if the sheet is clear or was not previously named.

If the filename is a duplicate of one that exists on the diskette already, the message "Overwrite existing file?" appears when you press RETURN. Press *Y* to replace the file on diskette with the worksheet on the screen. Pressing any other key cancels the Transfer Save command.

If you want to rename the sheet, we recommend using the Transfer Rename command if you have any external links to supporting sheets. Transfer Save will not update the "receipts" on the supporting sheets if you rename the active sheet using the Transfer Save command. Refer to "Files" in Chapter 15 for a discussion of external links and "receipts."

You can save your Multiplan files in either Normal or Symbolic mode.

Examples

To save the active sheet under the proposed name, simply press RETURN.

To save the active worksheet under the name *PRACTICE*:

TRANSFER SAVE filename: PRACTICE

See Also

Print File to put the displayed form of the sheet in a disk file.

Transfer Load to load a sheet saved previously.

Transfer Options to set the mode.

Transfer Rename to save the worksheet under a new name and to update "receipts."

Value

VALUE:

Enter a formula

Description

Used to enter a formula or a number into the active cell.

Besides selecting Value from the command menu by highlighting Value and pressing RETURN or by typing *V*, the Value command can be selected by:

1. typing any digit, 0-9

2. typing one of the characters =, +, −, ., ", and (. Except for the equal sign (=), these characters are also entered as the first character of the formula.

Inside formulas the direction keys enter relative references into the formula. See the "Editing" section of Chapter 15 for more information about editing responses to a command.

Terminate the Value command by:

1. pressing Return

or

2. pressing an action key that moves the cell pointer, such as a direction key or Nxt Unlk Cell at the end of a number or complete formula. The formula or number is stored in the active cell, and the cell pointer is moved as directed.

Multiplan then displays

ALPHA/VALUE:

and awaits the entry of text or another value. This feature is described in detail under the Alpha command.

Text may be entered if enclosed in double quotes.

Example

The simple method of entering a list of numbers, using a direction key:

31 *right* 28 *right* 31 *right* 30 *right* 31 *right*

is a series of Value commands.

Note that dates of the form 1/27/82 can be interpreted as formulas. Be sure to enter dates as text, using the Alpha command, or enclose them in double quotes.

See Also

Alpha for entering text and titles or a sequence of text and values.

Edit for editing formulas.

Window

WINDOW: Split Border Close Link

Select option or type command letter

Description

Presents a choice of window operations.

Window Split opens a new window by splitting the active window horizontally or vertically, or opens a window used for titles.

Window Border adds or removes a border around a window.

Window Close closes a window by removing it from the screen.

Window Link links two windows so that their contents scroll together.

The Next Window key moves the cell pointer from one window to another. Touch screen will also move the cell pointer from window to window.

The subcommands are explained individually on the following pages.

Window Border

WINDOW change border in window number: W

Enter a number

Description

Changes the border of the specified window. If the window presently has a border, it is removed. If it lacks a border, one is added.

A border takes up one screen position on each side of the window, reducing the area for the display of data by two screen lines and two screen columns.

Window Close

WINDOW CLOSE window number: W

Enter a number

Description

Removes the specified window from the screen. The active window is the proposed response.

The size of the remaining windows is increased to occupy the screen area used by the closed window. Windows are renumbered. Cells' contents are not affected by closing a window.

If there is only one window open, the Window Close command is ignored.

See Also

Window Split to open windows.

Window Link

```
WINDOW LINK  window number: W      with window number: W
             linked: Yes No

Enter a number
```

Description

Reviews and revises the links between two windows. The links may have been established under the Window Split command, or they may not exist yet, in which case you may establish links between windows split from a common window so that the two windows scroll together.

The proposed responses specify the active window and either a window split from the active window or the window from which the active window was split. If no window splitting has occurred, both proposed window responses will be the active window.

You may enter any two window numbers as responses. But, only those pairs that share the split relationship can be linked. Attempts to link other pairs receive the "Cannot link those windows" message in the message line.

When windows are linked, the contents of the two windows scroll together. If the window split was horizontal, the synchronized scrolling is horizontal. If the window split was vertical, the synchronized scrolling is vertical.

When two previously unlinked windows are linked, one set of row or column numbers disappears from the screen. If the pairs are related by a horizontal split, the column numbers disappear. Columns are identified by the numbers in the window above.

If the pairs are related by a vertical split, the row numbers disappear. Rows are identified by the numbers in the window to the left.

This command is also used to unlink windows, but you cannot unlink windows split by the Window Split Titles command.

Example

Window #4 was split from window #1. To link them so that they scroll together:

```
WINDOW LINK window number: 4      with window number: 1
           linked:(Yes)No
```

See Also

Window Split Horizontal for a description of window links.

Window Split

WINDOW SPLIT: Horizontal Vertical Titles

Select option or type command letter

Description

Presents a choice of three ways to open a window by splitting the active window.

Window Split Horizontal splits the active window across the screen, giving two windows, one above the other.

Window Split Vertical splits the active window between columns.

Window Split Titles splits the screen both vertically and horizontally to display titles in separate windows.

Up to eight windows may be opened using the Window Split commands.

The Window Split commands retain window borders, giving both windows a border if the original window has one.

See Also

Window Close to close a window.

Window Link to link or unlink existing windows.

Window Split Horizontal

```
WINDOW SPLIT HORIZONTAL at row: R      linked: Yes No

Enter a number
```

Description

The active window is split horizontally. The display space used by the given row and the rows below it becomes the new window. The space above the given row remains part of the original window.

The new window is given the next unused window number and is made the active window.

The original window and the new window may be linked. If you select "Yes" in the "linked" field, whenever you scroll one of the windows horizontally, both windows scroll together. Notice also that the column numbers of the lower window do not appear on the screen. Rather, the column numbers of the window above are used to identify columns in the linked window.

Examples

To split the active window at the active row, just press RETURN.

To split the active window at the display line presently showing row 34, and to link the windows:

```
WINDOW SPLIT HORIZONTAL at row: 34      linked:(Yes)No
```

See Also

Window Link to review or revise links between windows.

Window Split Titles

WINDOW SPLIT TITLES: # of rows: # of columns:

Enter a number

Description

The active window is split to form two or four windows. The windows formed are linked so that they scroll together. Windows linked by this command cannot be unlinked.

The specified number of rows becomes a window at the top of the display space occupied by the original window, unless the number is 0.

The specified number of columns becomes a window at the left of the display space occupied by the original window, unless the number is 0.

The remaining display space becomes the active window. It is linked for horizontal movement with the window above it, and for vertical movement with the window to its left, if any.

The proposed responses split the window so that the active cell becomes the upper left corner cell of the active window.

Example

Suppose that column 1 contains descriptive titles for the rows of the worksheet, and that columns 2-25 contain data matching those titles. You would like to scroll the data columns horizontally while holding the titles fixed on the screen. If you scroll vertically, both titles and data should move so that the titles will remain aligned with the matching data. Move the cell pointer to R1C2, then the proposed response will be:

WINDOW SPLIT TITLES: # of rows: 0 # of columns: 1

See Also

Window Border to draw a border around any of the windows.

Window Split Vertical

WINDOW SPLIT VERTICAL at column: C linked: Yes No

Enter a number

Description

The active window is split vertically. The display space used for the given column and the columns to its right is used for the new window. The space used for columns to the left of the active column remains part of the original window.

The new window is given the next unused window number and becomes the active window.

The original window and the new window may be linked. If you select "Yes" in the "linked" field, whenever you scroll one of the windows vertically, both windows scroll together. Notice also that the row numbers of the right window do not appear on the screen. Rather, the row numbers of the window to the left are used to identify rows in the linked window.

Examples

To split the window at the active column, just press Return.

To split the window at the column presently displaying column 3:

WINDOW SPLIT VERTICAL at column: 3 Linked:(Yes)No

See Also

Window Link to review or revise links between windows.

eXternal

EXTERNAL: Copy List Use

Select option or type command letter

Description

Presents a choice of actions relating to the use of data on inactive (external) sheets.

eXternal Copy copies data from an inactive worksheet to the active worksheet. This command can also establish an external link, a permanent relationship that automatically causes data to be copied from a source, or supporting sheet, to the active, or dependent, sheet every time the latter is loaded into Multiplan.

eXternal List displays the lists of supporting and dependent worksheets.

eXternal Use assigns a substitute name for a specified sheet.

See the "Files" section in Chapter 15 for more information on external links and file accesses.

The subcommands are explained individually on the following pages.

eXternal Copy

EXTERNAL COPY from sheet: name: to: RC
linked: (Yes)No

Enter filename

Description

Copies values from a group of cells on an external worksheet to the active sheet. The source sheet is defined in the "from sheet" field of the command. The proposed response for the "from sheet" field is the most recent new supporting sheet.

The cells to be copied from the source sheet are described in the "name" field. This field may contain a name which is defined on the source sheet to refer to a group of cells, or it may be an absolute reference to a single rectangle on that sheet (e.g., R2C1:12; see also the discussion of absolute references in the "Formulas" section of Chapter 15.

The "to" field is used to specify the destination of the copy on the active sheet. The proposed response is the active cell. If a single cell is specified in this field, the source group will be copied starting at that cell. If a group of cells is specified in the "to" field, the shape of the group must correspond to the shape of the source group, cell by cell. Otherwise, an error message is displayed, and the copy does not take place.

The integrity of the active sheet is further protected by checking that all destination cells are blank. An attempt to copy into a nonblank cell also causes an error message, and copying is canceled.

The eXternal Copy command does not copy formulas, but only the values derived from formulas. This is different from the "Copy" group of commands because those commands copy formulas as well as values. For example, if a cell containing the formula 100* *rate* is copied from an external sheet, the destination cell may receive the constant value 20 (assuming *rate* = .20).

This value alone does not show the dependence of the result on changes to the *rate* cell on an external sheet. The external link facility is provided to express permanently the relationship between the value on the "dependent" sheet and the source of the value (the formula on the "supporting" sheet).

External links are controlled by the options in the "link" field of the eXternal Copy command. If "No" link is selected, the command has no other effect than copying the values as described above. Information on possible dependencies is not recorded at all. If the source data is not expected to change, this option would be the most convenient.

Selecting "Yes" in the "link" field establishes an external link between the source data and the destination. The source sheet supports the active, or dependent, sheet. Of course, the same sheet may be in supporting and dependent roles in different external links.

After an external link is established, every time the dependent sheet is loaded (using the Transfer Load command), all the data described in the external links is automatically copied from the source sheets to the specified destinations. Any change in the source data is reflected on the dependent sheet.

The "formulas" associated with the destination cells—as seen on the status line or using the "formulas" Format Option—also show the data in the cells as dependent on a link, in the form:

[*sheetname sourcename*]

Destination cells are protected from changes just as if they were locked. They can be "unlocked" only by removing or redefining the external link in which the cells participate.

To remove a link, specify the source sheet, source name, empty destination, and "Yes" for linking in the eXternal Copy command.

To redefine a link so that it has a different destination on the active sheet, redefine the link with a new destination on the active sheet. Because a source area on an inactive sheet may be copied only once by each active sheet, the new destination replaces the former one in the link.

Both the removing and redefining of links, as well as the review of the existing links, are simplified by the use of the direction keys to step through the source (supporting) sheet names or the names of source cells in a given sheet. The "to" field is filled in by Multiplan to show the destination of the external link, as currently defined.

The Name command, when used immediately after an eXternal Copy, proposes to define the name

sheetname.sourcename

to refer to the desitnation of the copy. When defined (by pressing Return), this name can be used in other formulas on the active sheet to refer to the copied data.

The automatic copying process from supporting sheets requires that the files that contain the sheets be available to Multiplan. This topic is discussed in the "Files" section in Chapter 8.

Before copying the data in each link, the definition of the name for the source cells is checked. If the shape (size) of the named area has been changed, an error message is displayed, and the copy does not take place. Otherwise, the cells are copied to the destination cells, even if the destination cells are not blank but contain the results of the previous external copy.

