VisiCalc®

INSTANTLY CALCULATING 'ELECTRONIC WORKSHEET'

Program By
Software Arts, Inc.

Manual Written by
Joyce Uggla
and
Richard A. Bretschneider

Manufactured for
Radio Shack®
A Division of Tandy Corporation
Fort Worth, Texas 76102

by

VisiCorp™
2895 Zanker Road
San Jose, California 95134

Table of Contents VisiCalc® User's Guide

CHAPTER 1. INTRODUCTION

CHAPTER 2. THE VISICALC TUTORIAL

Lesson One

Lesson Two

Lesson Three

Lesson Four

Lesson Five

CHAPTER 3: VISICALC COMMAND REFERENCE

CHAPTER 1. INTRODUCTION

How to Use This Manual

This manual is organized to help you learn the VisiCalc® program easily and quickly. Its organization takes into account the fact that people using the VisiCalc program for the first time have different levels of experience with computers.

The VisiCalc program can be used with several computers including the TRS-80 Model II.

Because the basic operation of the VisiCalc program is the same on each of these computers this manual will refer all of these machines as TRS-80 Model II.

This manual describes the operation of the VisiCalc program. For information on the computer itself or operation of the disk operating system (TRSDOS), see the *TRS-80 Model II Owner's Manual.*

Chapter 1 of this manual describes the VisiCalc program, the equipment it requires.

Chapter 2 contains step-by-step lessons that show you how to use all major features of the VisiCalc program. Regardless of your experience with personal computers, the examples in this Tutorial provide the quickest way to learn the use of the program and answer most questions you may have.

The examples in Chapter 2 show you how to use the VisiCalc program and your computer to solve problems in your professional and personal activities. Each lesson shows you what to type, keystroke-by-keystroke, and should be used while sitting at the computer. As you practice, you'll gain familiarity and confidence in using the more advanced features of the VisiCalc program. Before long, you'll need only the reference information in Chapter 3 and the *VisiCalc Pocket Reference.*

Chapter 3 contains a description of each VisiCalc command and major feature, arranged in alphabetic order. These descriptions are summarized in the *VisiCalc Pocket Reference.*

Appendix A: Floppy Disk Drives, describes how to use the program with floppy diskettes. It covers loading TRSDOS, formatting storage diskettes, and loading the VisiCalc program.

Appendix B: Hard Disk Systems, describes copying the VisiCalc program to the TRS-80 Hard Disk System and running the VisiCalc program.

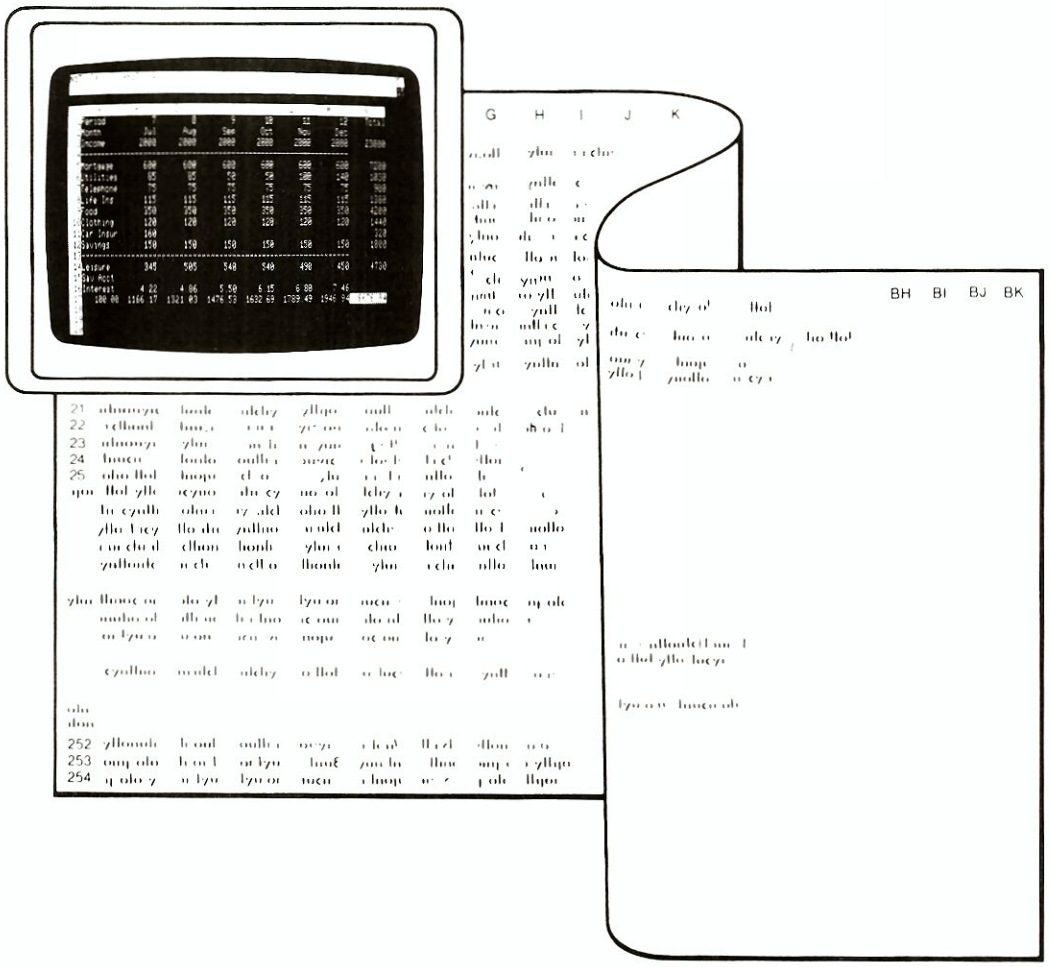
Appendix C: Exchanging Files describes how the VisiCalc program stores files in the DIF™ format. Within the VisiCalc program, you may use the DIF format to manipulate sections of the worksheet and to transfer sections of one worksheet to another. Outside of the VisiCalc program, it saves data in text files that can be read by other DIF-supporting programs. Using this information, an experienced programmer can write a program (in a language such as BASIC) to read a file written by the VisiCalc program or create a file that can be read by the VisiCalc program. This appendix includes sample programs for the experienced programmer.

The most effective way to learn how to use the VisiCalc program is to read Chapter 1 to learn its general capabilities, then sit down at the computer and let the lessons guide you step-by-step through the examples. In a few short sessions you should master the fundamentals of the VisiCalc program and be ready to apply it to your own needs.

The Electronic Worksheet

The VisiCalc program was born of the observation that many problems are commonly solved with a calculator, a pencil, and a sheet of paper-three nearly universal tools. Calculating sales projections, income taxes, financial ratios, a personal budget, engineering changes, cost estimates, and balancing a checkbook are all done with these tools.

The VisiCalc program combines the convenience and familiarity of a pocket calculator with the memory and display capabilities of the personal computer. With the VisiCalc program, the computer's screen becomes a window that shows part of a much larger electronic worksheet. You can move, or *scroll*, this window in any direction to look at any part of the worksheet. You can also split the screen into two windows, each of which can be scrolled, to see any two parts of the sheet at the same time.



A Window on the Worksheet

The worksheet is organized as a grid of columns and rows. The intersections of the columns and rows define thousands of entry positions, each identified by its row-column coordinates. At each position you can enter a *value*—a formula that consists of numbers, arithmetic operators, functions, and references to other locations—or a *label* that describes some part of the worksheet.

By writing values on the worksheet you can set up charts, tables, and records; formatting commands let you control the appearance of each entry. You can make the VisiCalc worksheet look just like a checkbook register or a profit-and-loss statement.

But the power of the VisiCalc program lies in the fact that the computer *remembers* the formulas and calculations you use while working through a problem. If you change a value on the worksheet, all related values change as the VisiCalc program recalculates the entire worksheet.

Recalculation makes the VisiCalc program a powerful planning and forecasting tool. Not only can you easily correct mistakes, you can also explore alternatives. For example, suppose you're doing sales projections using the VisiCalc program. You may want to know what the impact on your company will be if a specific project doesn't sell as well as you had anticipated. What if you sell only 200 units a month instead of 250? What if you sell 300? What if one of your sales representatives quits and it takes six weeks to bring a new person up to speed? What is the value of a training program that brings new sales representatives up to speed in two weeks?

Playing "what if" with the VisiCalc program is often a matter of changing a single value. If you enter a value at one location, you can copy it to any number of other positions. You can change, insert, delete, or move entire rows or columns. The worksheet is instantly restructured so that all relationships correspond to the changes. Doing the same thing with a calculator, pencil, and paper could take hours of erasing and recalculating.

The VisiCalc program can find the minimum, maximum, sum, average, and other calculations involving all or part of a row or column. Although the VisiCalc program automatically adjusts how values and titles are displayed to match your format commands, the full precision of values and length of titles remains in memory.

Once you've set up the worksheet to solve a particular problem, you can save it on diskette and use the same setup for repeated instances or similar problems. All or part of the worksheet can be printed for reports or permanent records.

What You Need

To use the VisiCalc program, you need the following components:

- A TRS-80 Model II with at least 64K of RAM memory. The computer includes the keyboard unit, the video display and one disk drive.

  or

  A TRS-80 Model 16 with at least 128K of RAM memory. The computer includes the keyboard unit, the video display and one disk drive.

- The VisiCalc/TRSDOS program diskette. You should copy the VisiCalc/TRSDOS to another diskette for backup. Store a copy of the VisiCalc/TRSDOS diskette in a safe place as a backup; do not use it unless the other diskette becomes unusable.

- At least three blank 8" floppy diskettes. This will be enough to get you started, but you may eventually need more and should plan for it.

- If you want to print the worksheet, a Radio Shack printer.

- The VisiCalc program optionally supports the Disk Expansion System (additional disk drives) and/or the Hard Disk Drive for data storage.

The memory of some TRS-80 Model II computers can be expanded above the minimum requirements listed above. The VisiCalc program uses this additional memory by increasing usable worksheet space. The memory indicator on the VisiCalc screen tells you how much worksheet memory is available.

The Keyboard

The following illustration shows the keyboard. Note the keys that are shaded; you will use them a great deal.

The four keys marked with arrows move the cursor on the screen. Small arrows are used to represent these keys in text and examples:

← → ↓ ↑.

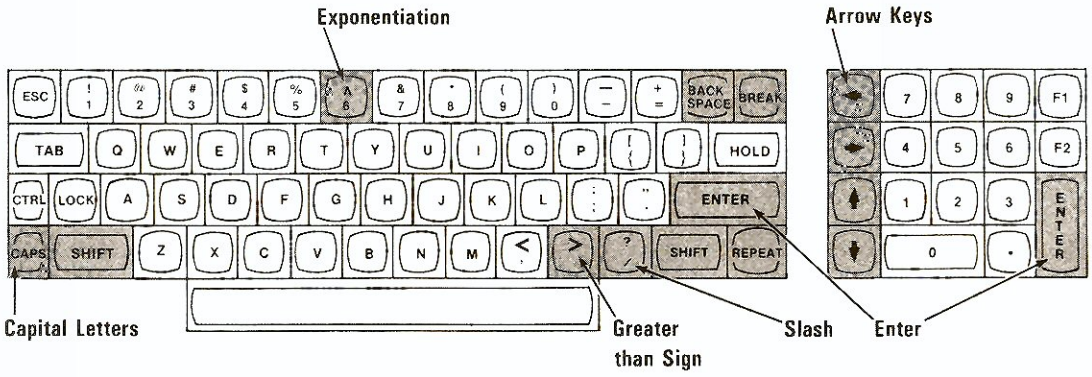
The ENTER key, indicated as [ENTER] in this manual, is used to end commands and worksheet entries.