Example

To copy the value of the area named *Sales* from the worksheet named *INCOME* to the area starting at cell R5C5 on the active worksheet, and to set a permanent link:

```
EXTERNAL COPY  from sheet: INCOME      name: Sales
               to: R5C5                linked: (Yes)No
```

Assuming that the area named *Sales* is a 12 cell wide part of a row, the destination for the copy will be R5C5:16. The Name command will propose:

```
NAME: define name: INCOME.Sales     to refer to R5C5:16
```

eXternal List

EXTERNAL LIST:

Description

Produces a display of the names of worksheets supporting the active sheet and those dependent on the active sheet. The "supporting" and "dependent" relationships are explained in detail under eXternal Copy and in the "Files" section in Chapter 8.

The list of supporting sheets includes the "alias" names defined by eXternal Use.

Example

```
Sheets supporting Department:
        Year81      instead of Year
        Labor

Sheets depending on Department:
        Consolidated
```

eXternal Use

EXTERNAL USE filename: instead of:

Enter filename

Description

Sets a substitute name (alias) for a sheet.

The proposed response in the second field is the previous response, if any; otherwise, blank.

All references to the name in the "instead of" field will be directed to the name in the "filename" field. Copies from the affected file, if any, will be redone.

The name in the "instead of" field need not be the name of an actual file. However, it must not be a substitute name. The example shows how the substitution is used.

Example

Assume that an active sheet has links to the supporting file *BUDGET82*. To view the figures that result from using the data on *BUDGET83* instead (which must be identical in format to *BUDGET82)*:

EXTERNAL USE filename: BUDGET83 instead of: BUDGET82

This saves removing the links from *BUDGET82* then redefining links to *BUDGET83*. Also, you can return to *BUDGET82* easily by specifying *BUDGET82* in both fields of this command.

As an alternative, you could use a "logical name" when referring to supporting sheets. (A "logical name" is not the name of an actual file, but a name used only for setting up external links.)

Under this method, a substitution must be made through the eXternal Use command before setting up links between sheets:

EXTERNAL USE filename: BUDGET82 instead of: BUDGET

Then, the name *BUDGET*, which is not a file but a "logical name" used for defining links, may be used to set up the links in the eXternal Copy command and as a response in the "instead of" field in the eXternal Use command in future substitutions. For example, when you want to see the results of your budget for 1983:

EXTERNAL USE filename: BUDGET83 instead of: BUDGET

and all links will now be changed to refer to *BUDGET83.*

This method permits you to refer to whatever file you choose in the eXternal Use command without having to remember which file is the pattern for the substitutions.

Chapter 17
Function Directory

This chapter describes the functions that can be used in Multiplan formulas. Each entry describes the operation of a function and any special requirements for its argument.

Use one of the methods described under the Value command in Chapter 16 to enter a formula. The functions are entered as part of a formula.

The argument to a function, enclosed in parentheses, follows the function name. No space is permitted between the function name and the left parenthesis.

Entries within the parentheses describe the argument to the function. The following abbreviations are used in argument descriptions:

N represents a number; a formula that yields a number. Wherever *N* is shown, only one entry is allowed. When more than one is allowed, *List* is shown.

T represents text; a formula that yields text.

Logical represents a logical value, which must be a reference to a single cell, a formula expressing a relation (=, <, >, <=, >=, <>), or a function that returns a logical value. Otherwise, a #VALUE! error value is returned.

List represents a list of items, separated by commas. An "item" may be either a value that represents itself or a reference to a group of cells that represents the collection of values in those cells. For example, the list

```
1,B
```

where *B* is defined as R1C2:3 and R1C2 contains the value 2 and R1C3 contains the value 3, represents the collection of values 1,2,3. Lists may be up to five items long, but they may represent any number of values through references.

See the "Formulas" section in Chapter 15 to review the descriptions of numbers, formulas, and text.

Related functions are listed under the heading "See Also" in each function listing in this chapter.

ABS(N)

Description

Returns the absolute value of the argument *N*.

Examples

```
"Difference:"&DOLLAR(ABS(first-second))
```

```
ABS(AVERAGE(R1C1:10)-R1C1)
```

Yields how far the first item is from the average.

See Also

SIGN for the sign of a number; ABS is equivalent to number*SIGN(number).

MAX for the maximum of two or more values.

MIN for the minimum of two or more values.

AND(List)

Description

Returns the logical value true if all of the specified argument values are true. Otherwise, returns false.

Requirements

The argument entries must be logical values. If not, the #VALUE! error value is returned.

Example

```
IF(AND(SUM(Homework)>82,Final>50)),credit,"not qualified")
```

See Also

OR and *NOT* to operate on logical values.

IF to test a logical value.

ATAN(N)

Description

Calculates the Arctangent (inverse Tangent) function of the argument, yielding an angle in radians in the range ($-\pi/2$ to $+\pi/2$). ATAN can be used to calculate Arcsin and Arccos (see Appendix 3, Table 1).

Example

```
ATAN(thetarow C)
```

See Also

TAN for the Tangent function.

AVERAGE(List)

Description

Calculates the average of the specified argument values. Yields the same result as entering the formula

SUM(list)/COUNT(list).

Examples

AVERAGE(Balance)

AVERAGE(1,5,6.5,5)

See Also

STDEV for the standard deviation of the number values.

SUM for the sum of number values.

COUNT for a count of number values.

COLUMN()

Description

Returns the number of the column in which the formula containing this function appears.

Example

1981+COLUMN()−4

can produce the sequence of years 1981, 1982, . . . , starting in column 4. (Place this formula in column 4, then Copy Right from column 4 as many cells as the number of years you want in the series.)

COS(N)

Description

Calculates the Cosine of the argument, an angle in radians.

Example

```
COS(thetarow C)
```

See Also

SIN and *TAN* for the other trigonometric functions.

COUNT(List)

Description

Returns the count of number values represented by the List. Cells are counted only if they contain number values.

Example

```
DOLLAR(COUNT(checks)*0.15+1.00)&" is service charge"
```

See Also

AVERAGE for the average value.

SUM for the sum of the number values.

DOLLAR(N)

Description

Converts the argument to text showing a dollar amount, just like the "$" format code under the Format Cells command in Chapter 9.

The argument is rounded to two decimal places. If the argument is less than 1, a zero appears in the units position. A dollar sign is added before the leftmost digit. If the argument is less than zero, the result is enclosed in parentheses (the standard way of showing a negative balance in bookkeeping).

Examples

DOLLAR(2.715)	produces $2.72
DOLLAR(.15)	produces $0.15
DOLLAR(0)	produces $0.00
DOLLAR(−1)	produces ($1.00)

See Also

FIXED to format a number without the dollar sign.

VALUE to change text back to a number.

EXP(N)

Description

Calculates e (2.7182818..., the base of the natural logarithm) to the power of the argument. This is the inverse function of LN.

Powers of other bases are calculated using the exponentiation operator (^).

Examples

```
"'e' is"&FIXED(EXP(1),14)

"SINH ="&FIXED((EXP(theta)-EXP(-theta))/2,8)
```

See Also

LN for the natural logarithm of a number.

FALSE()

Description

Returns the logical value false.

Example

If you are planning on putting a complicated condition into a cell, you can use FALSE() to put a logical value in for testing before you construct the more complicated expression.

See Also

AND, *OR*, and *NOT* to operate on logical values.

IF to test a logical value.

FIXED(N,Digits)

Description

Converts the specified value to text showing a fixed-decimal number with the number of decimal digits specified, just like the "Fix" format code under the Format Cells command in Chapter 9.

If the value is negative, a minus sign is placed before the leftmost digit. If digits is negative, rounding is done to the left of the decimal point.

Requirements

Digits must be an integer between 0 and 30.

Example

```
FIXED((first/second)*100,2)&"percent"
```

See Also

DOLLAR to format money amounts.

VALUE to convert text back to a number.

ROUND to return the number value of rounding.

IF(Logical,Then Value,Else Value)

Description

If the Logical is true, returns the Then value. Otherwise, returns the Else value. These values may be numeric, text, or logical values.

Example

IF(grade>80,"excellent",grade)

See Also

AND, *OR*, and *NOT* to operate on logical values.

ISNA and *ISERROR* to check for error values.

INDEX(Area,Subscripts)

Description

Returns the value of a cell selected by Subscripts from the rectangular area.

One or two subscripts may be given. With one subscript, the area must be part of one row or one column. Subscript value 1 selects the first cell in the row or column, value 2 the second cell, and so on.

If two subscripts (separated by commas) are given, the area may be rectangular. The subscripts select the row and column in the area, starting at 1 in each case.

If any index exceeds the limits of the area, the #N/A (not available) error value is returned.

Examples

To repeat the first column in the first row, copy the formula

```
INDEX(C1,COLUMN())
```

throughout the first row.

If the area Score is a table giving adjusted composite scores for raw scores on two components in a test, then:

```
INDEX(Score,Raw1 C,Raw2 C)
```

will give the appropriate composite score, based on the two raw scores.

INT(N)

Description

Returns the largest integer less than or equal to *N*.

Examples

```
"fraction="&FIXED(number-INT(number),4)
```

INT(6) is 6

INT(8.9) is 8

INT(−123.999) is −124

See Also

ROUND to round a number to a certain decimal place.

ISERROR(Value)

Description

Returns the logical value true if the argument is any of the error values (#N/A, #VALUE!, #REF!, #DIV/0!, #NUM!, #NAME?, #NULL!). Otherwise, returns false.

Example

```
IF(ISERROR(ratio),"check your numbers","")
```

See Also

IF to test a logical value.

ISNA(Value)

Description

Returns the logical value true if the argument is #N/A (not available). Otherwise, returns false.

Example

```
IF(ISNA(balance),"0",balance)
```

See Also

NA to produce #N/A value.

IF to test a logical value.

ISERROR to test for all error values.

LEN(T)

Description

Returns the number of characters in the text value.

Example

MID(T,LEN(T),1) is the last character of the text *T*.

See Also

MID to return specified characters from a text value.

LN(N)

Description

Calculates the natural logarithm of the argument.

Requirements

N must be positive. A #NUM! error value is returned if *N* is less than or equal to zero.

Example

```
"log2="&FIXED(LN(value)/LN(2),8)
```

See Also

ABS to ensure that the argument is positive.

EXP for the inverse of LN.

LOG10 for logarithms to the base 10.

LOG10(N)

Description

Calculates the base 10 logarithm of the argument.

Requirements

N must be positive. A #NUM! error value is returned if *N* is negative.

Example

```
"Order of Magnitude:    "&FIXED(LOG10(value),0)
```

See Also

ABS to ensure that the argument is positive.

LN for logarithms to the base e, and other bases.

LOOKUP(N,Table)

Description

Searches for *N* in the first row or column of Table. Returns the contents of a cell from the last row or column of Table. Table is a group of cells on the worksheet.

The dimensions of Table determine the direction of the search.

If Table is square, or higher than it is wide, Multiplan searches in the first column of Table until it finds the cell that has the largest value that is less than or equal to *N*. The value in the last cell in that row of Table is returned as the result of the function. If the values in all cells in the first column are less than *N*, the last row of Table is used. If the values in all cells in the first column are greater than *N*, a #N/A value is returned.

If Table is wider than it is high (has more columns than it has rows), then Multiplan searches for *N* in the first row of Table. The value in the last cell in that column of Table is returned as the result of the function. If the values in all cells in the first row are less than *N*, the last column of Table is used. If the values in all cells in the first row are greater than *N*, a #N/A value is returned.

Requirements

Table should be a cell reference to a rectangular area in the active worksheet. The result returned may be either a number value, a text value, or a logical value.

Example

Assume that column 1 (C1) lists base salaries, column 2 (C2) lists minimum tax, and column 3 (C3) lists marginal tax rates as percents:

C1	C2	C3
0	0	0%
2300	0	14%
3400	154	16%
4400	314	18%
6500	692	19%
8500	1072	21%
...	...	...

Also assume that a name *Salary* has been defined and that it contains a value *N*.

The tax on a salary in one of the brackets in Table can be expressed as:

```
LOOKUP(Salary,C1:C2)+(Salary-LOOKUP(Salary,C1))
        *LOOKUP(Salary,C1:C3)
```

Notice that in the first lookup, we find the tax on the "base" amount (using C1 to find a value in C2). In the second lookup, we find the actual base amount (using C1 to find a value in itself; in fact, Table can be one column wide or one row high). And in the third lookup, we find the marginal tax rate for the amount of the salary that exceeds the base amount (using C1 to find a value in C3).

MAX(List)

Description

Returns the largest number value from List. Returns zero if List represents no number values.

Example

```
"Best of"&FIXED(COUNT(scores),0)&
      "is"&FIXED(MAX(scores),2)
```

See Also

MIN for the minimum of two or more values.

MID(T,Start,Count)

Description

Returns specified characters from *T*.

Start specifies the position of the first character of *T* to be taken, counted from the left end of *T*. The first character is position 1.

Count specifies the number of characters to be taken.

If Count is zero, or if start is greater than the length of the result of *T*, no characters are returned.

If Count is negative, a #VALUE! error value is returned.

Requirements

Start and Count must be *N* values. If either Start or Count has a fraction, the fraction part is truncated before the integer part is used.

Example

```
MID("FFFFFFDCBAA",INT(grade/10),1)
```

See Also

LEN for the length of the text value.

MIN(List)

Description

Returns the smallest number value from List.

Example

```
"Lowest of"&FIXED(COUNT(times),0)&
        "is"&FIXED(MIN(times),0)
```

See Also

MAX for the maximum of two or more values.

MOD(Dividend,Divisor)

Description

Returns the remainder of Dividend divided by Divisor. The result has the same sign as Divisor.

Requirements

Both parts of the argument must be an *N* value. If Divisor is zero, a #DIV/0! error value is returned.

Examples

MOD(3,2) = 1
MOD(−3,2) = 1
MOD(−3,−2) = −1
MOD(3,−2) = −1

In general: MOD(x,y)=x−INT(x/y)*y

NA()

Description

Returns the #N/A (not available) special value. This value may be used to mark data points that are yet to be defined.

Example

By assigning NA() to the interest rate, all values on the worksheet that depend on the interest rate will change to #N/A.

NOT(Logical)

Description

Returns the opposite of the logical value argument (false if the argument is true; true if the argument is false).

Example

```
IF(OR(credit>limit,NOT(AND(conditions))),
        "not qualified","")
```

where "conditions" is a group of cells and each cell contains one necessary condition of credit worthiness.

See Also

AND and *OR* to operate on logical values.

IF to test a logical value.

NPV(Rate,List)

Description

Net Present Value (NPV) calculates the amount of money required now to produce a specified cash flow in the future, given some interest rate.

The formula used is:

$$\sum_{i=1}^{n} \frac{\text{list}_i}{(1+\text{rate})^i}$$

Requirements

Rate is an interest rate, expressed as a decimal fraction (0.11 is a rate of 11%). It must be an *N* value.

The first value represented by List is income required at the end of the first period, the second the income required at the end of the next period, and so on.

Example

You are given the opportunity to lease a parking lot for five years for an $80,000 one time payment. The lot currently generates $15,000 net operating income annually. Based on research and profit studies you have done, you expect the income to increase 30% annually.

Place $15,000 in cell R1C1. Place R[−1]C*1.3 in cell R1C2 and copy it right to the next three cells. Name the area *Flow*. Now, you can figure the net present value of the cash flow.

If your opportunity rate is 15%, then NPV(15%,Flow) gives you the present value of $84,598.24. Since this is greater than the cost of the lease, you conclude that it is a worthwhile investment.

OR(List)

Description

Returns the logical value true if any value in List is true. Otherwise, returns false.

Requirements

The argument entries must be logical values. If not, the #VALUE! error value is returned.

Example

```
IF(OR(grade>80,final>=150),"good work","")
```

See Also

AND and *NOT* to operate on logical values.

IF to test a logical value.

PI()

Description

Returns the value 3.1415926535898, an approximation of the mathematical constant π.

Example

```
SIN(PI()/4)
```

REPT(T,Count)

Description

Returns a text value consisting of Count repetitions of *T*. If Count is zero or negative, #VALUE! is returned. Otherwise, the length of the result will be the length of *T* multiplied by Count.

This function may be used to create bar graphs, or repeating patterns (such as printer's rules) to separate areas of the worksheet.

Requirements

T is usually a single character, but it may be any number of characters.

Count must be an *N* value, which will be truncated to an integer.

Example

```
REPT("+",Score/3)
```

ROUND(N,Digits)

Description

Returns a value, rounded to the number of decimal places specified by Digits.

Digits specifies the rounding as follows:

If Digits is greater than zero, then the result will be rounded to that many decimal places. For example, ROUND(3.1416,3) produces 3.142.

If Digits is zero, the result is rounded to an integer.

If Digits is negative, rounding is carried into the integer. For example, ROUND(21,−1) produces 20 while ROUND(991,−2) produces 1000.

Requirements

Digits must be an *N* value.

Example

```
Balance+ROUND(Balance*Interest/12,2)
```

See Also

INT to return the integer part of a number.

ROW()

Description

Returns the number of the row in which the formula containing this function appears.

Example

Copying the expression ROW()*10 throughout the first column creates the sequence of numbers:

```
10
20
30
...
```

See Also

COLUMN for the current column number.

SIGN(N)

Description

Returns a number representing the algebraic sign of the argument.

If the sign of the argument is positive, the function returns 1.

If the argument value is zero, the function returns 0.

If the sign of the argument is negative, the function returns −1.

Example

To display the magnitude of a number in bar chart form and its sign:

```
REPT(MID('- +',SIGN(num)+2,1),ABS(num))
```

See Also

ABS to return the absolute value of a number.

SIN(N)

Description

Calculates the sine of the argument, an angle in radians.

Example

```
SIN(thetarow C)
```

See Also

COS and *TAN* for the other trigonometric functions.

SQRT(N)

Description

Returns the square root of the argument.

Requirements

N must be positive. If *N* is negative, a #NUM! error value is returned.

Example

```
SQRT(x*x+y*y)
```

STDEV(List)

Description

Calculates the sample standard deviation of the number values represented by List according to the formula:

$$s = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$$

Example

```
STDEV(grades)
```

See Also

AVERAGE for the average value.

SUM(List)

Description

Returns sum of number values represented by List.

Example

```
(1+rate)*SUM(deposits January)
```

See Also

MAX for the maximum of two or more values.

MIN for the minimum of two or more values.

AVERAGE for the average value.

COUNT for the count of the number values.

TAN(N)

Description

Calculates the tangent of the argument, an angle in radians.

Example

```
TAN(thetarow C)
```

See Also

COS and *SIN* for the other trigonometric functions.

ATAN for the inverse tangent function.

TRUE()

Description

Returns the logical value true.

Example

If you are planning on putting a complicated condition into a cell, you can use TRUE() to put a logical value in for testing before you construct the more complicated expression.

See Also

AND, *OR*, and *NOT* to operate on logical values.

IF to test a logical value.

VALUE(T)

Description

Returns the number in the argument, represented as text. The argument must be the text form of a number, similar to those produced by the formatting codes used by Multiplan. It may contain a leading dollar sign or a leading minus sign. It may be written in scientific notation.

For example, all the following text forms yield the value 10: 10, $10.00, 1E1. The following text forms yield negative 10: −10, −1E1.

Requirements

If the contents of *T* do not describe a number—if they include letters, for instance, or two decimal points—a #VALUE! error value is returned. You can avoid this problem by first isolating numbers mixed with nonnumeric characters, as the example below shows.

Example

Suppose that the cell named *date* contains the text "6/14/83." Then,

```
VALUE(MID(date,3,2))
```

returns the number 14.

Chapter 18
Message Directory

The following directory lists in alphabetical order all the possible messages that Multiplan may display, along with descriptions of possible causes and what actions you may take in response to them.

Cannot copy into non-blank cell

Cause. The destination area of an eXternal Copy contains a nonblank cell.

Action. Review the response to the eXternal Copy command. Make sure that the destination area you specify is not used for any other purpose. If appropriate, blank the cells that are not blank.

Cannot link those windows

Cause. An attempt was made to link two windows that were not split from each other. Also occurs on unlinking, especially unlinking a Title split.

Action. Refer to the Window Link command in Chapter 16.

Cannot read file

Cause. Confirms a negative response to the "Enter Y to retry access to filename" message. Also may appear when directory display is requested, but an unknown file is named.

Action. No special action is necessary. See the "Files" section in Chapter 15 for more information.

Cannot write file

Cause. The file last named is available but cannot be written to disk; either because (1) the diskette is full, or (2) the diskette is write-protected.

Action. First, save your work on a different diskette. Check the available space and write protection of the diskette that caused the error message. See the "Files" section in Chapter 15 and the section at the beginning of this volume entitled "Operating Information" for more information.

Cell locked by eXternal Copy

Cause. Either an attempt was made to unlock a cell that is the destination of a linked eXternal Copy, or an attempt was made to copy from an area of the worksheet that is the destination of a linked eXternal Copy.

Action. Such cells must not be changed, for any change would be erased the next time the sheets were loaded and the external copies executed. To regain access to the cell, exclude it from copying. Redefine the eXternal Copy command accordingly.

Cells to recalculate: *number*

Cause. You entered a new value into the worksheet while Multiplan was in automatic recalculation mode, or you pressed Recalc after entering a new value while Multiplan was not in automatic recalculation mode. This message appears only if there are more than 32 cells to be recalculated.

Action. Simply watch the *number* count down to zero. The number tells you where Multiplan is in the recalculation. When the number reaches zero, you can continue your Multiplan session.

Circular references unresolved

Cause. Cells refer to each other in a chain so that the last refers back to the first. (The simplest case is a cell containing a reference to itself—RC—but the chain may be many steps long.) Multiplan has calculated all the cells of the chain once and found itself starting over. It stops calculating, leaving the cells in the circular chain in an undefined state.

Action. Alter the logic of the sheet so that there is no circularity. Use the same methods described in the "Formulas" section of Chapter 15 for finding the source of error values.

Command is too long

Cause. The command, formula, or text on the command line is too long to be displayed there.

Action. The command, formula, or text must be shortened.

Confirm change: *sheet name*

Cause. The name of an area, which is the source of a linked eXternal Copy, has been changed on the supporting sheet. Copying will not take place. The system will wait for a character to be typed.

Action. Type any character. The rest of the specified files, if any, will be loaded. Review the eXternal Copy command in light of the change on the supporting sheet. Redefine the eXternal Copy command as appropriate.

Disk error

Cause. While attempting to read or write a file, Multiplan was told of a serious error by the operating system.

Action. See the "Files" section in Chapter 15 for possible problems with reading or writing files.

Disk full

Cause. There is no more room on the diskette.

Action. Use the Transfer Delete command to look at the file directory on the diskette, and delete unneeded files. As an alternative, use a different diskette.

Enter a filename

Cause. The active field of the command takes the name of a file to be written.

Action. Enter a filename, or press CANCEL to cancel the command.

Enter a filename, or use direction keys to view directory

Cause. The active field of the command takes a filename existing on a disk.

Action. If you know the name of the file desired, enter it. If you want to examine the names of all saved sheets, use the direction keys as described under the Transfer Load command. Or, press Cancel to cancel the command.

Enter a formula

Cause. Multiplan awaits a formula. The direction keys can be used to put a reference into the formula.

Action. Enter a formula, a number, or text (enclosed in quotes), or press Cancel to cancel the command.