The BACKSPACE key, indicated as [BACKSPACE] in this manual, is used to correct typing errors.

The BREAK key, indicated as [BREAK] in this manual, cancels an entire entry or command; it also stops the printer or diskette drive when printing or saving a worksheet.

The SHIFT key, indicated as [SHIFT] in this manual, capitalizes letters just as it does on a typewriter. The VisiCalc program isn't concerned whether you type a letter in upper case or lower case; it capitalizes them where necessary.

The CONTROL key gives special meaning to keys. It is used like the shift key: hold it down and press the other key. This is represented in text by [CTRL] followed by a hyphen and the other key ([CTRL]-E for example, means hold down the [CTRL] key and type E).

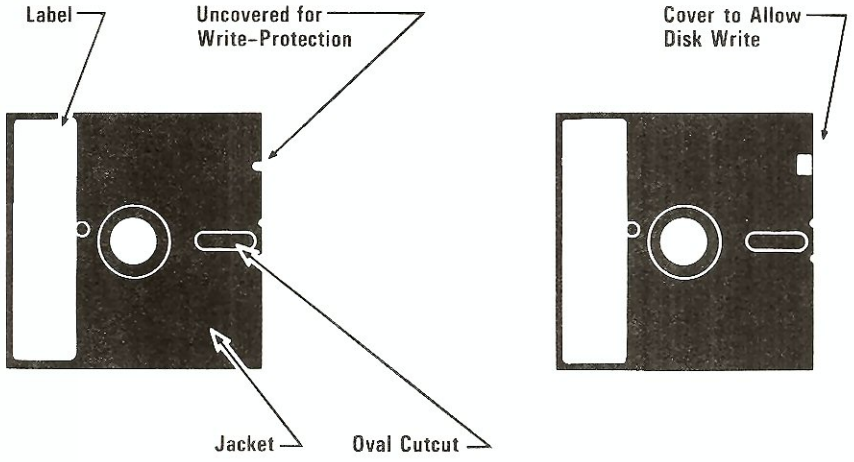


A Word on Diskettes

A word of caution about the handling of diskettes is in order here: You can't be too careful with diskettes. Each diskette is a magnetically coated mylar disk, sealed in a protective square plastic cover. Through the oval cutout in the square cover, you can see the magnetic surface of the actual diskette.

Never touch the exposed magnetic surface with your fingers or any implement. Protect the diskette from dust by storing it in the paper sleeve it comes in. Keep it at least six inches from magnetic fields such as those generated by a TV. Extremes of temperature (such as in a car trunk on a warm day) can damage a diskette, destroying valuable data or your VisiCalc program. Don't bend, staple, or write on the square plastic cover with a hard pen or pencil (use only the soft felt-tip pens).

Sometimes there is a small square notch cut out of one side of a diskette. The square notch is sensed by the disk drive and tells the computer that you may not write information on the diskette surface. For its protection, the VisiCalc program diskette has this notch; hence it is said to be "write-protected." When you want to write on a storage diskette, the notch must be covered with one of the adhesive tabs that comes in a box of diskettes.



Before You Begin

Before you begin the tutorial section of the manual you will have to load TRSDOS into your computer, make some storage diskettes, and load the VisiCalc program. If you are using floppy diskettes for storage you will read Appendix A, Floppy Disk Drives. Hard disk users will need to read Appendix B, Hard Disk Systems. When you have read the appendix and have VisiCalc loaded in your machine turn to Chapter 2 and begin the tutorial.

CHAPTER 2. THE VISICALC TUTORIAL

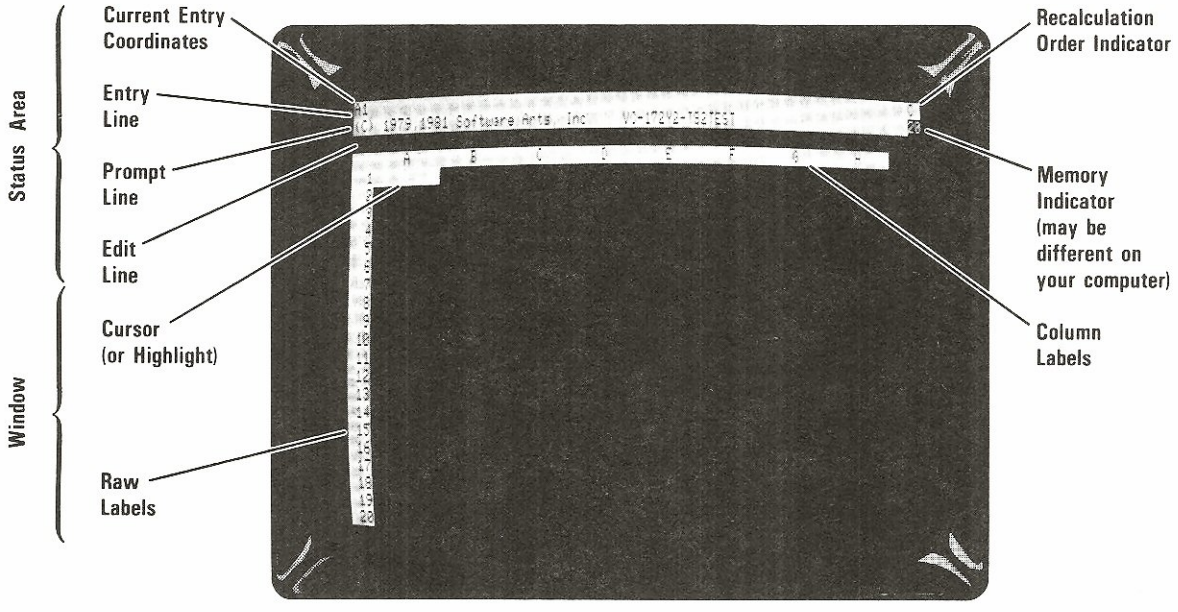
Lesson One

Chapter 2. The VisiCalc Tutorial

Chapter Two, the VisiCalc Tutorial, consists of five lessons that introduce all the major features of the VisiCalc program. The lessons are written to be used as a keystroke-by-keystroke guide while sitting at the computer.

The lessons require at least one storage diskette. If you have not yet made a storage diskette, do so now, following the instructions in either Appendix A or B (see the instructions at the end of the Introduction). Hard disk users may use floppy diskettes at their own discretion (instructions can be found in the *Hard Disk Owner's Manual*).

If the VisiCalc program is already loaded, type /CY to clear the screen. (If the program is not loaded read the "Before You Begin" section of Chapter 1.) The screen should look like the following photograph:



The screen has become a *window* into the computer's memory. The VisiCalc program has organized it as an *electronic worksheet* by dividing it into rows and columns. Rows are numbered 1, 2, 3, etc., and columns are lettered A, B, C, etc. Each intersection of a row and a column is an *entry position*; it is referred to by its coordinates (A1, B3, C17, etc.).

Now turn to Lesson One.

Lesson One

At each entry position, you can type a label, a number, or a formula. In a moment you'll write at different entry positions on this electronic worksheet.

Look at the white bar and dark line at the top of the screen (just above the column letters). This is the *status area*. The bar is actually two lines; the top line is the *entry line* and the second line is the *prompt line*.

The prompt line is displaying the VisiCalc copyright notice and version number. Should you ever need to call or write to ask questions or to report problems with the VisiCalc program, please refer to your version number and the model of your computer.

The dark line below the prompt line is the *edit line*.

The letter in the upper right corner of the screen tells you whether the VisiCalc program calculates new values by rows (R) or by columns (C). The number below it tells you how much memory is available. (The number shown in these photographs will not always match the number on your screen. This will be explained later.)

Press the key marked ENTER (this key is represented by [ENTER] in this book). The copyright notice and version number disappear. Now type /V and they reappear. Type /V (the Version command) whenever you want to see the VisiCalc version number.

Moving the Cursor

Look at the intersection of column A and row 1; this is location A1. The *cursor* is the white rectangle covering it. Think of the cursor as the point where your pencil meets the paper. It marks where you can write on the worksheet. To keep you from getting lost on the worksheet, the VisiCalc program displays the cursor's coordinate on the entry line.

The arrow keys move the cursor in the direction indicated by the arrow. Type ➡. The cursor moves to B1 (column B, row 1). Look at the entry line. Not only are the copyright and version numbers gone, but the new coordinate (B1) is displayed. Type ⬅ and the cursor moves back to A1.

Type ⬇. The cursor moves down to entry position A2 (column A, row 2). Now type ⬆. The cursor returns to entry position A1.

If, while you are practicing, you make a typing error and see Value or Label on the prompt line, don't worry. Just type [BREAK]. The word disappears, along with the number or letter beneath it.

Scrolling the Window

When you load the VisiCalc program, the cursor is at A1, the upper-left corner of the worksheet. Type ➡ until the cursor rests at the right edge of the screen. Type ➡ again. The next column to the right comes into view, while column A disappears off the left edge.

The window has scrolled to the right. Type ➡ a few more times, watching more columns appear at the right edge of the window while others disappear at the left.

The window also scrolls to the left. (In fact, it scrolls in all four directions.) Type ⬅ until the cursor is at the left edge of the window. Now type ⬅ several more times; the columns that disappeared as you scrolled the window to the right come back into view. Type ⬅ until the cursor is back at A1.

Now type ⬅ once more. Notice that the cursor coordinate on the entry line flashes. This is the VisiCalc program's way of telling you that you're bumping into the edge of the worksheet. Type ⬆. This time you see the coordinate flash because you're bumping into the top edge of the worksheet. So far you have encountered the left edge and the top edge of the worksheet. There are two other edges.

Type ⬇ until the cursor moves down to the bottom of the window. Now type ⬇ once more. The next row comes into view, while row 1 disappears off the top of the window. Type ⬇ a few more times. As you can see, the worksheet is quite a bit larger than an ordinary sheet of paper.

Repeat Action

You can scroll to the bottom edge of the worksheet more quickly by taking advantage of the [REPEAT] key on the keyboard. Hold down ⬇ and [**REPEAT**] at the same time; the cursor and the window scroll down rapidly. Continue to hold down both keys until you bump into the bottom edge of the worksheet. The cursor has reached position A254. The entry coordinate on the edit line may continue flashing. This happens when the typeahead buffer, which allows you to type faster than the letters appear on the screen, becomes full. The coordinate will keep flashing until all the down arrows stored in the buffer are used up. To cancel the buffer, just type [**CTRL**]-C (by pressing [**CTRL**] and C at the same time) or [**BREAK**].

To move the cursor to the right edge of the worksheet, hold down ➡ and [**REPEAT**]. The cursor and window go scrolling off to the right. As they scroll, notice how succeeding columns are lettered. (These coordinates also appear in the upper left corner of the screen.) After A, B, C,...Z come AA, AB,AC...AZ then BA, BB, BC... The cursor finally stops at position BK254 as it bumps into the right edge of the worksheet. You are now at the lower right corner of the VisiCalc worksheet.