Enter a number

Cause. The active field of the command takes a single number: a row or column number, or a quantity, such as margin spacing.

Action. Enter a number or press Cancel to cancel the command. Note that it is possible to enter a formula, though it must result in a small integer.

Enter a number, or d for default

Cause. In the Format Width command, the width of a column can be set to a specific width in characters, or to the width set by the Format Default Width command.

Action. Enter a number from 3 to 32, or the letter *d*, or press Cancel to cancel the command.

Enter name

Cause. The active field of the command takes a name. See the Name command in Chapter 15 for the rules governing names.

Action. Enter a name, or press Cancel to cancel the command.

Enter reference to cell or group of cells

Cause. The active field of the command takes a reference of any kind, including a range, intersection, or a list (a union) of references.

Action. Enter a reference to a cell (or cells), or press Cancel to cancel the command. The direction keys may be used to enter references to particular cells.

Enter sheet name

Cause. In eXternal Use command, prompts for the sheet name for which a substitution will be made.

Action. Supply the sheet name, or press Cancel to cancel the command.

Enter text (no double quotes)

Cause. The active field of the command takes text. Double quotes are not permitted because they are used to delimit text in formulas.

Action. Enter text, or press Cancel to cancel the command.

Enter text or value

Cause. You press a cursor movement key (such as a direction key), following either the Alpha command or Value command or Edit command.

Action. If you want to enter additional data, simply type what you want entered. Multiplan automatically selects the appropriate command (Alpha or Value). If you want to return to the main command menu, press Cancel. If you press Return instead of a cursor movement key following these three commands, Multiplan returns to the main command menu as soon as the command is carried out.

Enter Y to confirm

Cause. You have asked Multiplan to make a major change in the active sheet. Please carefully consider whether this action is correct.

Action. If it is safe for the command to proceed, type a *Y*. If it is not safe, press any other character, and Multiplan will return to the main command menu without changing the worksheet.

Enter Y to retry access to *filename*

Cause. The file named is not accessible to Multiplan.

Action. Enter *N* if the file is not appropriate. Make sure that the correct diskette is mounted in the correct drive. Change the "default drive" if necessary. See the "Files" section in Chapter 15 and the section at the beginning of this volume entitled "Operating Information" for more information. Then try *Y* again. If you still get this message, *N* cancels the command and returns the main command menu and worksheet display. If Multiplan is asking for the system disk, entering *N* will terminate the session immediately.

Error in formula

Cause. See the rules for formulas in the "Formulas" section in Chapter 15. The highlighted area begins at the point an error was noted.

Action. Check all punctuation, especially parentheses, quotes, and brackets. Check the spelling of function names. Check for a mismatch of data types, as would occur if you concatenated text to a number.

Field has too many words

Cause. The formula or text being edited has more numbers or words than Multiplan can handle for purposes of moving from word to word with Word Left and Word Right.

Action. None needed: the formula or text is valid and may be used. However, Word Left and Word Right cannot be used while editing it.

File format error: line *number*

Cause. File being read is in an incorrect format. The file read stopped at the line *number* displayed.

Action. Check the mode setting of the Transfer Options command. Be sure that the mode setting is the same as the format of the file being read.

File is not a saved worksheet

Cause. The file you are trying to load or link to was not saved with the Transfer Save command.

Action. Check the spelling of the filename. Make sure the "mode" of the transfer is correct if you are trying to load other than Normal format files.

Help file not available

Cause. The disk file containing the on-line reference information can't be found.

Action. See the "Files" section in Chapter 15.

Illegal option

Cause. A menu is displayed, and a character is typed that does not appear as a starting letter of any of the menu options.

Action. Check the menu for the option that you wish to select, and type the first letter of the menu item, or press Cancel to cancel the command.

Illegal parameter

Cause. One field of the command last entered had a numeric response that was illegal. For instance, if the "number of cells" field of Copy Down was given the response 299, this message would appear when Return was pressed. There are only 255 rows, so 299 copies could never be made.

Action. The command had no effect, so reenter it correctly.

Illegal width of column

Cause. The column width you requested was out of range.

Action. Reenter the command. Make sure you specify the width as a number between 3 and 32 inclusive.

Insufficient memory

Cause. Multiplan has run out of storage space; it has no space left for new cell contents.

Action. Save the sheet at once. Then consider ways to simplify it. Blank cells take little space, so blank any unwanted cells. If you have large areas of blanks between areas in use, make the sheet more compact. The Delete commands remove cells from your sheet. Beyond that, you may have to break the application into additional sheets to fit in all the information.

Locked cells may not be changed

Cause. An attempt was made to modify the value of a locked cell. Note that the lock may have been set by eXternal Copy.

Action. If you need to change the cell, unlock it first, using the Lock Cells command.

Name not defined: *sheet name*

Cause. An eXternal Copy was attempted from a named area that is not defined on the source sheet.

Action. Check the source sheet for the correct name. Redefine the external link if necessary.

Name too long

Cause. Names may not exceed 31 characters. The name you have entered exceeds this.

Action. Use a shorter name.

Overwrite existing file?

Cause. The disk file Multiplan is about to create—either a saved worksheet or a file of printer lines from the Print File command— has the same name as an existing file. If Multiplan continues, it will replace the existing file with the new one.

Action. Think carefully! If you agree that the existing file is of no importance, reply *Y* to let the command proceed. If the file might be important, reply *N* and re-enter the command giving a different, unique filename.

Press any key to redraw screen

Cause. The eXternal List command has put an information display on the screen in place of the usual display.

Action. When you have seen enough of the information display press any key to return to the normal display.

Printer error

Cause. The printer is not responding to a request from Multiplan.

Action. Check if the printer is connected properly and ready to print.

Reading line *number*

Cause. You command Multiplan to read a symbolic file.

Action. None. The line *number* increases as Multiplan reads through the file. When the file has been read completely, you can continue your Multiplan session.

Select option

Cause. Multiplan is waiting for your choice among a short list of options.

Action. Selection in this case is similar to command selection. Move the edit cursor to the desired option using the space bar and Back space (as necessary). Or type the initial letter of the option.

Select option or type command letter

Cause. Multiplan awaits your choice from a list of options.

Action. Select one of the items shown by moving the edit cursor to it with the space bar and Back space, then pressing Return. Or, just type the initial letter of the item you want.

Shapes of areas do not match

Cause. The destination area of an eXternal Copy command does not have the same "shape" (size) as the source area.

Action. Specifying a single cell as the upper left corner of the destination will suppress the shape check. However, the mismatch suggests a review of the names on the supporting sheet and on the active sheet.

Too many depending sheets

Cause. Multiplan can keep track of at most eight dependent sheets. The message signals that there are more than eight dependent sheets.

Action. No action is necessary, but you cannot rely on the accuracy of the eXternal List command. See also the discussion of eXternal Relationships in the "Files" section in Chapter 15.

Too many windows

Cause. There is a limit of eight windows and the Window Split command has been used in an attempt to open a ninth.

Action. Review the existing windows; use the Window Close command to delete some of them.

Window will not fit

Cause. The window you are trying to Border or Split is too small.

Action. Close an adjacent window to get more room on the screen, or rethink your screen layout.

Appendices

Appendix A
Helpful Hints

This appendix offers hints for saving space in memory and on your discs, for saving time during your Multiplan sessions, and for making Multiplan easier to use.

1. When first using Multiplan —

   - Read the message line as you do each operation: Multiplan frequently gives you information on what to do and corrections to make.

   - Save your worksheet often; do so before changing your worksheet significantly, especially before deleting rows or columns.

2. Use the eXternal commands to split sheets at logical places. The method of splitting up your work should follow the natural breaks in your tasks. By splitting up your task into smaller tasks, you can keep your worksheets smaller and faster to work with.

3. Keep the worksheet compact. Keep the amount of blank space within the worksheet to a minimum. Also, avoid extending the worksheet size unnecessarily.

   Placing any number outside the general work area, even formatting a cell unintentionally, can use more memory and disc storage than necessary.

   If you suspect that too much memory is being used (check the % Free indicator at the bottom of the screen), try deleting all columns to the right and all rows below your work area on the sheet. This ensures the minimum size for your worksheet.

4. Place common subexpressions in an intermediate cell, then refer to that cell when the subexpression is needed in a formula in another cell. This saves retyping and recomputing the same information. For example, if SUM(Sales) appears in several formulas:

   MIN(1000,SUM(Sales))
   SUM(Sales)*commission%
   AVERAGE(Sales) (this example has it hidden)

   it is more efficient to compute SUM(Sales) once in a cell, then refer to that cell from the formulas. Having the intermediate result visible also helps with tracing problems in the setup of the formulas.

5. Define names for the common areas on your worksheet. By defining names, you speed up references to a group of cells. For example, it is much easier and faster to type "Sales" than R2C3:15, or "Hotspots" than R3C4,R5C6,R5C8. Use the Reference Toggle to enter names directly from the name table.

6. Use the Copy commands for filling in cells with identical values, especially formulas, but also numbers and text. Copying is simpler, less error prone, and more space efficient than manually entering repeated values into cells individually.

7. To copy quickly the format of a group of cells into another part of the worksheet, first copy the group of cells as they are. Then, blank the cells in the new area.

8. Use primitive forms of references wherever possible. For example, it is more efficient to use R2C2 than R2 C2; or R1:2C1 than R1C1:R2C1.

9. Turn off automatic recalculation, and use Recalc. This way you can enter new values and edit current values without waiting for each recalculation. Recalculation also occurs when you change text.

10. Use "Continuous" cell format code sparingly. Formatting whole rows with "Continuous" format or specifying "Continuous" as the default setting is expensive in its use of memory.

11. Format entire rows or columns at one time, except for "Continuous" format. Formatting entire rows or columns does not extend your worksheet.

12. Avoid functions or operations over unnecessarily large ranges. For example, instead of SUM(R2), specify only the range of columns that contain values, for instance SUM(R2C1:5). Or, try to restructure the function or operation so that large ranges are not necessary.

13. Avoid extensive use of forward references because they are slower to recalculate. For example, a reference to cell R10C10 from cell R5C5 is slower than a reference to R5C5 from R10C10.

14. Use the page keys, [ ], [Shift] [ ], and global scrolling to scroll rapidly across and down the worksheet.

15. Perform similar operations together. Try to define all names at once. Copy all cells at once. Many Multiplan commands offer you proposed responses. By performing similar operations together, you can make maximum use of the proposed responses, which saves considerable time.

16. Simply press [Return] to select the Alpha command whenever the main command menu is displayed.

17. Position the cell pointer before selecting a command. This also makes it easier to use proposed responses.

18. Use the Normal mode for saving and loading files, whenever possible (see Transfer Options command). If you load a file that is in Symbolic or Other mode, save it in Normal mode when you are finished with it. Files in Normal mode load much faster than files in the other modes.

Appendix B
Notes for the VisiCalc™ User

If you have used VisiCalc previously, you are probably curious about how that product differs from Multiplan. This appendix compares the operations and features of the two. Described first are the operations the two programs have in common, roughly in the order they are presented on the VisiCalc reference card. The features unique to Multiplan are described second.

The Multiplan Screen

Multiplan divides the screen into a display area, command lines, a message line, and a status line. Parts of the worksheet are shown in the display area. Unlike VisiCalc, which allows you to create just two windows, Multiplan allows you to create as many as eight windows within the display area. You have control over the size and placement of each window, you can have windows with or without borders, and you can freeze title columns and rows. All these functions are controlled by the Window commands (see Chapter 16).

The message line displays Multiplan's comments on the progress of any command. The status line at the bottom of the screen displays the coordinates of the active cell, its actual contents, and the percent of storage that remains.

Moving the Cell Pointer

The four direction keys move the cell pointer around the active window. Pressing [↖] sends the cell pointer to the upper left corner of the worksheet. Pressing [Shift] [↘] sends the cell pointer to the lower right corner. You may also move the cell pointer to a specific cell with the Goto command, which lets you move to

a particular row and column or to a particlar cell by name (see "Names" below). Next Window moves the cell pointer to the next window in sequence.

Correcting Errors, Canceling Commands

In Multiplan the Cancel key cancels any command you have begun. The Back space key erases the last character typed. There are several other editing keys used to correct typing errors (see Chapter 15).

Entering Titles and Text

In Multiplan, a cell may contain a title or simple text made of characters documenting a row or column on the worksheet. To enter text, choose the Alpha command, type the title, and press Return or any direction key.

Unlike VisiCalc, Multiplan can use text in formulas. To include text as part of a formula, enter it in double quotes. You can use the titles on your worksheet in formulas (as references to parts of the worksheet) if the titles are also defined with the Name command.

Entering Numbers

A cell may contain a number. To enter one, just start typing it. Put the finished number in the active cell by pressing Return or any direction key. Numbers may be in decimal form or in scientific notation.

Entering Formulas

A formula is composed of text, numbers, cell references, operators (+ − * /), and function names (SUM, MIN, etc.). Unlike VisiCalc, but like most programming languages, Multiplan evaluates formulas according to the precedence of operators: −(negative value) is evaluated first, then %, then exponentiation (^), then multiplication (*) and division (/), then addition (+) and subtraction (−), and finally text concatenation (&). You may use parentheses to change the order of calculation.

Values can be compared using the operators less than (<), greater than (>), less than or equal (<=), greater than or equal (>=), equal (=), and not equal (<>).

The & (concatenate) and % (percent) operators are unique to Multiplan.

To enter a formula, first type = or +, then the formula. Within a formula, you may enter a reference to another cell by pointing to that cell with the direction keys. All the editing keys are available to you while entering a formula; the Word Right and Word Left keys are especially helpful.

References

Note that Rows and Columns are both numbered, the Row indication given first. Thus, the VisiCalc reference B3 can be written in Multiplan as R3C2.

In a formula, you may refer to the value of a cell or a group of cells in any of several ways. You may give an absolute reference to a row and column (R3C5) or to a range along a row or column (R3:6 C9, R5, C1:8). You may give a reference relative to the cell holding the formula (R[−1] C for "this column, one row up"). Most important, you can give a name to any cell or group of cells. For instance, the name *Sales* might refer to R9C2:9 (row 9, columns 2 through 9). The formula SUM(Sales) produces the sum of all numbers in those cells.

References of any of those three kinds may be combined by intersection or union to make other references (see Chapter 15 for details and examples).

Multiplan Names

In Multiplan, the Name command allows you to define a name as a reference to a single cell, or to any group of cells. Once you've done so, you may use that name as an argument of a function or, in many cases, as a response in a command. A name must start with a letter, and it may contain letters, numbers, periods (.), and underline (_) characters, up to 31 characters maximum.

This naming ability can make a big difference in the clarity of your sheets. Consider this formula (as VisiCalc presents it):

```
B1 * B2 * (1-B3)
```

Notice the improvement if you write it using names:

```
Quantity * Price * (1 - Discount)
```

The Name command also allows you to review your name definitions using the direction keys.

Functions

Multiplan supports all of the functions familiar to you from VisiCalc, and others unique to Multiplan. Table 1 compares the Multiplan functions with their VisiCalc counterparts. See Chapter 10 for details on each Multiplan function. Note that Multiplan function names do not begin with "@".

Multiplan also provides several unique functions. See Table 2.

Table 1

Multiplan Functions and Their VisiCalc Counterparts

Multiplan	VisiCalc
ABS(*N*)	@ABS(*N*)
use PI()/2−ATAN(*N*/SQRT(1−*N***N*))	@ACOS(*N*)
AND(list)	@AND(list)
use ATAN(*N*/SQRT(1−*N***N*))	@ASIN(*N*)
ATAN(*N*)	@ATAN(*N*)
AVERAGE(list)	@AVERAGE(list)
INDEX (area,subscripts)	@CHOOSE
COS(*N*)	@COS(*N*)
COUNT(list)	@COUNT(list)
use undefined name	@ERROR
EXP(*N*)	@EXP(*N*)
FALSE()	@FALSE
IF(l,v1,v2)	@IF(l,v1,v2)
INT(*N*)	@INT(*N*)
ISERROR(*N*)	@ISERROR(*N*)
ISNA(*N*)	@ISNA(*N*)
LN(*N*)	@LN(*N*)
LOG10(*N*)	@LOG10(*N*)
LOOKUP(*N*, area)	@LOOKUP(*N*,range)
MAX(list)	@MAX(list)
MIN(list)	@MIN(list)
NA()	@NA
NOT(l)	@NOT(l)
NPV(dr, list)	@NPV(dr,range)
OR(list)	@OR(list)
PI()	@PI
SIN(*N*)	@SIN(*N*)
SQRT(*N*)	@SQRT(*N*)
SUM(list)	@SUM(list)
TAN(*N*)	@TAN(*N*)
TRUE()	@TRUE

Table 2

Functions Unique to Multiplan

Function	Description
COLUMN( )	Current column number
DOLLAR(*N*)	Text form of *N* formatted as dollar amount; negative *N* shown in parentheses
FIXED(*N*,d)	Text form of *N* formatted with d decimal places
LEN(*T*)	Length of text *T* in characters
MID(*T*,s,c)	The c characters of text value *T* starting at s
MOD(*N*1,*N*2)	Remainder of *N*1/*N*2
REPT(*T*,*N*)	Text made of *N* repetitions of text *T*
ROUND(*N*,d)	Value of *N* rounded to d decimal places
ROW( )	Current row number
SIGN(*N*)	−1, 0, or +1 depending on *N*
STDEV(List)	Standard deviation
VALUE(*T*)	Number value of text *T*

Commands

Multiplan commands are chosen from the menu by highlighting a command word or by typing the first letter of a menu item. Table 3 shows the Multiplan commands and their VisiCalc counterparts (for complete details on the Multiplan commands see Chapter 16). Remember as you scan Table 3 that you type only the capitalized letters when choosing a Multiplan command.

If a command has more than one argument "field," they are separated by Tab instead of Return, as in VisiCalc. In Multiplan, Return executes the command.

It's worth noting that Multiplan's Insert, Delete, and Move commands can operate on more than one row or column at a time. You can Insert several blank rows, or Delete several rows. Move allows you to move any rectangular area; you aren't restricted to moving entire rows or columns. Multiplan adjusts all references (absolute or relative) and name definitions to account for the changes.

The Multiplan Format command can set the format of one cell, or of a group of cells.

Multiplan automatically recalculates cells until all have reached the correct values (or until Multiplan finds an endless chain of references) so the VisiCalc "/GO" (order of calculation) command isn't needed. You don't have to be concerned with the order of calculation in Multiplan, or worry about forward references.

Multiplan provides several unique commands which VisiCalc does not have. See Table 4.

Table 3

Multiplan Commands and Their VisiCalc Counterparts

Multiplan	VisiCalc
Blank	/B
Transfer Clear	/C
Delete Columns, Delete Rows	/D
Edit, Alpha	/E
Format Cells	/F
Format Width	/GC
Format Default	/GF
not needed; see text	/GO
Options	/GR, /V
Insert Columns, Insert Rows	/I
Move Columns, Move Rows	/M
Print	/P
Copy	/R
Transfer Load	/SL
Quit	/SQ
Transfer Save	/SS
Window Split Titles	/T
Window Open, Window Split, etc.	/W
Window Link	/WS, /WU
Goto Row-col	>
Next Window key	;
Recalc key	!
use references	#
see Table 2, REPT function	/–

NOTE: You type only the capitalized characters of the Multiplan command names.

Table 4

Commands Unique to Multiplan

Format Options
Help
Lock
Name
Sort
Window
eXternal

Printing

Multiplan has a full set of printing operations, invoked by the Print command. You may print all or any rectangular area of the worksheet; an area can be specified by name or specific references. Multiplan can send the printed representation of the worksheet to a file on disk. You may then use that file with operating system commands and other programs: you could, for instance, incorporate a worksheet listing into another document. Multiplan also gives you the option to print the formulas in cells instead of their resulting values.

Copying Cells

Multiplan's Copy command performs the operations that, in VisiCalc, are done with "/R". Copy Down and Copy Right provide especially easy ways to duplicate one cell down a column or across a row. The general Copy From operation will duplicate a single cell into an area of any shape or duplicate an area of any shape in another area of the same shape. Multiplan doesn't ask whether references should be adjusted or not; if you build your formulas with relative references and names, they will be position-independent.

Worksheet Transfers

The Transfer command handles operations on the whole worksheet.

The DIF™ format is not directly supported by Multiplan. However, DIF files can be readily converted into the Multiplan SYLK format described in Appendix C.

By the proper choice of Transfer Options (see the Transfer Options command in Chapter 16), Multiplan can load saved VisiCalc files directly. Simply select the Transfer Options command and set the "mode" to Other. Then use the Transfer Load command as you would for any Multiplan file. Just as in VisiCalc, the loaded sheet will be merged with the active sheet. This feature automatically compensates for the following differences:

- names of functions and the order of arguments
- format of cell references (all cell references are converted to relative references)

Linking Sheets

The Multiplan eXternal Copy command may be used to copy data from a named area in a saved worksheet to the active sheet. The data-sharing relationship between the sheets may be made permanent, in which case Multiplan will automatically copy the data from the "supporting" sheet every time the "dependent" sheet is loaded. You can find the details of this important Multiplan feature in Chapter 16.

Sorting

The Multiplan Sort command (described in Chapter 9) may be used to sort the worksheet on any column or columns containing numbers or text, in ascending or descending order.

Lock

The Multiplan Lock command can be used to lock individual cells or to lock all cells that contain formulas or text. This command makes it safe to test "What if...?" situations without disrupting or destroying your valuable worksheet structure.

Appendix C

The SYLK (Symbolic Link) File Format

The purpose of the SYLK (SYmbolic LinK) file format is to exchange information between the Microsoft Professional Series applications programs and other application programs. The format is designed with extensibility, ease of generation, ease of parsing, and storage efficiency in mind. The worksheet can be completely represented by SYLK files. This means that a program can generate a Multiplan worksheet, such as a program to build a cash-flow forecasting worksheet from a general ledger chart of accounts. It is useful to subdivide the definition of SYLK into the following "layers":

1. SYLK record and field formats. This layer provides for the identification of the files, a degree of data compression, and an easy way for a program to separate information that is important for its purpose from information that the program is not interested in handling.

2. The "C" or cell or data-point record. This is probably the record type of the most universal interest.

3. Other Multiplan-specific records and fields. This collection of formats affords complete control or complete overview for a communicating program of the state of a Multiplan session, including the worksheet, windows, options, etc.

The first layer is defined as follows. The contents of a SYLK file —encoded in ASCII—are divided into records by either CR or LF characters. Empty records are ignored. Nonempty records are further subdivided into an RTD (record-type descriptor) optionally followed by a list of fields. Each field in the list is preceded by an FTD (field-type descriptor). The contents of the

fields is determined by the RTD and the FTD, as described below:

RTDs consist of up to two letters. They determine the meaning of the record according to the standards described below.

FTDs consist of a semicolon and a single letter that determines the meaning of the field. The meanings of FTDs ;U, ;V, ;W, ;X, ;Y, and ;Z will be the same for all records. The meanings of other FTDs will depend on the record type.

The field contents can be arbitrary except for the following: CRs or LFs may not be included, and semicolons must be doubled.

A degree of data compression is achieved by the following rule: for certain fields, the last field value will be automatically substituted if the field contents are empty. Such fields are said to be differentially encoded and will be marked by (diff) in their description.

The FTDs ;X and ;Y determine x and y coordinates in a worksheet or other two-dimensional space containing data points. Coordinates of the first cell are 1,1. ;X and ;Y are differentially encoded, and they may be altogether omitted from records if the last defined value is to be used.