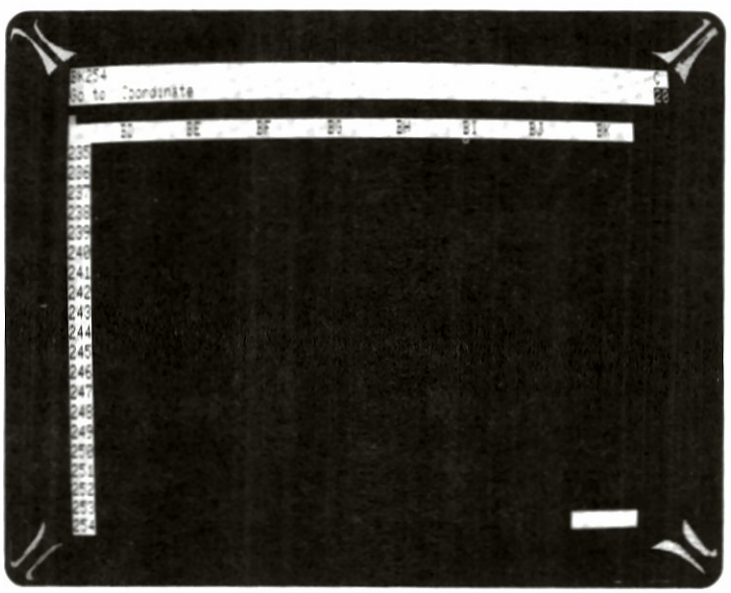
Direct Cursor Movement

Even with the aid of [REPEAT], it takes a while to scroll all the way to the lower right corner of the VisiCalc worksheet. There's an easy way to move the cursor to another position on the worksheet that takes only a few keystrokes.

Type >. Two things happen:

- Go To: Coordinate appears on the prompt line just under BK254
- The edit cue (the white box) appears on the edit line, directly below the prompt line.

The screen should look like the following photograph:



In general, each time you press a key the prompt line tells you what you can type next. On the screen in the preceding photograph, the prompt line tells you that the VisiCalc program has recognized the Go To command (>) and wants to know what coordinate to Go To. It is waiting for you to type in the letter and number of the coordinate to which you want the cursor to move.

Type **A**. The letter A appears on the edit line (the dark line just above the column labels), followed by the edit cue. Type **1** to specify position A1.

So far, A1 is on the edit line followed by the edit cue. The VisiCalc program is still waiting for you to type something. It doesn't know yet whether you want to go to position A1, or A11, or A121, or some other position.

Type **[ENTER]**. The prompt and edit lines clear, and the cursor and window move back to the upper-left corner of the worksheet at A1.

Try another example. Type **>C10 [ENTER]**. The cursor now rests in mid-screen, directly below C and to the right of 10.

Editing With the [BACKSPACE] Key

Earlier, you used [BREAK] to cancel something you typed. The VisiCalc program has a less drastic way of correcting errors—the backspace key, located next to the [BREAK] key (represented in this manual by [BACKSPACE]).

Type **>A11**, but pause for a moment before typing [ENTER]. Suppose you intended to move the cursor to position A1, but accidentally typed 1 twice. The edit line now reads:

A11

followed by the edit cue.

Type [**BACKSPACE**] once. The edit cue backs up one character and erases the extra 1, leaving A1. Type [**ENTER**]. The cursor jumps to entry position A1, and the prompt and edit lines clear.

In general, the VisiCalc program lets you correct typing errors by backing up with the [BACKSPACE] key; each time you type [BACKSPACE], the last character on the edit line is erased. Type **>A11** again. Now type [**BACKSPACE**] twice leaving just A, then type 2 to get A2 and [**ENTER**] to end the command. The cursor moves to A2.

Besides backing up, you can cancel a command with [BACKSPACE]. Type **>B5**, then pause. Suppose you change your mind and decide you don't want to move the cursor. Type [**BACKSPACE**] and the 5 disappears from the edit line. Type [**BACKSPACE**] again; the B disappears from the edit line and Go To: Coordinate disappears from the prompt line. You have canceled the Go To command by erasing everything on the edit line; this accomplishes the same thing as typing [BREAK].

Before going on, spend a few more minutes moving the cursor around with the arrow keys and > (the Go To command). Try moving the cursor to a nonexistent position such as AB525. What happens? Try moving to an invalid coordinate such as 25A instead of A25. What happens?

Writing on the Worksheet

As you have seen, moving the cursor and window around is pretty easy, but so far your worksheet is (or should be) empty. You'll find that writing on the worksheet is even easier.

Type **/CY** to clear the worksheet. The worksheet disappears, then reappears with the copyright and version number on the prompt line. The Clear command erases everything written on the worksheet, redisplays the worksheet, and positions the cursor at A1.

To begin, label a row: type **Sales.**

Stop and look at the prompt line. The word Label appears on the prompt line; this is the VisiCalc program's name for a worksheet entry that isn't used in making calculations. On the edit line is the word Sales followed by the edit cue. The edit cue indicates that you can use [BACKSPACE] to back up and make corrections or [BREAK] to cancel the command. Sales also appears under the cursor at position A1 on the worksheet.

Now type ➡. The prompt and edit lines clear and the cursor moves to position B1, leaving the label Sales at A1. You can use any arrow key instead of [ENTER] to end an entry and write the label or value on the worksheet.

Type **100**. Look at the status area again. The prompt line says Value, the VisiCalc program's term for a number or formula. The number 100 followed by the edit cue appears on the edit line. Type [BACKSPACE] three times and watch the numbers disappear: first 0, then 0, then 1.

Now type the formula **75+25**. If you make a typing error, watch the edit line and type [BACKSPACE] to back up.

The word Value is still on the prompt line, and the edit line reads 75 + 25, followed by the edit cue. Type !. The VisiCalc program calculates 75+25 and displays 100 on the edit line. You can use this feature to perform quick calculations before writing a number on the worksheet.

Nothing appears under the cursor at B1; everything has happened on the edit line. Now type **[ENTER]**. The prompt and edit lines clear and 100 appears at position B1 on the worksheet. The entry line reads

```
B1 (V) 100
```

The entry line gives a full explanation of the contents of the entry position highlighted by the cursor. Right now the entry line reads B1 (the coordinate), (V) for Value, followed by 100.

Try typing **[BACKSPACE]**. Nothing happens. Typing **[ENTER]** told the VisiCalc program to write 100 on the worksheet. Type ⬅, and the cursor moves back to position A1. Now the entry line reads:

```
A1 (L) Sales
```

The (L) stands for Label.

Formulas and Recalculation

Move the cursor down to position A2 by typing ⬇. Type **Cost**, then ➡. The cursor moves to B2, leaving Cost at A2.

You're going to write a formula for cost at B2 that says cost is 60% of sales, or .6 times 100. Instead of typing 100, however, you'll use its coordinate (B1). Type **.6*B1**.

The * specifies multiplication. The edit line should now read .6*B1. If it doesn't, use [BACKSPACE] to correct any error. The formula tells the VisiCalc program to multiply whatever is at coordinate B1 by .6. Now type **[ENTER]** and watch what happens. The prompt and edit lines clear, and the edit line reads:

```
B2 (V) .6*B1
```

Position B2 reads 60, the result of multiplying .6 times 100, the number at B1.

To give you a quick look at the VisiCalc program's power, type ↑ to move the cursor up to position B1. Watch the screen and type **200 [ENTER]**. The new number (200) replaces the old number (100) at B1. What else happened?

Type ↓ to move the cursor to B2. The formula you typed earlier, .6*B1, is on the entry line at the top of the screen. When the number at B1 changed to 200, the VisiCalc program recalculated the formula at B2 as .6*200, or 120. Cost is still 60% of sales. You'll see many more examples of this recalculation feature.

More on Labels and Values

This topic looks more carefully at labels and values, and explores an even simpler way to write formulas. You'll start by writing a formula that calculates gross profit by subtracting cost from sales. First, position the cursor to write a new label: type **>A3 [ENTER]** to move the cursor to A3.

To write the label Gross, type **G**. The prompt line says Label. When you write at an entry position, the VisiCalc program looks at the first character you type to determine whether you are typing a label or a value. If you start with one of the letters A through Z, as you did here, the VisiCalc program assumes that you are typing a label.

If you start with one of the digits 0 through 9, a decimal point (.), something that could begin a formula—such as plus (+), minus (−), or left parenthesis (()—or @ or # (explained later), the VisiCalc program assumes that you are typing a value. For now, type [BREAK] to cancel what you have typed.

What happens if you want to write a label such as "−Gross−" or "1st Qtr"? Try typing **−Gross−**. The VisiCalc program interprets the initial dash as a minus sign. It assumes you are typing a formula, and that the letter G starts a coordinate. However, it indicates an error and refuses further input when you type something that can't be a formula. Type **[BREAK]** to cancel this entry.

To begin a label with a symbol that the VisiCalc program interprets as the beginning of a value, type a quotation mark (") as the first character. The VisiCalc program takes the " to mean that you want to type a label regardless of what the next character is. The quotation mark does not become part of the label itself. As soon as you type ", the prompt line reads Label followed by the edit cue.

Type **"−Gross−** (don't type a closing quotation mark unless you want it as part of the label). Now type →; the cursor moves to position B3, leaving −Gross− at A3.

Note: To begin a label with a quotation mark, you must type " twice at the beginning; once to identify the entry as a label and again to enter the quotation mark itself.

You're ready to calculate sales minus cost. The formula is sales (B1) minus cost (B2). Type **B1−B2 [ENTER]**. What happens when you type B1−B2? Look at the prompt line. It shows that the VisiCalc program assumed you were entering a label, not a value, as soon as you typed the first B. B1−B2 is a perfectly legitimate label, but it doesn't calculate anything. Only a value (number or formula) can calculate.

Start again by eliminating the label B1 − B2. To erase an entry you have written on the worksheet, use the Blank command, which blanks out the entry position where the cursor rests. Type **/B [ENTER]**. The label B1−B2 under the cursor disappears, and the entry line clears except for the coordinate B3.

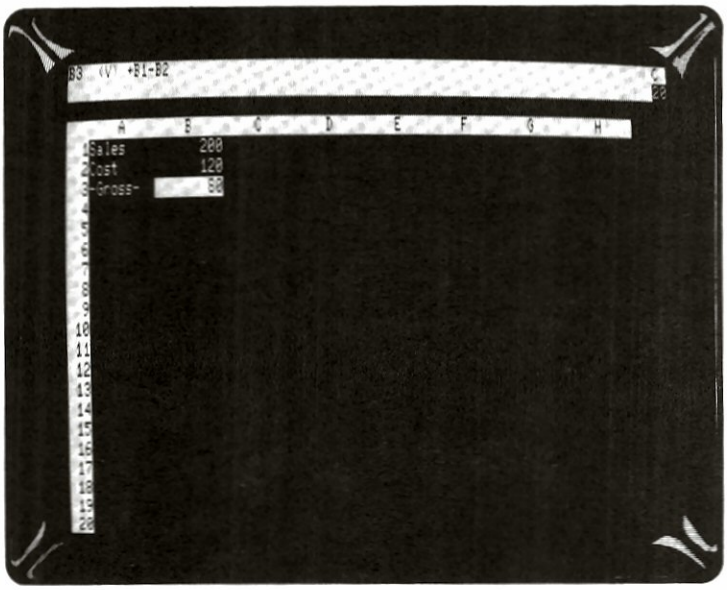
Remember that you used " to type a label when the VisiCalc program would otherwise have treated it as a value. A similar technique makes the VisiCalc program accept the formula B1−B2 as a value instead of a label. The formula +B1−B2 is equivalent to B1−B2, and VisiCalc interprets the + as the first character of a value. Type the following formula for gross profit (be sure to include the +):

+B1−B2 [ENTER]

The entry line reads:

B3 (V) +B1 − B2

The cursor rests on 80, the result of calculating +B1−B2, or +200−120.