In general, programs that process SYLK files cannot be expected to handle all RTDs, all FTDs, or even the full range of field contents for two reasons. First, their interest may be limited to some aspect of the available data. Second, SYLK may very well be expanded after the release of the program in question. This means that programs must be prepared to ignore records and fields that they do not understand. Data with coordinates that lie outside of the space that the program can process should also be ignored.

The following sections describe data records and fields that are currently defined.

Record Type: C

These records describe a data point that exists in a two-dimensional space with coordinates ;X and ;Y. The Multiplan concept of cell is one example of a data point. Besides its coordinates, data points may also possess a number or text value, an expression, a protection state (locked or unlocked), and several Multiplan-specific properties. Formatting properties for data points may be specified in a separate record type (F, see below).

Fields are:

;X, ;Y	(diff) cell coordinates.
;K	Value of the data point. Numerical values are given in decimal or exponential form (see Multiplan "Gen" format code). Text values are enclosed in double quotes. The logical values TRUE and FALSE are given this way. Error values are preceded by # and appear as in Multiplan.
;P	Protection state. If ;P appears, the data is locked; otherwise, it is not locked.
;E	An expression that computes the value of the data point. The field contents appear exactly as a Multiplan formula.
;R,;C	(diff) Used by ;S.
;S	Expression for the data point is given at another coordinate. X is given by ;C (column), y is given by ;R (row). The field contents are decimal coordinates. Note that ;E must not appear together with ;S. Moreover, the data point at (;R, ;C) must be marked with either ;D or ;G. In the latter case, the value of the data point is taken to be the (constant) expression.

;D	;E expression is shared by some other data point.
;G	;K value is shared by some other data point. ;E must not appear.

Record Type: B

Defines the bounds of the two-dimensional space of data points. This record should appear at the beginning of a SYLK file.

Record Type: E

Defines the end of the SYLK file.

Record Type: F

Describes the Multiplan formatting properties of individual cells or of the whole worksheet. (See also the descriptions of the Format group of commands in Chapter 9.)

Fields are:

;X, ;Y	(diff) Cell coordinates.
;Fc1nc2	(diff) Cell-formatting properties are defined by the contents where c1 is a one-character formatting code (D, C, E, F, G, $, or *), n is the "# of digits" argument, and c2 is a one-character alignment code (D, C, G, L, or R).
;R, ;C	;F properties are to be applied to a whole row or whole column of the Multiplan worksheet. Contents are decimal row or column numbers, respectively.

;Dc1nc2n3	"Default" format properties are defined as in ;F (except that the "D" codes may not be used). n3 is the "default" width of columns (see also the Format Default Width command, Chapter 9).
;K,;E	Appear if the commas and formulas Format Options are set, respectively.
;Wn1 n2 n3	Defines the widths of a group of columns in the worksheet where n1 is the first column (x), n2 is the last column in the group, and n3 is the width of the columns in the group expressed as number of characters (cf. Format Width command). Columns that are not mentioned in any format record will have the "default" width setting.

Record Type: ID

The first record in the SYLK file must be an ID record. This convention helps with the identification of the file as a SYLK file.

Field is:

;Pname	The name of the program that produced the file (for example, MP).

Record Type: NN

This record defines a Multiplan name as a union of rectangular areas expressed with absolute references (see also the Name command, Chapter 9).

Fields are:

;Nname	The name to be defined.
;Ee	Expression describing the area. Its general form is:

Rn11:n12Cn13:n14,Rn21:n22Cn23:n24,...

Ranges over single values may be written without the ":" operator. Ranges R1:255 or C1:63 (but not both) may be omitted.

Record Type: NE

The record describes a link to an inactive sheet. See also the eXternal group of commands in Chapter 16.

Fields are:

;F	Filename (or logical filename) for source sheet.
;S	Description of the source area, typically a name of a group of cells.
;E	Expression defining target area, as in NN.

Record Type: NU

Describes an external filename substitution. See eXternal Use command, Chapter 9.

Fields are:

;L	Filename (or logical filename).
;F	Filename to be used instead of ;L.

Record Type: W

The window structure of a Multiplan screen is described in part by the states of the windows and in part by the operations that create the windows. To discover the correct description for a particular screen fenestration, the best approach is to use Multiplan to set up the windows and then to inspect SYLK output from Multiplan.

Fields are:

;N	Window number, as shown by Multiplan.
;Ay x	Coordinates of the cell shown in the upper left corner of window ;N
;B	Window ;N is bordered if (and only if) ;B appears.
;STcy cx ;SHlcy ;SVLcx	Split window ;N to create new window. The window number of the new window will be one greater than the largest number previously in use. The letters T, H, or V define Title, Horizontal, or Vertical splits, respectively. The symbol l stands for the letter L if the windows are to be linked for scrolling, otherwise it is omitted. Cx is the number of character positions in the new window, cy is the number of screen lines, also in the new window.

Order of Records

There are only a few restrictions on the order of records in SYLK files.

1. ID must be the first record.
2. B should be used (although not required) for Multiplan input.
3. For Multiplan C records: ;D or ;G must appear before another C record that refers to it (with ;S, ;R, ;C).
4. Name definition should precede name use for efficiency, although this is not required.
5. Window splits and window properties must be in strict logical order.
6. NU records must precede NE records.
7. E must be the last record.

Appendix D

Solving Extended Problems with the Iteration Option

The Microsoft Multiplan electronic worksheet includes an option that extends the number of solvable problems.

Consider this example. Spencer Ceramics must pay a bonus that is equal to 10% of its profits. The bonus is calculated then subtracted from the profits to yield the net profit.

Set up this simple calculation in Multiplan as follows (the "Suggested Steps" column is just one way to enter data on the worksheet).

Entries	Suggested Steps
Move cell pointer to R1C1	Press ↖
Enter *Gross P* in R1C1	Press *A*, type *Gross P*, press ↓
Enter *Bonus* in R2C1	Type *Bonus*, press ↓
Enter *Net P* in R3C1	Type *Net P*, press Return
Name R3C2 as Net_P	Press *N*, Tab, →, Return
Name R2C2 as Bonus	Press ↑, *N*, Tab, →, Return
Name R1C2 as Gro_P	Press ↑, *N*, Tab, →, Return
Enter *1000* in R1C2	Press →, type *1000*, press ↓
Enter *Gross_P* 10%* in R2C2	Type *=Gross_P*10%*, press ↓
Enter *Gross_P-Bonus*	Type *=Gross_P—Bonus*, press Return
Format column 2 to $	Press *F*, *C*, type *C2*
	Press Tab, Tab, *$*, Return

At this point, your screen looks like:

Gross P	$1000.00
Bonus	$100.00
Net P	$900.00

This bonus is calculated on the gross profits. But, the contract calls for the bonus to be calculated on the net profit instead of the gross. You may try to change the worksheet:

Enter *Net_P*10%* in R2C2	Press [▲], *V* Type *Net_P*10%* Press [Return]

Multiplan displays the error message:

Circular references unresolved

The error message indicates a more complicated calculation that requires a different approach. The bonus calculation depends on the net profit. The net profit, in turn, depends on the size of the bonus, which must be subtracted from gross profit to get net profit; a seemingly endless circle. To solve the problem on paper, we would set up an equation and use algebra to find the bonus from the gross profit. Once the equation is set up, the bonus can be calculated manually or using any calculator.

Instead of spending time setting up complex algebraic formulas, you can let Multiplan automatically solve this extended problem without algebra, as follows:

Press *O* (for Options)

Make sure "Yes" is selected in the "recalc" field

Press [Tab] twice to move to the "iteration" field

Press *Y* (for "Yes")

Press [Return]

The numbers on the screen change in rapid succession until they become $90.91 for Bonus and $909.09 for Net P. These are the solutions. If you change the gross profit to $1100, Multiplan quickly recalculates the new bonus as $100 and the net profit as $1000. The "Circular references unresolved" error message does not reappear.

What happened? Multiplan used iteration to calculate the solution. To iterate means to repeat a calculation using the results of the previous calculation instead of an unknown quantity. Of course, previous results do not solve the problem exactly, but each iteration produces results that fit better. In the Spencer Ceramics example, the solution was produced as follows.

Just before the first iteration, we had the initial values:

Bonus	$90.00
Net P	$900.00

The calculations then progressed as follows:

```
 90
900      900*.1 =  90
        1000-90 = 910     910*.1 =  91
                         1000-91 = 909     909*.1 =  90.9
                                          1000-90.9 = 909.1
```

. . . and so on.

When iteration causes values to become more precise, the process is called "convergence." Not all models converge. Some models converge only partially. Convergence may also depend on the initial values as well as on the model. Unless you specify otherwise, however, Multiplan stops iterating when the maximum change in all cell values on the worksheet is less than 0.001. This limit assures that the results are precise at least to the penny or percent without jeopardizing the chances for normal termination.

If, for some reason, a model fails to converge within the limit, pressing Cancel interrupts the recalculation at the end of the iteration that is in progress (see the description of the Options command below).

In the next section, you'll find descriptions of the Multiplan command and functions for controlling iteration: the Options command and the ITERCNT and DELTA functions.

Following that, you'll find examples of some useful iterative worksheets; one for an Income Statement and Balance Sheet, one for calculating the Internal Rate of Return (IRR), and one for finding roots of equations using the binary search technique.

Finally, you'll find a summary of hints for creating iterative models.

For more information on the mathematical theories of iterative methods, consult any handbook on numerical analysis.

The Iteration Option and Supporting Functions

Multiplan enters an iteration phase at the end of any normal worksheet recalculation if the following conditions exist:

1. The worksheet contains at least one circular chain of references.
2. The "iteration" field of the Options command is set "Yes."
3. The completion test (see below) is not TRUE at the end of the first recalculation.

The Options command and two functions (DELTA and ITERCNT) support the iteration option.

Options

OPTIONS recalc: Yes No mute: Yes No
iteration: Yes No completion test at:

Select option

Description

See the Options command in Chapter 9 for details of the "recalc" and "mute" fields.

Select "Yes" in the "iteration" field if you want to calculate values from formulas that form a circle of references. Select "No" in the "recalc" field while making new entries to the worksheet. This saves time when entering or changing values. Also, selecting "No" in the "recalc" field instead of in the "iteration" field prevents Multiplan from displaying the "Circular references unresolved" error message.

In the "completion test at" field, you enter an absolute or name reference to the cell that contains a completion test. A completion test is a formula in the cell that returns a logical value (TRUE or FALSE). Multiplan tests the value of the cell after each iteration. If the value is TRUE, Multiplan stops iteration. If the value is FALSE, Multiplan continues iteration. See the DELTA and ITERCNT functions for more details about completion tests.

Storing the test formula in a cell lets you store and display a complex test as a part of the worksheet. If you leave the "completion test at" field blank, Multiplan applies the formula

DELTA()<0.001

as the convergence test (see the DELTA function below for details).

Stepping through an iteration model one iteration at a time permits debugging and illustrating an iterative solution. To set this up, enter as a response in the "completion test at" field an absolute or name reference of a cell that contains the TRUE()

function. This means that Multiplan calculates the model only once. And, repeatedly pressing the RECALC key produces a step-by-step solution.

Pressing Cancel stops iteration. Other keys are ignored during iteration. Multiplan checks for Cancel at the beginning of each iteration. If you press Cancel during an iteration, Multiplan completes that iteration, checks the completion test, and finally (if the completion test is not TRUE) stops iteration and displays the "Circular references unresolved" error message.

The responses in the Options command "iteration" and "completion test at" fields are saved with the worksheet in Normal mode (see the Transfer Options command in Chapter 16). When you load a worksheet that contains an iterating model, the fields of the Options command receive the responses saved with the worksheet. If you later start another sheet, you may want to reset "iteration" to "No" and delete the response in the "completion test at" field.