Cursor Moves in Formulas

So far, you know how to move the cursor to an entry position and how to write labels and numbers. You also know how to write a formula (such as +B1−B2 in the previous example) that refers to other positions on the worksheet. You have also seen that if you change the numbers at B1 or B2, the VisiCalc program recalculates the formula +B1−B2 and displays the result at the formula's coordinate, B3.

As you wrote the formula for sales minus cost, you probably had to check the screen to see that the number for sales was at position B1 and that the number for cost was at B3. Imagine what it's like when you write a large number of formulas on the worksheet.

Keeping track of the coordinates of many numbers can be time-consuming and somewhat confusing. Further, when you scroll columns A and B off the left edge of the window to work on other parts of the worksheet, you can't see the numbers next to Sales and Cost. This makes writing a new formula involving sales and cost rather difficult. There's an easy way to solve this problem: you write the formula, but let the VisiCalc program fill in the coordinates.

Type +. The prompt line reads Value and the + appears on the edit line, followed by the edit cue. At this point you could type B1, but what you really want is the number next to the label Sales (currently 200).

Point to the 200 on the screen with your finger. You're about to do the same thing electronically by pointing with the cursor. Watch the edit line and type ↑. The cursor moves up to highlight 120; its coordinate, B2, appears on the edit line. Now type ↑ again. See what pointing the cursor means? You have taken the cursor from its starting position at B3 and pointed it to B1.

The edit line now reads +B1 followed by the edit cue. These are the first three characters of the formula you typed earlier. Type−(the hyphen, for a minus sign). The cursor jumps back to B3, the entry position at which you began writing the formula. The edit line now reads +B1− followed by the edit cue. As a rule, after pointing the cursor at the position you want to include in the formula, simply continue the formula by typing an arithmetic operator such as −, +, * or /.

Now enter the second part of the formula by pointing to it. Watch the edit line and type ↑ once more. The cursor moves up to 120, the number next to Cost, and the edit line now reads +B1−B2—exactly the same formula you typed before. To write the formula on the worksheet as it appears on the edit line, type **[ENTER]**. The prompt and edit lines clear.

The result of pointing to coordinates with the cursor is the same as typing those coordinates. The entry line still reads:

B3 (V) +B1-B2

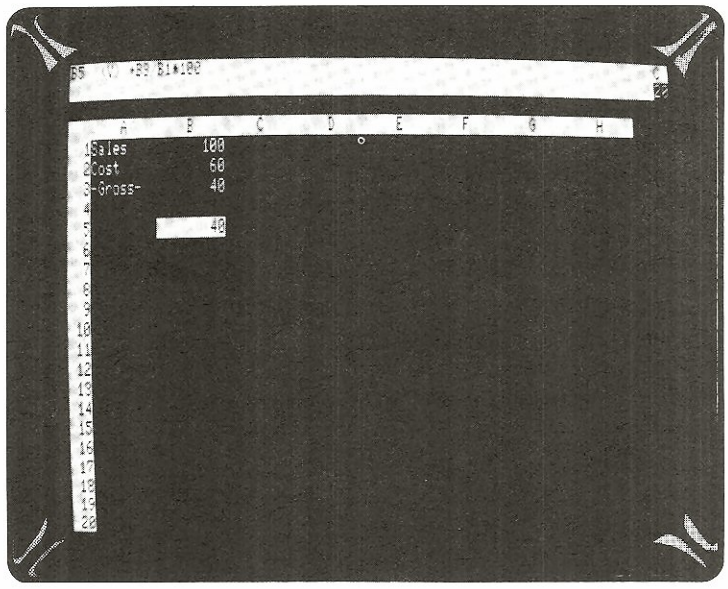
The number on which the cursor rests is 80, the result of calculating B1 minus B2. Nothing has changed except the way you wrote the formula.

To demonstrate the VisiCalc recalculation feature again, type ↑ twice to move the cursor up to B1. Change the number there by typing **100 [ENTER]**. Now B2 changes back to 60 (.6 times 100), and B3 changes to 40 (100−60).

In general, whatever you see on the edit line you can type. Likewise, you can point to any position on the worksheet instead of typing its coordinates.

As you gain experience and familiarity with the VisiCalc program, you'll find that the technique of moving the cursor to the positions you want becomes easier. In time, you'll find you can almost forget about coordinates entirely and think only in terms of the visual positions of labels and values on the worksheet.

To test your understanding of the process of moving the cursor as you write formulas, try an example yourself. Move the cursor down to position B5 and write a formula there for gross profit as a percentage of sales. Hint: the formula is gross profit divided by sales, multiplied by 100 (+B3/B1*100). Write this formula on the worksheet just by moving the cursor and typing + and /. The screen should look like the following photograph:



After you obtain the result (40), keep the cursor at B5 and type **/B [ENTER]** to blank the coordinate and **>B1 [ENTER]** to move the cursor to B1.

More on Editing

Suppose you wanted to change the cost in the example from 60% to 55%. Move the cursor to B2. The entry line reads:

```
B2 (V) .6*B1
```

To change that formula, type /**E** (the Edit command). The prompt line reads:

```
[Edit]: Value
```

(because the entry is a value) and the formula .6*B1 is displayed on the edit line; the edit cue is over the first character, the decimal point.

To change .6 to .55, type ➡ twice to move the edit cue to the *, just to the right of the character to be changed. Nothing has changed so far except the position of the edit cue. Now type [**BACKSPACE**]. This works just like it did when you erased with [BACKSPACE] before. The edit cue backs up one space and erases the 6. The edit line now reads .*B1. Type **55**. The edit line reads .55*B1—the formula you want. Type [**ENTER**]. The prompt and edit lines clear and the entry line reads:

```
B2 (V) .55*B1
```

The number at B2 has changed to 55 and B3 is 45.

Typing [BACKSPACE] erases the character just to the left of the edit cue. Typing a character puts that character on the edit line just in front of (to the left of) the edit cue.

To change cost back to 60% of sales, type:

/E ➡ ➡ ➡
[BACKSPACE] [BACKSPACE] 6 [ENTER]

The formula returns to its previous form.

The Edit command can be entered in one of two ways. Typing /E when the edit line is clear lets you edit the contents of the cursor location. Typing [CTRL]-E while typing a label, value, or command lets you edit what is on the edit line.

You can edit anything you type. Type **>A6 [ENTER] January Profit Margin**. Suppose you meant to type "February" instead of "January." Type **[CTRL]-E** (hold down **[CTRL]** and type **E**). This time the prompt line reads [Edit]: Label because you are typing a label. Type ⬅ until the edit cue is on the blank just to the right of the Y. Type **[BACKSPACE]** seven times to erase January, then type **February**. If you were to type [ENTER] now, you would enter "February Profit Margin" at A6. For now, return to the original sheet by typing **[BREAK] >B1 [ENTER]**.

Saving the Worksheet on Diskette

If you save the work from this lesson, you can carry it over into Lesson Two. You can save it on one of the diskettes that you initialized earlier. (If you haven't initialized any diskettes yet, follow the instructions under "Before You Begin" in Chapter 1.)

If you don't have any extra diskettes, don't worry. Lesson Two starts by telling you what to type to set up the worksheet with the same labels, numbers, and formulas now written on it. You should, however, at least skim the material in the remainder of this lesson and the beginning of Lesson Two that describes how to save and load the worksheet.

A saved worksheet is called a file. The name that identifies a file is called a file name. Because a diskette can hold several worksheets, you must give each worksheet on the same diskette a different file name. This way, you can find the worksheet later and load it into the computer.

There are a few simple rules for creating a valid file name:

- It can be up to eight characters long
- The first character must be a letter
- Only letters and numbers can be used

When a file name is given, the TRS-80 Model II system will search for that file name beginning with drive 0 and continuing with drives 1, 2, 3 until it finds the file. If the storage diskette isn't in drive 0, you can add a *suffix* to the file name that specifies the the drive. The suffix consists of a colon (:) followed by the drive number. To specify a file named "budget" in drive 1, for example, you would type budget:1.

The VisiCalc program adds the suffix /VC to the file name of a worksheet you save with the Save option of the Storage command. This lets you later recognize the file as a VisiCalc worksheet.

To save the worksheet, open the door of the drive. If the VisiCalc program diskette is still in the drive, remove it and put it back in its paper sleeve. Insert an initialized storage diskette, gently push it all the way in, and close the door.

Now type **/S** (the VisiCalc Storage command). The prompt line reads:

```
Storage: L S D Q E #
```

The characters following Storage: are options:

L Load the worksheet contents from a diskette.

S Save the worksheet in a diskette file.

D Delete a file from a diskette.

Q Quit the VisiCalc program.

E Execute TRSDOS command.

Save or load a worksheet in the DIF format.

Type **S**. The prompt line reads Storage: File for Saving and the edit cue is on the edit line. The VisiCalc program is waiting for you to type the file name. Because this worksheet is an example, type **example [ENTER]**. As usual, you can correct typing errors with [BACKSPACE]. The disk drive begins whirring and the light comes on. After a moment the drive quiets down, the light goes off, and the prompt and edit lines clear. The worksheet is safely filed away on the storage diskette.

Protecting Your Work

Have you ever worked out a problem or made some notes to yourself on a sheet of paper, only to find later that you lost the sheet or that someone accidentally threw it away? Or perhaps you lost the results of some work you were doing on a calculator because power was turned off or the battery died. Things can and do go wrong.

As you begin to use the VisiCalc program, you'll find that at times the results you see on the screen are quite important to you. Losing the information could be a real nuisance and, at worst, something of a disaster. How can you protect yourself against such losses?

The VisiCalc program does its best to protect you. If you type the Clear command (/C), the VisiCalc program displays Clear: Type Y to confirm on the prompt line. It erases the worksheet only if you type Y at this point. If you type anything else, the Clear command is canceled and the worksheet is left unchanged.

Similarly, if you type /B to blank an entry, the prompt line displays Blank but the entry is not erased unless you type [ENTER] or one of the arrow keys. Any other key cancels the Blank command.

However, things beyond the VisiCalc program's control can go wrong. What if your building has a power failure? What if someone pulls the plug from the socket? What if you are called away from the computer and the janitor turns it off?

Saving the Worksheet

To protect yourself, you should periodically save the worksheet on diskette. As you work, think how long it has been since you last saved the worksheet. If you have spent more time than you would care to lose if something goes wrong, or if you have results which might be difficult to reconstruct, then it's time to save the worksheet.

To keep track of several versions of the same worksheet on diskette, you can add a sequence number to the file name. Thus, you might save successive versions of a worksheet with the file names budget1, budget2, budget3, etc. (Remember, the VisiCalc program adds /VC to the file name you type.)

Note: If you must remove a file from a diskette to make room for your worksheet, use the Delete option of the Storage command (/SD). See "Storage Command" in Chapter 3 for details on saving, loading, and deleting files.

Printing the worksheet is another security measure. You can print not only the worksheet, but also the formulas and formats behind it. See "Print Command" and "Storage Command" in Chapter 3 for descriptions of how to print the content and structure of the worksheet. With printed copies of the worksheet and its underlying formats and formulas, you can reconstruct the work without a disk file, if necessary.

Making Backup Copies

Although a diskette is a safe and reliable medium for storing information, saving your work periodically is only the first step in protecting yourself. A diskette can be scratched or pick up grease and dust. It can be damaged by heat, exposed to a magnetic field, accidentally reformatted (which erases it), and eventually it wears out. The average lifetime of a diskette is about 40 hours of use (whenever the disk drive light is on, the diskette is in use). For complete protection, you should make backup copies of your important files on separate diskettes.

Use the Storage command to make a backup copy of a file. Insert the diskette that contains the file you want to copy into drive 0 (or whatever drive you are currently using). Then use the Load option of the Storage command (/SL) to load the worksheet. Remove the diskette, insert an initialized diskette, and use the Save option of the Storage command (/SS) to save the same worksheet on the second (backup) diskette.

You can also copy an entire diskette. See the *TRS-80 Model II Owner's Manual* for instructions. Test your understanding of the procedures on a diskette you make expressly for experimentation. Until you thoroughly understand the procedures, don't risk a diskette with important data on it; you may lose valuable data while learning.

Making backup files is important. It's all too easy to read about these protective measures, use them once or twice, then when you're in a hurry skip the backup steps. Remember Murphy's Law: If anything can possibly go wrong, it will. Protect yourself. The time it takes to make backup files is amply repaid the first time you try to load a file, only to get a message telling you that an error occurred reading the disk.

Summary

This completes Lesson One. You may wish to experiment for a while, moving the cursor around and writing your own labels, numbers, and formulas. Try writing some formulas by pointing the cursor to specify the coordinates. The VisiCalc program has many more features not yet described, and you may stumble upon one of them. If something happens that you don't understand, make a note of it. When you're ready to continue with the next lesson, turn to Lesson Two. Most of your questions will be answered as you go.

You already know enough about the VisiCalc program to use it for some simple applications. Try it!

Lesson Two

Lesson Two

This lesson extends your knowledge of the capabilities of the VisiCalc program learned in Lesson One by applying them in more powerful ways and by learning some new commands. It begins with the example built up in Lesson One, calculating gross profit from sales and cost of goods sold.

If you have just finished Lesson One, everything you need should still be on the worksheet. Check the screen against the following photograph and continue with the heading "Replicating a Formula."

To practice loading the worksheet you saved in Lesson One, type **/CY** and continue with the heading "Loading the Worksheet."

If you're starting Lesson Two in a new session, the first step is to load the VisiCalc program. Follow the instructions under "Loading the VisiCalc Program" in Chapter 1, then continue with the heading "Loading the Worksheet."

If you didn't save the worksheet on diskette, type the following:

/CY
Sales ➡ 100 [ENTER]
>A2 [ENTER]
Cost ➡.6*B1 [ENTER]
>A3 [ENTER]
−Gross− ➡ +B1−B2 [ENTER]
>B1 [ENTER]

The screen should look like the next photograph. Continue with the heading "Replicating a Formula."

Loading the Worksheet

Remove the VisiCalc program diskette. Take out the storage diskette on which you saved the worksheet and put it in drive 0. Be sure the label on the diskette jacket is on the side of the diskette opposite the drive door. Gently push the diskette all the way in and close the drive door.

Type **/S** (the Storage command). The prompt line reads:

Storage: L S D Q E #

To review the meanings of the option characters, see "Saving the Worksheet on Diskette" at the end of Lesson One.

Type **L**. The prompt line reads:

Storage: File to Load

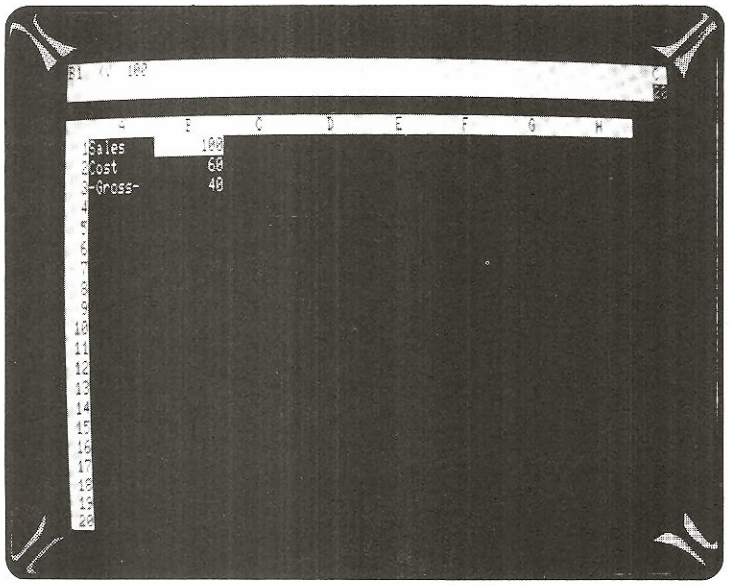
At this point you could type **example [ENTER]**, but there's another way: you can display the file names, one by one, from the storage diskette.

Type ➡. The disk drive whirs for a moment, the light comes on, and example/VC:0 appears on the edit line. (If a different name appears, type ➡ until you see example/VC:0. The VisiCalc program is reading the names of the files stored on the diskette.)

If you keep typing ➡, you eventually display each file name on the diskette. The prompt and edit lines clear, and the VisiCalc program waits for you to type another command.

This same procedure, pressing ➡ to display filenames, can be used with the save command. The edit line will list each file name on the disk, one at a time, allowing you to replace that existing worksheet with the one currently displayed. Pressing **[ENTER]** will select the filename currently on the edit line and save the worksheet with that name.

Assuming that example/VC:0 is on the edit line, type **[ENTER]**. The word Loading replaces File to Load on the prompt line, followed by a blinking asterisk (*), the VisiCalc program's way of telling you it is loading the file. When the file is loaded, the screen should look like the following photograph:



Replicating a Formula

The screen should look like the preceding photograph. The cursor should be at B1; if it's not, type >**B1** [**ENTER**]. If the number at B1 is not 100, type **100** [**ENTER**].

At present, the worksheet contains figures for sales, cost of goods, and gross profit for only one month. Now to project these figures for 12 months.

Begin by assuming that sales will increase by 10% each month. Type → **1.1*** ← [**ENTER**] to move the cursor to C1 and write the formula. The entry line reads:

C1 (V) 1.1*B1

The number under the cursor at C1 is 110 , which is 1.1*100.

To calculate sales for the remaining 10 months, you would have to move the cursor to D1 and type the formula 1.1*C1, move on to E1 and type 1.1*D1, and so forth. Since this is such a common operation and requires so many keystrokes, the VisiCalc program provides a shortcut.

That shortcut is the VisiCalc Replicate command. It copies—or *replicates*—formulas, labels, numbers, formats, etc., down columns or across rows. This lesson uses the Replicate command in some simple examples. This versatile command is explored more fully in Lessons Three, Four, and Five.

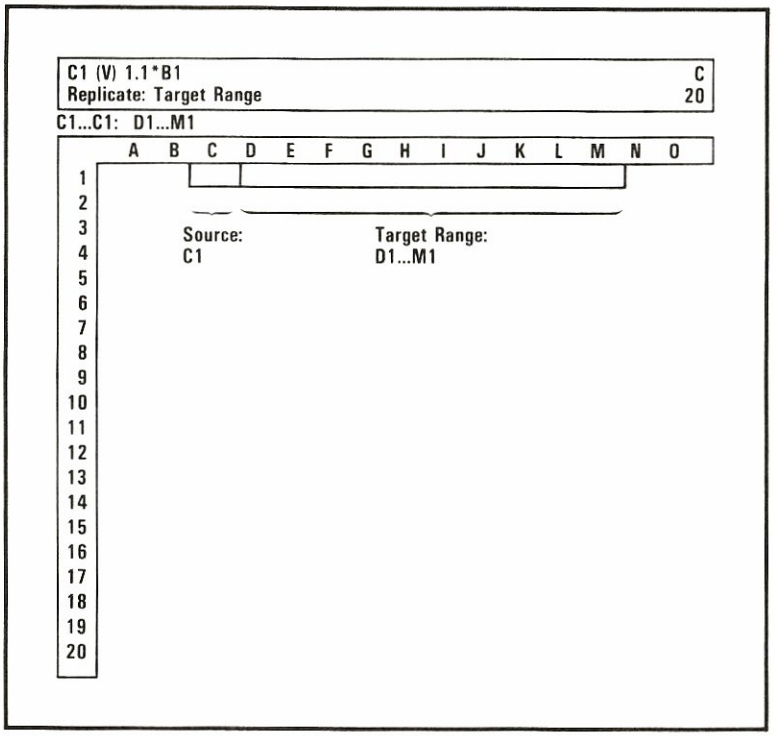
With the cursor at C1, type /**R** (the Replicate command). The prompt line reads:

Replicate: Source range or ENTER

The VisiCalc program is asking what you want to replicate; you can replicate either a single entry or a range of entries. The edit line shows C1, the coordinate of the formula on which the cursor rests, followed by the edit cue. The source range is only one location, so type [**ENTER**] to select C1 as the single location to be replicated. The edit line reads C1...C1: followed by the edit cue. You've told the VisiCalc program what to replicate (the formula at C1). Now the prompt line reads:

Replicate: Target range

The VisiCalc program needs to know *where* to replicate (the target range). Your intent is to project sales for 12 months. The first month is shown at B1, the second at C1, so the twelfth month is at M1. The formula should be replicated in the target range D1 to M1.



Type ➡ to move the cursor to D1. Now type a period (.) to tell the VisiCalc program that you have specified the beginning of the range. The VisiCalc program displays three periods following D1. The edit line reads:

C1...C1: D1...

You can define the end of the target range by moving the cursor. Type ➡ until the cursor rests on M1. As you move the cursor to D1, E1, F1, etc., the target range on the edit line expands accordingly:

D1...D1
D1...E1
D1...F1

and so on.

The VisiCalc program is filling in the final coordinate of the target range, just as it did when you moved the cursor while typing a formula. When the cursor is on M1 the edit line reads:

If you move too far with ➡, you can move back with ⬅. Now type [**ENTER**]. The cursor moves back to C1, where the original formula is written. The edit line reads:

C1: D1...M1: 1.1*B1

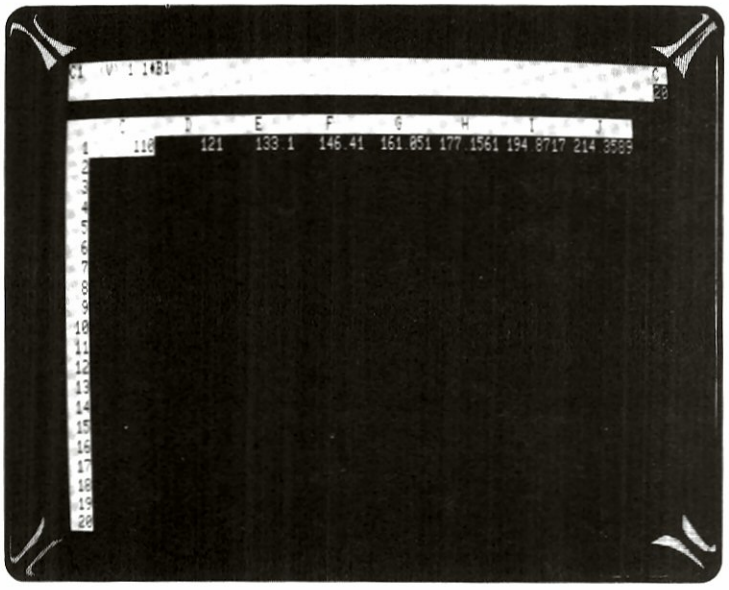
A white box highlights B1 followed by the edit cue. The prompt line reads:

Replicate: N = No Change, R = Relative

The VisiCalc program is asking whether you want the same formula, 1.1*B1, at each of the positions in the target range D1...M1, or whether the coordinate B1 should be interpreted as *relative* to the position of the formula.