Example

To cause Multiplan to recalculate the worksheet using iteration and to place a completion or convergence test in R20C5, which you have named "Done":

```
OPTIONS    recalc:(Yes)No          mute: Yes(No)
           iteration:(Yes)No       completion test at: Done
```

See "Creating Iteration Models" for actual models that include iteration.

DELTA()

Description

Returns the maximum absolute value of the changes in values from one iteration to the next. Returns #N/A if "No" is selected in the "iteration" field. Multiplan counts only the values in the cells that it evaluates between two successive DELTA functions. The DELTA function returns the #N/A error value when ITERCNT()=1 or when ISNA(ITERCNT()) returns TRUE (that is, during the first calculation of a circular model) because no previous values exist from which to calculate changes.

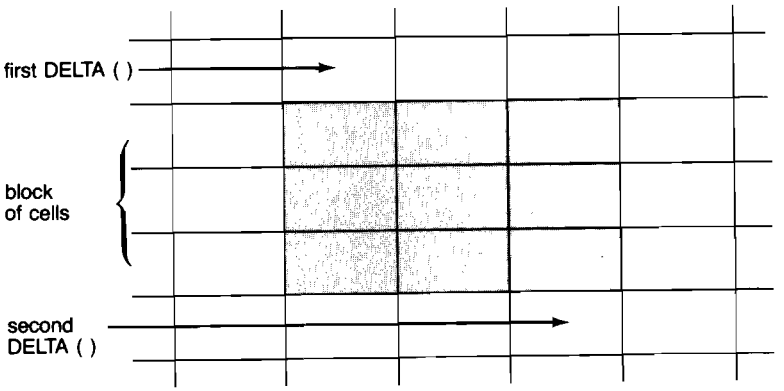
You can enter the DELTA function in a convergence test formula to calculate the results of an iteration to any desired precision. For example:

DELTA()<0.000001

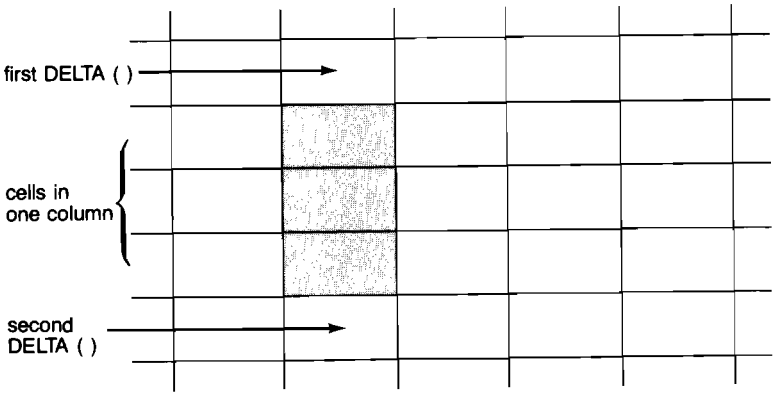
returns TRUE when convergence results are less than 0.000001.

Each time Multiplan encounters a DELTA function, it resets the internal DELTA value to 0. By entering more than one DELTA function, you can isolate the maximum change in a particular part of the worksheet. To create a DELTA() that only applies to the differences of a part of the worksheet, bracket the cells with cells that contain the DELTA function. Each DELTA() resets the DELTA value to 0. To avoid problems with order of evaluation, enter the first DELTA function in the cell immediately above the block of cells for which you want a local DELTA value. Then, enter the test DELTA formula in the cell immediately below the block of cells to return a local DELTA value.

The following sketches illustrate these guidelines:



Multiplan recalculates the block of cells column by column. This model provides local values of DELTA only if these columns contain no other circular references. The next sketch illustrates a better model design:



Note that subsequent evaluations of the second DELTA function normally include changes to the cell with the first DELTA function. The simple formula DELTA() is usually not sufficient to isolate local values of DELTA. Instead, enter a formula such as:

IF(TRUE(),"",DELTA())

which clears the maximum DELTA value while appearing blank on the screen and presenting no value for the following DELTA to evaluate.

Note that if you enter the DELTA function as a completion test and the ITERCNT function by itself in a model (see the ITERCNT function), you may create divergence. The DELTA function also reads the cell that contains the ITERCNT function. Because ITERCNT changes by 1 during each iteration, DELTA will always return at least 1 unless you set up the worksheet model to return local values of DELTA or you eliminate the ITERCNT formula. Note that the formula ITERCNT()>20 returns TRUE or FALSE after each iteration and therefore would not affect convergence.

Example

Take the simple example of Spencer Ceramics given at the beginning of this appendix, but now calculate the results to the nearest dollar instead of to the nearest penny:

1. Enter *DELTA()<1* in R4C2.

   This gives a TRUE value when the difference between the previous and the current result is less than one dollar.

2. Select the Options command and enter *R4C2* in the "completion test at" field.

3. Now, enter *1000* in R1C2, the gross profit cell.

The results that Multiplan returns are not the same as before, but are now within one dollar of *the more accurate (to-the-penny) result;* that is, Bonus is now $90.90 instead of $90.91 ($90.90 is the first result that had less than $1 change from the previous result—$91). (Refer to the series of calculations that iteration produced in the Spencer Ceramics example.)

See "Creating Iteration Models" for actual models that include the DELTA function.

ITERCNT()

Description

Returns the current iteration count, starting with 1 for the first iteration. During the first recalculation after each change to the worksheet, ITERCNT returns the #N/A error value.

The ITERCNT function is especially helpful for providing initial values for iterative models, for creating a table of iteration results, and for providing a completion test.

Initial Values

Many worksheet models require an explicit initial value. Yet, during subsequent iterations, the model requires a formula. To arrange this, substitute a conditional formula (with the IF function) in place of the formula that requires an initial value.

For example, as in the Spencer Ceramics example, to start with an initial value of Initial_Net_Profit, then switch to the formula Gross_Profit–Bonus, enter the formula:

```
IF(ISNA(ITERCNT()),Initial_Net_Profit,
Gross_Profit–Bonus)
```

IF selects Initial_Net_Profit when the condition is TRUE; that is, when ITERCNT() returns the #N/A error value (which it does during the first recalculation after each change to the worksheet), the ISNA() function returns TRUE. After that, ITERCNT returns a number, making ISNA return FALSE; then, IF selects the formula Gross_Profit–Bonus.

Table of Iteration Results

You can create a table of partial results from an iteration by copying the formula:

IF(ITERCNT()=ROW()−9,Net_Profit,RC)

into successive rows starting at row 10. Note that each row receives the value of Net_Profit during a particular iteration and stays unchanged (RC) for all other iterations, before and after.

Completion Test

Enter a formula that includes ITERCNT to limit the number of iterations. For example, enter the formula:

ITERCNT()>20

Enter the absolute or name reference to the cell that contains this formula in the "completion test at" field of the Options command. During subsequent recalculations, Multiplan completes 20 iterations then stops.

Creating Iteration Models

Iteration is a powerful problem-solving tool. To illustrate using iteration, we provide three examples. Before you begin to study the examples, you should be aware of the order of evaluation Multiplan follows during iteration.

Unlike Multiplan worksheet models without iteration, models with iteration must take into account the order of evaluation of each cell. During iteration the current value of cells referred to in the formulas affects the iteration. Fortunately for the worksheet builder, the order of evaluation of cells participating in circular references is strictly defined when ITERCNT()>=1. Multiplan always calculates these cells one column at a time, top to bottom, starting with the first cell of the first column.

A general guideline that helps avoid problems is to place all the circular references in a single column. Care must also be taken that the ordering is correct for iterative methods such as Newton's method (see Example 2) and binary search (see Example 3). In some situations, the order of evaluation determines whether the solution converges or diverges. If the original order of evaluation does not converge, reconsider the order to get convergence.

Example 1
Financial Gap Model

Integrated Income Statement and Balance Sheet

We based the discussion of this example on the following model. If you want to recreate the model, the formulas, text, and data appear following the discussion.

	1	2	3	4	5	6
1	sales	$100.00	$300.00	$800.00		
2	costs	$50.00	$420.00	$620.00		
3	profit	$50.00	($120.00)	$180.00		
4	int income		$3.89	$23.21		
5	int expense		$0.00	$0.00		
6	net profit	$50.00	($116.11)	$203.21	delta	0.000415
7	beg ret earns	$75.00	$125.00	$8.89	itercnt	13
8	end ret earns	$125.00	$8.89	$212.10		
9	cash	$10.00	$10.00	$10.00		
10	funds surplus	$155.00	$38.89	$232.10	done	TRUE
11	total assets	$165.00	$48.89	$242.10	max i	50
12					max d	0.001
13	liabilities	$40.00	$40.00	$30.00		
14	funds deficit	$0.00	$0.00	$0.00		
15	tot liab	$40.00	$40.00	$30.00		
16	tot liab + re	$165.00	$48.89	$242.10		
17	difference	$0.00	$0.00	$0.00		
18	funds		$38.89	$232.10		

This model shows a common business application of iteration. Throughout, this model contains examples of one result depending on the result of another calculation in a circular pattern. That is the situation that iteration handles.

Entries and calculations on a balance sheet must satisfy the condition:

total assets	=	total liabilities	+	retained earnings

To achieve this balance, you vary the funds surplus and the funds deficit. This is an iterative process because varying the funds alters the interest, which affects the profit, which changes the retained earnings. This circle of calculation throws the sheet back out of balance.

Funds surplus and funds deficit both refer to the value in the "funds" line (R18). Either funds surplus or funds deficit will always equal 0. If the value in the "funds" line (R18) is positive, you have funds surplus. If this value is negative, you have funds deficit.

Notice the formulas (in the next section) for funds surplus and funds deficit. For funds surplus, the formula MAX(0,funds) returns the value of funds only if funds is positive; otherwise, it returns 0. For funds deficit, the formula −MIN(0,funds) returns the absolute value of funds when funds is negative.

Notice also the formula IF(TRUE(),"",DELTA()) in R8C6. This formula keeps the ITERCNT() function in R7C6 from interfering with the DELTA() function in R6C6.

The completion test is in R10C6. It checks both the DELTA value and the ITERCNT value. When one of the two returns TRUE (that is, either a maximum DELTA of 0.001 or an ITERCNT of 50), iteration stops.

Columns 3 and 4 show two new time periods. Column 3 shows a large increase in capital outlay and an increase in sales that is not large enough to offset it. Thus, the profit line (R3) shows a loss. In column 4, however, sales have grown enough to offset the capital outlay. The profit line (R3) shows a profit. This is a typical situation in which the effect of a capital outlay on sales is delayed. You can apply these same formulas to analyze how much increase in sales you need to offset a particular capital outlay.

This model can also help you analyze how much money you must borrow at any specific interest rate to receive as much usable funds as you need.

See the listing of the formulas in the next section.

Formulas for Integrated Income and Balance Sheet Model

To show the formulas without breaking them across several lines, the worksheet appears in two parts, in a manner similar to the Multiplan method of printing. Columns 1 and 2 appear first, then columns 3 and 4, then columns 5 and 6. Note that the row numbers are the same for each part; that is, enter the six columns side-by-side.