Sales are to increase by 10% each month, so the formulas should be 1.1*B1, 1.1*C1, 1.1*D1, etc. In other words, the coordinate B1 should be relative to the location of each copy of the formula. That is, each new sales figure should be 1.1 times the previous month's sales.

Watch the screen as you type **R**. The prompt and edit lines clear and numbers appear. The screen should look like the following photograph:



Use ➡ to move the cursor to D1, E1, and F1, and watch the entry line:

1.1*C1
1.1*D1
1.1*E1

and so on.

Type ➡ to scroll from G1 through M1. The VisiCalc program has written the formulas for you and calculated the sales values for all 12 months. M1, the twelfth month's sales, should read 285.3117 (to four decimal places).

Other Replicate options are covered in succeeding lessons. For the moment, however, remember these easy steps for replicating a single coordinate:

1. Position the cursor at the location you want to replicate.
2. Type /**R** to start the Replicate command.
3. Type [**ENTER**] to define the source range as one coordinate.
4. Point the cursor at the first location where the formula is to be copied.
5. Type a period (.).
6. Point the the last location (you could also type the coordinates instead of pointing to them).
7. Type [**ENTER**].
8. In response to the prompts, type either **N** or **R** to specify whether the coordinate should be copied with no change or relative to the position of each copy.

Replicating a Range of Formulas

Type >A2 [**ENTER**] to jump back to the left edge of the worksheet and then press ➡ to move the cursor to B2. To complete the 12-month projection, you'll replicate the formulas for cost of goods sold and gross profit. At the moment, the entry line shows the formula for cost of goods. If you were to move the cursor to B3, you would see the formula for gross profit, +B1 – B2. You can replicate both these formulas simultaneously across the worksheet.

Type /**R**. The prompt line reads:

Replicate: Source range or ENTER

B2 is on the edit line, followed by the edit cue. If you were to type [ENTER] at this point, as you did before, you would replicate just the formula for cost of goods sold at B2. When you finished, you would have to come back to the formula for gross profit at B3 and replicate it into the same range of columns. You can accomplish both these steps at once. Type **.B3 [ENTER]**. The edit line now reads:

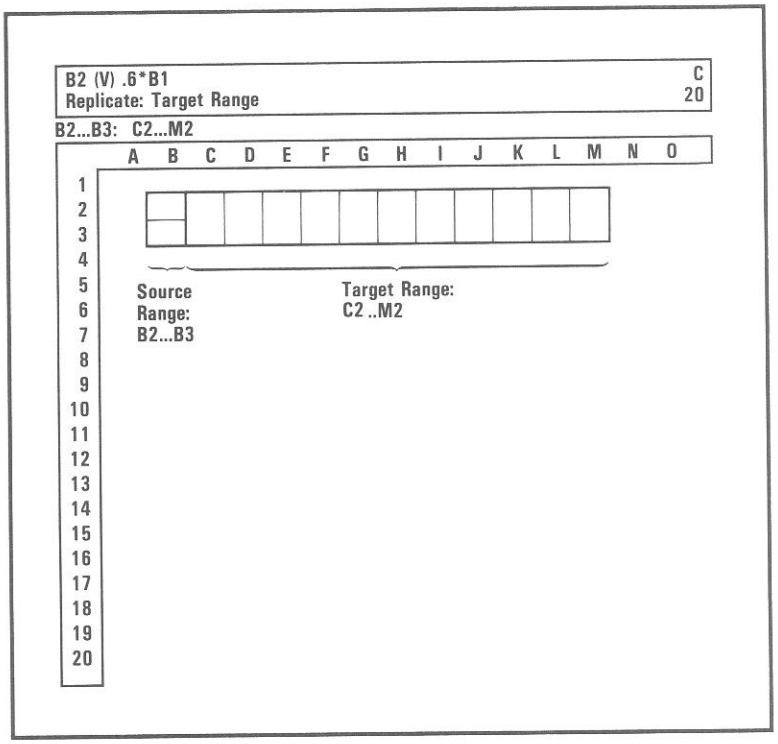
B2...B3:

The VisiCalc program acknowledges that you want to replicate a source range of two coordinates, B2 through B3, instead of just one. The prompt line reads:

Replicate: Target range

Instead of pointing at the first and last positions as you did before, type the coordinates of the target range:

C2.M2 [ENTER].



When you specify a source range of B2...B3 and a target range of C2...M2, the VisiCalc program assumes that the formula at B2 (cost of goods) is to be replicated at positions C2 through M2, and the formula at B3 (gross profit) is to be replicated at positions C3 through M3.

The prompt line now reads:

Replicate: N = No Change, R = Relative

The edit line reads:

B2: C2...M2: .6*B1

The white box is over the coordinate B1.

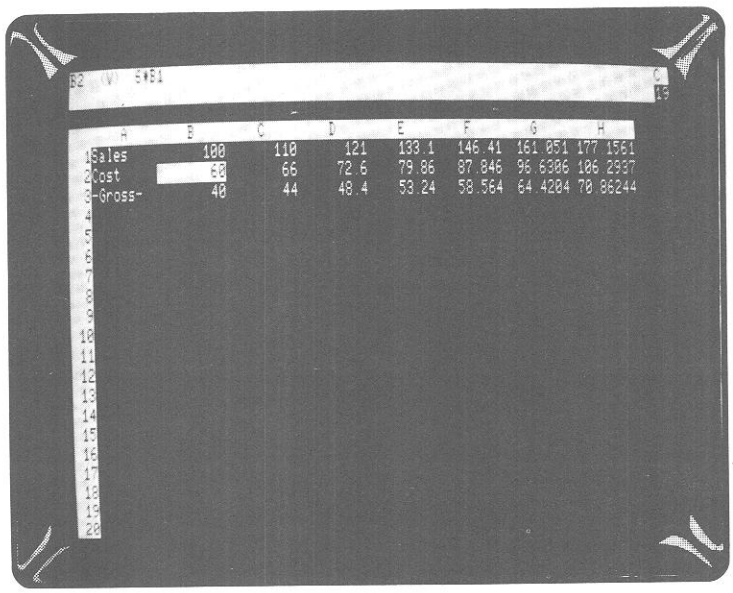
How should the formula at B2 be interpreted? The cost of goods sold in any given month should be 60% of that month's sales. The formula at B2 uses the sales figure above it, or B1. The formula at C2 uses the sales figure above it , or C1; and so on. Therefore, B1—the coordinate for Sales—should be *relative* to the position of each copy of the formula. Type **R**. Almost instantly, numbers appear in the other columns. The edit line now reads:

B3: C3...M3: +B1

The white box highlights B1. The VisiCalc program is ready to replicate the formula for gross profit at B3 into positions C3 through M3. +B1 is the beginning portion of the formula +B1−B2. Again, B1 should be relative to the position of each copy of the formula. Type **R** again.

Now the rest of the formula appears on the edit line: +B1 − B2. This time the white box highlights B2, which contains the formula for cost of goods; it, too, should be relative in the gross profit formula. Type **R** once more.

Numbers appear in the other columns of row 3, and the prompt and edit lines clear. The Replicate command has finished its work. The screen should look like the following photograph:



Scroll across row 3 to examine the formulas and results displayed in columns C, D, E, and so on. Finally, type >**M1 [ENTER]** to display the last month's sales, cost of goods, and gross profit in column M. The VisiCalc program has saved you a good deal of work already. But these numbers are somewhat hard to read because they fill the columns and don't always line up. This can be improved.

Formatting the Display

You can change the entire worksheet—a *global* change—so that it displays integers. Type /**GFI** (for Global Format Integer). Scroll the window to the left; all numbers on the worksheet have been rounded to integers and lined up on the right side of each column.

The VisiCalc program, however, does not actually round the numbers; it merely displays the rounded values. Each value is calculated and maintained with 11 (and sometimes 12) significant digits. Each new month's sales, therefore, is based on an accurate version of the previous month's sales, not on the rounded values as displayed. The numbers are rounded only for display, not calculation purposes.

Perhaps you'd prefer to see two decimal places (the VisiCalc program calls this *Dollars-and-cents* format). Type / (the keystroke that starts all commands). The prompt line reads:

Command: BCDEFGIMPRSTVW –

Each of the characters following Command: represents a different command. So far, you have used /B (Blank), /C (Clear), /R (Replicate), and /S (Storage). Now type G. The prompt line reads:

Global: C O R F

The Global command changes some aspect of the entire screen. You want to change the global format from Integer to Dollars-and-cents, so type **F** for Format. The prompt line reads:

Format: D G I L R $ *

The VisiCalc program is ready to change the format (the way labels and values are displayed and printed) over the entire worksheet. A moment ago, you used the letter I to display all numbers in the Integer format. This time, type $. The screen displays all values to two decimal places.

The Format option list (D G I L R $ *) offers various ways to format numbers and labels. You can set the format of an individual entry or the entire worksheet. These options are covered more fully in Lessons Three, Four, and Five.

Fixing Titles in Place

If the cursor is not on M1, type >**M1** [**ENTER**]. Only numbers are on the screen. The labels Sales, Cost, and – Gross – have scrolled off to the left.

What if you were preparing a more complex income projection, with many rows of numbers for selling and administrative costs, taxes, and other expenses? It would be difficult to remember what each row of figures represented once the labels scrolled off the screen. Here's a way to keep the left edge visible no matter how far you scroll to the right.

First, put the cursor back to the left edge, where the labels are. Type **>A1 [ENTER]**to bring Sales, Cost, and –Gross– into view. Now type **/T** (the Titles command). The prompt line reads Titles: H V B N. The characters following Titles: are options:

H Horizontal titles

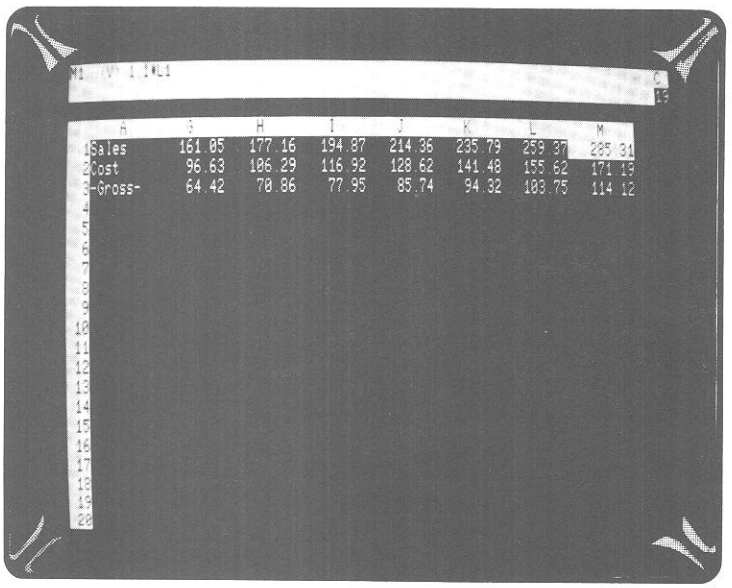
V Vertical titles

B Both horizontal and vertical titles

N No titles

Type **V** to tell the VisiCalc program to fix vertical titles (column A, where the cursor lies) as the left column of the screen. Watch the screen and type ➡ until the window scrolls. Column A stays fixed in place while the remaining columns scroll to the left, disappearing when they reach column A.

Now type ⬅ until you scroll back to the titles. If you aren't sure what happened, type ⬅ again. You are bumping into column A, just as you bumped into the left edge of the worksheet earlier. Next type **>M1 [ENTER]**. Column A is still visible, making it easy to identify each row of numbers. The screen should look like the following photograph:



A Quick Recalculation

So far, with the aid of the Replicate command, you have written one number (the beginning number for sales at B1) and 35 formulas on the electronic worksheet. How are these formulas related? Type **>B1 [ENTER]** to bring the first column into view with the cursor on the initial sales figure.

The formula for cost at B2 is .6*B1, which depends on the figures for sales at B1. The formula for gross profit at B3, in turn, depends on both sales and cost (+B1−B2). What about succeeding columns? At C1, the formula is 1.1*B1, so this entry also depends on the initial sales figure. Cost of goods at C2 depends on the figure at C1, while C3 depends on both C1 and C2. D1 reads 1.1*C1, and so on.

As you can see, a change to the initial sales figure at B1 affects every other number on the worksheet. Try it. Type a new number, such as **123.45 [ENTER]**. How long did it take to recalculate 12 months of sales, cost of goods, and gross profit formulas? Type **100 [ENTER]** and watch the changes ripple through the other figures on the screen. Scroll the screen window to the right to see M1, the last month's sales.

At this point, you might be wondering how to change the percentages themselves—sales growth figure of 10% or the cost of goods percentage of 60%—to recalculate gross profit. For simplicity's sake, the only changeable figure in this example is the initial value for sales. Because the figures 1.1 and .6 are built into each of the 12 formulas for sales and cost of goods, you can't change these percentages without replicating all the formulas again.

A more flexible approach would be to write the factors 1.1 and .6 into separate positions on the worksheet, and make the sales and cost of goods formulas refer to these positions. In this way, changing the sales growth and cost of goods percentages would be as easy as changing the initial sales. Lesson Three uses techniques like this in an example related to personal budgeting.

Changing the Column Width

For some time now, you've been scrolling the window back and forth to see the figures for different months. To eliminate some of this scrolling, you can make the columns smaller so that more columns fit on the screen. Type **>B1 [ENTER]** to return the cursor to B1.

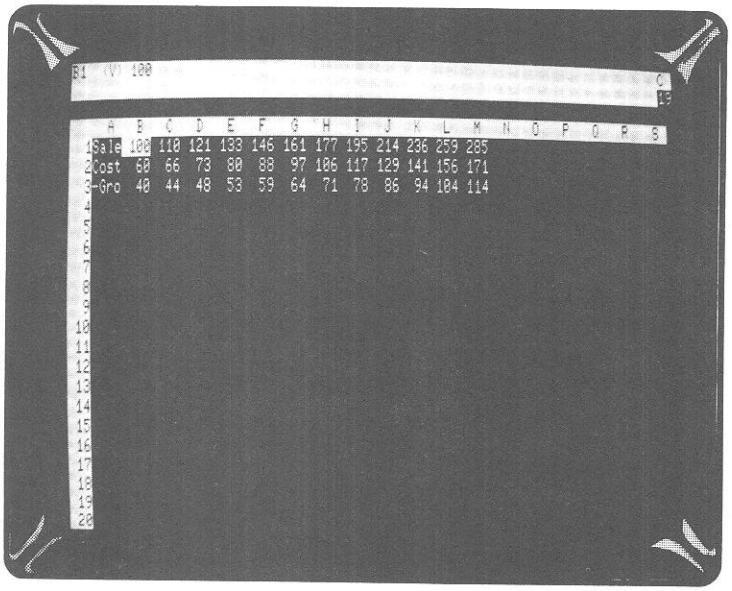
Type another Global command to change the column width to 7 characters: **/GC7 [ENTER]**. In an instant, the screen displays more columns. Each column has narrowed from nine characters to seven.

In general, you can use the Column Width option of the Global command (/GC) to set the column width to any value from 3 to the maximum number of characters that fit on the screen. Given a column width, the VisiCalc program fits as many columns as it can across the screen.

Right now, the numbers with two decimal places just about fill the available space in these 7-character columns. Type **/GFI** to round the displayed numbers to integers. With this extra space you can narrow the columns further. Type **/GC4**

[ENTER]. Even more columns of figures are on the screen; each is four characters wide and displays three digits.

The VisiCalc program leaves the first character of each location blank when a value is displayed to keep columns of numbers from running together. Labels do not have this extra space. The screen should look like the following photograph:



Look at the labels in column A. Sales has been shortened to Sale and – Gross – is now – Gro. Type >**A1 [ENTER]** (if you type ← to get to A1, you bump into column A, which you fixed as a title). Although the label at A1 is displayed as Sale, the entry line above reads:

A1 (L) Sales

Type ↓ twice to move to A3. The entry line displays the full label:

A3 (L) – Gross –

Just as the VisiCalc program retains the full precision of numbers when it displays rounded values, so does it retain the full length of a label when narrow columns require displaying a shortened version.

Labels aren't limited to the width of the column. You can type a label as long as 125 characters, regardless of the current column width; the VisiCalc program accepts the full label. With the cursor still at A3, type **Gross Profit [ENTER]**. Then type ↑ **Cost of Goods Sold [ENTER]** to move up to A2 and enter a more descriptive label. Finally, type **/GC12 [ENTER]**.

The label Gross Profit is displayed in full; the number of columns on the screen is reduced. Type **/GC18 [ENTER]**. Now the even longer label Cost of Goods Sold is displayed. Type **/GC9 [ENTER]** to return to the standard column width.

Note: The VisiCalc program makes all columns in a window the same width. You can only have different column widths on the screen if you split it into two windows (described later in this lesson).

To display a label longer than the current column width, but keep a narrow column width to display a large number of columns, enter the label in two or more columns. For example, to display the full label Cost of Goods Sold beginning in column A with a column width of nine, type the following:

Cost of G ➡ oods Sold [ENTER]

The label is displayed in A2 and B2. You can no longer use B2 for numbers or formulas.

The ability to fix titles in place and adjust column widths lets you take maximum advantage of the screen. But suppose you wanted to change the initial sales figure at B1 and watch what happens to the final sales and gross profit in column M at the same time.

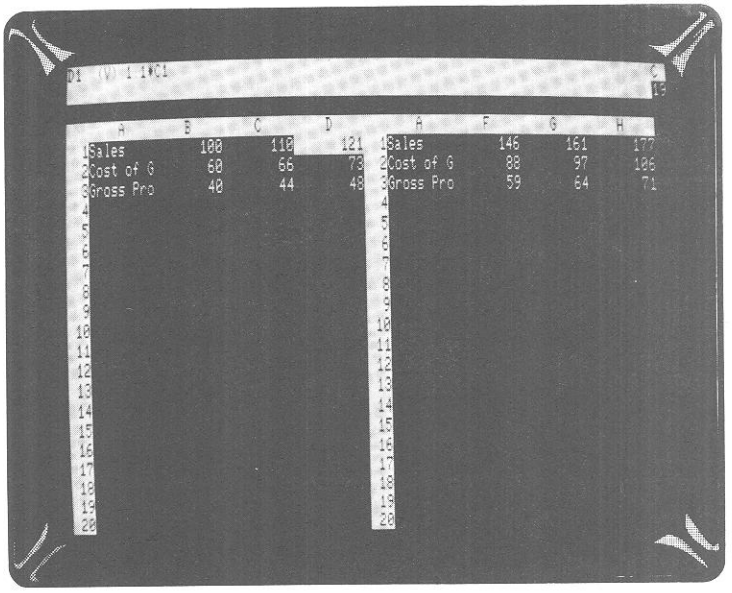
If only there were two screens . . .

Splitting the Screen

Type **>E1 [ENTER]** to move the cursor to column E, then /W (the Window command). The prompt line reads:

Window: H V 1 S U

Type **V** for Vertical. The screen should look like the following photograph:



You have created two windows, each of which can be scrolled independently to view any portion of the worksheet. The cursor is in the left window. Move the cursor down until the window scrolls down to follow it; the right window remains still. Bring the left window back to the top of the worksheet with **>B1 [ENTER]**.

Type a semicolon (;) to move the cursor into the right window. Scroll the right window across to column M. Now the beginning and ending months sales, cost of goods, and gross profit figures are visible at the same time.

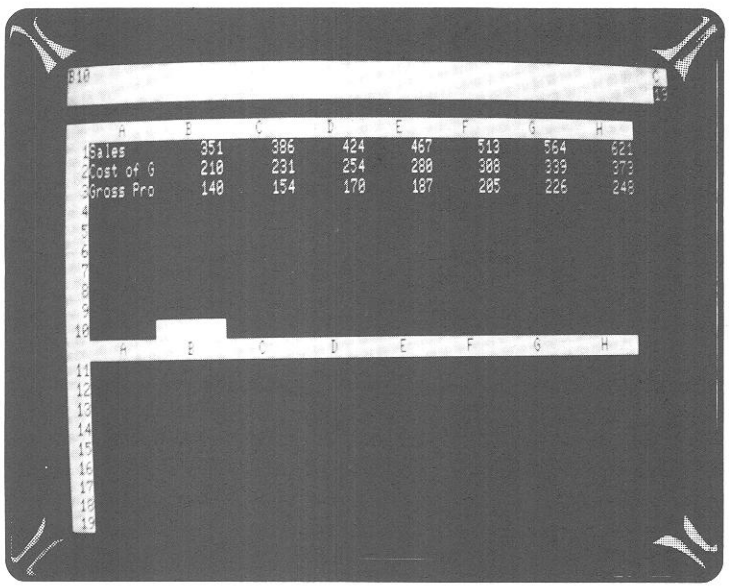
Type ; again. The cursor moves back to the left window. Each time you type ; the cursor moves to the other window. It moves to the same position it was on when it was last in the window.

Now you can change the initial sales figure and see what happens in the final month. With the cursor at B1 type **123 [ENTER]**. (While the VisiCalc program is recalculating, an exclamation point appears to the right of the C in the upper-right corner of the screen.) Sales in column M should be 351. Type a few more numbers with the cursor at B1.

See if you can find, by trial and error, the initial sales figure that yields twelfth month sales of 1000. Hint: You can type a number with a decimal point, even though it is displayed in rounded form.

When you finish experimenting with recalculation, type **/W1** for one window, the normal screen. Much of the screen is empty; perhaps you can use the lower part of the screen to better advantage.