	1	2
1	"sales"	100
2	"costs"	0.5*R[−1]C
3	"profit"	R[−2]C−R[−1]C
4	"int income"	
5	"int expense"	
6	"net profit"	R[−3]C+R[−2]C−R[−1]C
7	"beg ret earns"	75
8	"end ret earns"	R[−2]C+R[−1]C
9	"cash"	10
10	"funds surplus"	155
11	"total assets"	R[−2]C+R[−1]C
12		
13	"liabilities"	40
14	"funds deficit"	0
15	"tot liab"	R[−2]C+R[−1]C
16	"tot liab + re"	R[−1]C+R[−8]C
17	"difference"	R[−6]C−R[−1]C
18	"funds"	
19		

	3	4
1	300	800
2	300+(0.4*R[−1]C)	300+(0.4*R[−1]C)
3	R[−2]C−R[−1]C	R[−2]C−R[−1]C
4	0.1*R[+6]C	0.1*R[+6]C
5	0.1*R[+9]C	0.1*R[+9]C
6	R[−3]C+R[−2]C−R[−1]C	R[−3]C+R[−2]C−R[−1]C
7	R[+1]C[−1]	R[+1]C[−1]
8	R[−2]C+R[−1]C	R[−2]C+R[−1]C
9	10	10
10	MAX(0,R[+8]C)	MAX(0,R[+8]C)
11	R[−2]C+R[−1]C	R[−2]C+R[−1]C
12		
13	40	30
14	−MIN(0,R[+4]C)	−MIN(0,R[+4]C)
15	R[−2]C+R[−1]C	R[−2]C+R[−1]C
16	R[−1]C+R[−8]C	R[−1]C+R[−8]C
17	R[−6]C−R[−1]C	R[−6]C−R[−1]C
18	IF(ISNA(ITERCNT()),0, RC−diff)	IF(ISNA(ITERCNT()),0, RC−diff)
19		

	5	6
1		
2		
3		
4		
5		
6	"delta"	DELTA()
7	"itercnt"	ITERCNT()
8		IF(TRUE(),"",DELTA())
9		
10	"done"	OR(R[−4]C<R[+2]C,R[−3]C>R[+1]C)
11	"max i"	50
12	"max d"	0.001
13		
14		
15		
16		
17		
18		
19		

Example 2
IRR Model

Internal Rate of Return Calculation

In Multiplan, the Internal Rate of Return (IRR) of a group of cash flows is the Rate for which

NPV(Rate,Cash_Flow)=0

The name Cash_Flow refers to the part of the worksheet that contains the cash flows. There may be many solutions to the IRR equation. The one found by this method will typically be the one closest to the initial estimate.

The following set of formulas automatically searches for the correct Rate. You can include these formulas in any worksheet under the following conditions:

1. Enter each of these formulas in a single row.

2. When other parts of the model include iteration and the completion test refers to the IRR convergence, also include the method for returning local values of DELTA (see the DELTA function).

Formulas for IRR Model

	1	2	3	4
1				"Cash Flow"

2	"IRR"	IF(ISNA(ITERCNT()),
		R[+4]C,
		IF(ABS(RC)>R[+8]C,
		−(R[+4]C+ITERCNT()/100),
		IF(R[+2]C=0,
		RC+SIGN(R[+1]C)*0.000001,
		RC−R[+1]C/R[+2]C)))
				"----------"

3	"NPV"	NPV(IRR,Cash_Flow)		−1000
4	"NPV'"	IF(IRR=0, (NPV(0.001, Cash_Flow) −R[−1]C)/0.001, (NPV(IRR*1.01, Cash_Flow) −R[−1]C)/(IRR*0.01))		300
5				400
6	"EST.IRR"	0.01		300
7				−200
8	"STATUS"	DELTA()<0.01		1000
9				−1000
10	"LIMIT"	500		2000
11				"----------"

For this model, the following names are defined:

IRR = R2C2

Cash_Flow = R3:10C4

The labels represent:

IRR	is the Internal Rate of Return.
NPV	is the Net Present Value.
NPV'	is the first derivative of NPV (used for Newton's method).
EST.IRR	is the initial IRR entered by you. An IRR close to 0, such as 1%, usually gives the first positive IRR, which is the one you seek.
STATUS	indicates when the calculation is done.
LIMIT	is the largest positive IRR to try before trying negative roots.

These formulas yield the following results:

	1	2	3	4
1				Cash Flow
2	IRR	27%		----------
3	NPV	0.0		−1000
4	NPV'	−2226.3		300
5				400
6	EST. IRR	1%		300
7				−200
8	STATUS	TRUE		1000
9				−1000
10	LIMIT	50000%		2000
11				----------

The following paragraphs explain briefly the mathematical basis of IRR calculation.

Solving the equation

NPV(IRR,Cash_Flow)=0

for IRR employs the numerical method known as Newton's method. (This method was first published by Sir Isaac Newton in *Principia* (1686) as a solution for a cubic polynomial.) Newton's method solves for an initial estimate that is close to a root of the equation then extrapolates along the tangent of this root to find its intersection with the x-axis as the next root to try. Iteration continues until either successive x values converge or the value of the function converges on 0.

The tangent of a given equation f(x) is the first derivative f'(x). Therefore, Newton's method for successive approximations is:

$$x_{(n+1)}=x_n-(f(x_n)/f'(x_n)$$

Applying this equation to the solution of the IRR equation produces:

$$IRR_{(n+1)}=IRR_n-$$
$$(NPV(IRR_n,Cash\_Flow)/NPV'(IRR_n,Cash\_Flow))$$

Now, f'(x) becomes:

$$f'(x)=\lim_{delta(x)->0}(f(x+delta(x))-f(x))/delta(x)$$

In our case, with a delta(x) of 0.01 of x, the equation becomes:

$$NPV'(IRR_n,Cash\_Flow)=$$
$$(NPV(IRR_n+(IRR_n*0.01),$$
$$Cash\_Flow)-NPV(IRR_n))/(IRR_n*0.01)$$

This general method solves many equations that have more than one root, although you must realize that this method may converge to a root different from the expected root or may even diverge if the starting value is not close enough to the root. In the case of IRR, the first root found that is greater than zero is normally the correct answer.

Example 3
Binary Search Model

Binary Search to Find Roots of Equations

The IRR formulas in the last section readily adapt to finding the roots of arbitrary equations using the binary search technique.

Assume that you have a polynomial

```
x^3+4*x*x+5
```

Further suppose that you want to solve for a value of x that yields a result of 30. The following model solves for one root of the polynomial using the binary search technique.

	1	2	3
1	"f(x)"	"c_low"	"c_high"
2	x^3+4*x*x+5	IF(ISNA (ITERCNT()), low,IF(fx>res, RC,x))	IF(ISNA (ITERCNT()), high,IF(fx<res, RC,x))
3			
4			
5	"result"		
6	30		

	4	5	6
1	"x"	"low"	"high"
2	(c_low+c_high)/2	0	100

For this model, the following names are defined:

c_low	=	R2C2	(current low value)
c_high	=	R2C3	(current high value)
x	=	R2C4	
low	=	R2C5	(low value entered by you)
high	=	R2C6	(high value entered by you)
fx	=	R2C1	
res	=	R6C1	(your desired result; you enter)

The calculation proceeds as follows:

1. In cell R2C2, Multiplan evaluates the IF function. During the first iteration, the ITERCNT function returns the #N/A error value, making the ISNA function return TRUE. Thus, IF selects the value of "low," which in this model is 0.

2. For all other iterations, ITERCNT returns an integer, making ISNA return FALSE. Thus, IF selects the "Else" value, which is another conditional formula.

3. The second IF formula in R2C2 compares the result of using the value of "x," (calculated in R2C4) in the polynomial f(x) in R2C1 with the desired result, 30, in R6C1. If the value of f(x) is more than 30, IF selects the current value of the cell (for the second iteration, 0). If the value of f(x) is less than 30, IF selects the value of "x" calculated in R2C4.

4. The same steps apply to the conditional formula in R2C3, except this formula selects the "high" value during the first iteration. During subsequent iterations, IF selects the current value of the cell if f(x) is less than 30 or the value of "x" in R2C4 if f(x) is more than 30.

Once Multiplan begins iteration, the calculations proceed rapidly, and it is difficult to see the numbers clearly before they change.

The following list of values for each cell describes, in part, what happens as Multiplan iterates toward a result:

	1	2	3
1			
2		0	100
3		0	50
4		0	25
5		0	12.5
6		0	6.25
7		0	3.125
8		1.5625	3.125
...			
16	29.999762	2.0352602	2.035284

4	5	6
50	0	100
25	0	100
12.5	0	100
6.25	0	100
3.125	0	100
1.5625	0	100
2.34375	0	100
2.0352721	0	100

At this point, iteration stops because the maximum change in any value is less than 0.001, the internal DELTA value of Multiplan. The root Multiplan calculated is 2.0352721. (The changing values for f(x) in column one are left to you to find.)

For more precision, enter a DELTA formula in a cell that sets a limit smaller than 0.001. Or, enter an ITERCNT formula that sets a limit higher than 16. Then, enter either an absolute reference to that cell or the name of the cell in the "completion test at" field of the Options command.

Summary of Hints for Creating Iteration Models

1. Order of Evaluation

   Unlike Multiplan worksheet models without iteration, models with iteration must take into account the order of evaluation of each cell. During iteration the current value of cells referred to in the formulas affects the iteration. Fortunately for the worksheet builder, the order of evaluation of circular references is strictly defined when ITERCNT()>=1. Multiplan always calculates the circular references one column at a time, top to bottom, starting with the first cell of the first column.

   A general guideline that helps avoid problems is to place all the circular references in a single column. Care must also be taken that the ordering is correct for iterative methods such as Newton's method (see Example 2) and binary search (see Example 3).

   For solving simultaneous equations, order is less critical because Multiplan assumes that each iteration converges on the solution. However, in some situations the order of evaluation determines whether the solution converges or diverges. If the original order produces divergence, rearranging the order may bring about convergence.

2. Providing for Initial Values

As discussed in the section on the ITERCNT function, you may enter a conditional formula to provide an initial value for formulas on the worksheet. For example, because ITERCNT() returns #N/A the first time it is called, a simple IF statement such as:

IF(ISNA(ITERCNT()),initial_value,formula)

provides initial_value for the first calculation, then the formula in subsequent iterations.

3. Obtaining Local Values of DELTA

To obtain a DELTA() that applies only to the differences of a part of the worksheet, bracket the cells with cells that contain the DELTA function. Each DELTA() resets the DELTA value to 0. To avoid problems with order of evaluation, enter the first DELTA function in the cell immediately above the block of cells for which you want a local DELTA value. Enter a formula such as:

IF(TRUE(),"",DELTA())

which clears the maximum DELTA value while appearing blank on the screen. Then, enter the test DELTA formula in the cell immediately below the block of cells to return a local DELTA value. See the section on the DELTA function for further details.

4. ITERCNT() and DELTA() Interaction

If you enter both the DELTA function with a specific limit and the ITERCNT function as a formula by itself in a model, you may create divergence. The DELTA function also reads the cell that contains the ITERCNT function. Because ITERCNT changes by 1 during each iteration, DELTA will always return at least 1 unless you set up the worksheet model to return local values of DELTA or you eliminate the ITERCNT formula. Note that the formula ITERCNT()>20 returns TRUE or FALSE after each iteration and therefore would not affect convergence.

5. Single Stepping Iteration Models

Stepping through an iteration model one iteration at a time permits debugging and illustrating an iterative solution. To set this up, enter as a response in the "completion test at" field an absolute or name reference of a cell that contains the TRUE() function. This means that Multiplan calculates the model only once. And, repeatedly pressing the RECALC key produces a step-by-step solution.

6. General Information

Turn off iteration and/or automatic recalculation when building models to save time.

The responses in the Options command "iteration" and "completion test at" fields are saved with the worksheet in Normal mode (see the Transfer Options command in Chapter 16). Thus, when you load a worksheet that contains an iterating model, the fields of the Options command receive the responses saved with the worksheet. If you later start another sheet, you may want to reset "iteration" to "No" and delete the response in the "completion test at" field.

Pressing Cancel stops iteration. Only Cancel has an affect during iteration because all other keys would be entries and are therefore ignored. This also means that any characters you type during iteration are not saved, so the type-ahead feature does not work.

Multiplan checks for Cancel at the beginning of each iteration. Thus, if you press Cancel during an iteration, then Multiplan completes that iteration, checks the completion or convergence test, and finally (if the completion or convergence test is not TRUE) stops iteration and displays the "Circular references unresolved" error message. (If the completion or convergence test is TRUE, Multiplan ends iteration as if you had not pressed Cancel.

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Note: See also Chapter 13, Glossary.

Signs and Symbols (in ASCII order)

A

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