Type **>B11 [ENTER]** to move the cursor down to the middle row of the screen, then **/WH** (for horizontal windows). The screen should look like the following photograph:



This time the screen is split horizontally into a top and bottom window. Type ; to move the cursor into the bottom window. Scroll the bottom window up until the cursor bumps into the top edge of the worksheet. Both windows now display the same portion of the worksheet.

The cursor should be at B1 in the bottom window; change the number there to **100**. The recalculation affects both windows. Scroll the bottom window to the right until column M comes into view. Now you can see the figures for the first and last month at the same time.

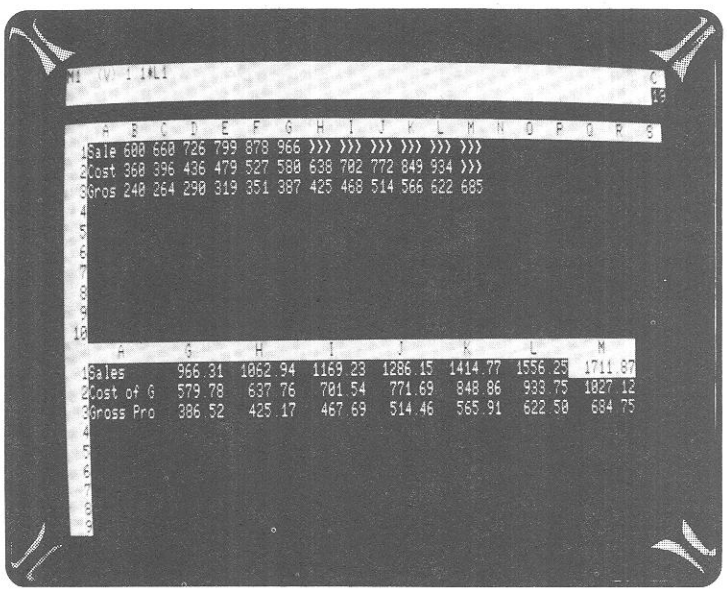
Global Commands in Separate Windows

The VisiCalc program allows different column widths in each window. Type ; to move the cursor into the top window, then **/GC4 [ENTER]** to change the upper window column width to four characters.

Note: The Column Width and Format options of the Global command (/GC and /GF) affect *only* the window in which the cursor rests at the time the command is typed.

You've just done a global column change. Now try a global format change. Type ; to move the cursor to the bottom window, then **/GF$**. Numbers are displayed to two decimal places (Dollars-and-cents format) in the bottom window and as integers in the top. Type ; to move the cursor into the top window, then **>B1 [ENTER]** to highlight the original sales figure. At B1, type **300 [ENTER]** and watch the changes ripple through the columns as the VisiCalc program recalculates all the formulas.

Now type **600 [ENTER]**. What happens? Columns H through M show >>> in some positions instead of numbers. The calculated results are too large to display in integer form in the narrow columns of the top window. The screen should look like the following photograph:



Memory and the Worksheet

The VisiCalc program expands the size and shape of the worksheet as you use it. It starts as a 1-by-1 worksheet, beginning and ending at position A1. Although you can move the cursor to any position up to BK254, no memory is taken up by the worksheet until you write something on it.

The worksheet grows into a rectangle just large enough to include the rightmost and bottommost positions in which something is written. If you type a label or formula at an entry location, the VisiCalc program uses enough memory for the position, but all other positions on the worksheet remain just large enough to hold the information you have written in them.

The VisiCalc program displays the amount of memory available in the right corner of the prompt line just below the C. This number is the amount of memory, in units of 1024 characters, available for additional entries on the worksheet. The number varies as you type labels or values or use commands (such as Replicate) to write on the worksheet.

As you write on the worksheet further down and to the right, more and more memory is used. If you finally exhaust all available memory, the VisiCalc program replaces the memory indicator with 0M and refuses to write anything more on the worksheet.

The memory indicator shown in the pictures in this manual will not always match up with what you see on your screen. This is because the TRS-80 Model II computers can be equipped with different amounts of memory. All of the examples in this book can be performed within the 64K minimum memory required by the VisiCalc program.

Shrinking the Sheet

The VisiCalc program does not automatically shrink the worksheet. Suppose you have written on various portions of the worksheet, causing it to grow to a 100-by-63 rectangle, then erase or blank out the entry positions near the right and bottom edges. The worksheet remains a 100-by-63 rectangle, with each empty position requiring 2 characters of memory. If you begin using additional memory by writing labels and formulas in other positions, you may run out of memory even though much of the worksheet is empty.

To shrink the worksheet, you must save it on diskette (or hard disk) with the Save option of the Storage command (/SS), clear it with the Clear command (/CY), and reload it with the Load option of the Storage command (/SL). As the VisiCalc program reloads the worksheet, it enters only those labels, numbers, and formulas actually saved. The worksheet grows from a 1-by-1 rectangle to just the size needed for the information saved. All unused memory is available for more labels and formulas.

Summary

You have covered a lot of ground in this lesson. Review any difficult points and try your own experiments. The more you work with the VisiCalc program, observing and analyzing the results, the more quickly you will master it for your own work. Just remember the following key points:

- No matter what you type at the keyboard, you cannot hurt either the computer or the VisiCalc program. Moreover, it's fairly difficult to destroy the contents of the worksheet, particularly if you watch the prompt line for keystroke-by-keystroke feedback and save the worksheet periodically on diskette.

- This lesson introduced four new commands:

  —Replicate (/R), to copy labels, numbers, and formats.

  —Global (/G), to change the column width (/GC) and the way numbers are formatted (/GF).

  —Titles (/T), to fix rows or columns of titles in place as part of the top or left border.

  —Window (/W), to split the screen, either horizontally or vertically, into two independently scrollable, formattable windows.

- Aside from the Replicate command, which saves you time as you write on the worksheet, all the commands described in this lesson affect only the *appearance* of the worksheet (generally in an effort to take greatest advantage of the screen). Nothing you might do with the Global, Titles, or Window commands can affect the labels, numbers, or formulas actually written on the worksheet. When in doubt, you can always type **/W1/TN/GFG/GC9 [ENTER]** to return everything to normal.

Armed with what you have learned up to this point, you should be ready to experiment. Clear the screen and try out these commands with a problem of your own. If you don't understand something, go back through this lesson to see what you might have missed. For more details, check the command descriptions in Chapter 3 or the *VisiCalc Pocket Reference*. Once you understand the fundamentals of this lesson, you'll know enough about the VisiCalc program to use it effectively.

Lesson Three

Lesson Three

In Lessons One and Two, several examples illustrated both the simplicity and the power of the VisiCalc program. Lesson Three expands on the use of previously learned commands, bringing them into more powerful combinations, and introduces several new commands.

The worksheet is set up as a personal budget to present this. Work through the examples, and don't hesitate to experiment. Your skill in using the VisiCalc program grows proportionally with the time you spend practicing with it.

Begin with a clean slate. Load the VisiCalc program as described in "Loading the VisiCalc Program" in Chapter 1 or, if the program is running, clear the worksheet by typing **/CY**.

To prepare a budget you first project income for the next 12 months. You'll also project necessary expenses such as food, rent or mortgage, telephone, etc., as well as less frequent expenses such as car insurance. Then you'll use the VisiCalc program to find out how much income is left for leisure and savings and what percentage of the income is going to each category of expense. Finally, various enhancements such as calculating the interest on a savings account are presented.

Setting Up the Budget Example

Begin by laying out 12 periods (months) across the worksheet. With the cursor at A1, type **Period** ➡ to label row 1 and move to position B1. You can number the 12 periods either by typing the numbers 1 through 12 at B1 through M1, or typing 1 at B1 and replicating it with a formula that adds 1 to each previous number.

To speed setting up the worksheet, use the second method. As the earlier example showed, if a label at A1 is followed by 12 periods, the twelfth period is at M1. With the cursor at B1, type **1** (The first month), then ➡. The formula, which adds one to each previous number, goes at C1; type **1+B1 [ENTER]**. The entry line reads:

```
C1 (V) 1 + B1
```

Coordinate C1, highlighted by the cursor, reads 2, the result of that formula.

Replicate this formula at D1 through M1. Type **/R [ENTER]**. The prompt line reads:

```
Replicate: Target range
```

The edit line reads:

```
C1...C1:
```

Type **D1.M1**; D1 is the beginning of the target range, the period tells the VisiCalc program that we're ready to type the end of the target range, and M1 is the end of the target range. (You could also type D1, a period, ➡ 12 times, and [ENTER].) The edit line reads:

C1...C1: D1...M1

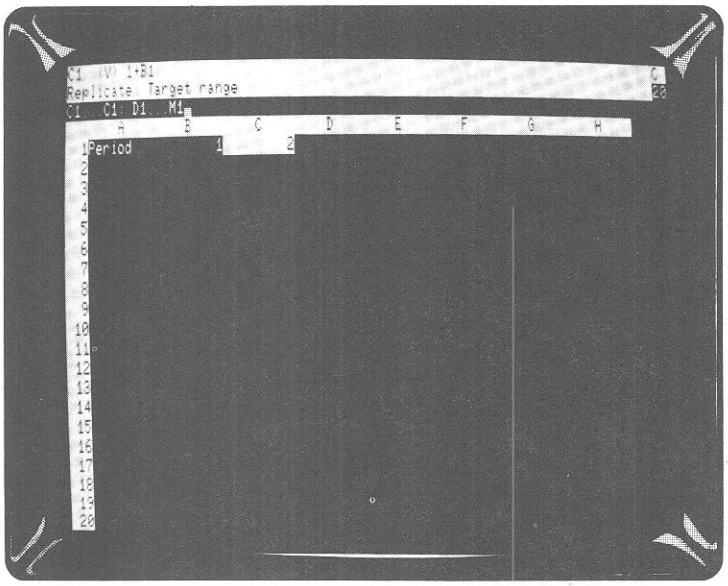
Now type **[ENTER]**. The prompt line reads:

Replicate: N = No Change, R = Relative

The edit line reads:

C1: D1...M1: 1 + B1

The white box is on B1. The screen should look like the following photograph:



Type **R** to make the coordinate relative. This produces 1+C1, 1+D1, etc., in the succeeding locations of the target range. (If you typed N—making the coordinate absolute—the formula at each location would be 1+B2.) The prompt and edit lines clear. Move the cursor to column M to check your work. Position M1 should read 12.

Replicating Numbers and Labels

To start filling in the budget worksheet, type **>A2 [ENTER] Income ➡ 1800 [ENTER]**.

$1800 is the monthly take-home pay after taxes and other deductions. You could write 1800 in each month. Can you replicate a single number as well as a formula?

Of course. A number is actually the simplest case of a formula. With the cursor at B2 type **/R [ENTER]**. For the target range, type **C2.M2 [ENTER]**. The VisiCalc program doesn't ask whether the new formula is relative or not, because 1800 has no coordinates. All 12 columns—positions B2 through M2—read 1800.

Next you'll draw a line across the worksheet. Type **>A3 [ENTER]** to move the cursor, then /—. The prompt line reads:

Label: Repeating

and the edit cue is on the edit line. Whatever character or characters you type next are repeated to fill entry position A3.

Type **— [ENTER]**. You should now have a line of nine hyphens at A3. Is this any different from typing the hyphens manually? Yes. Type **/GC12 [ENTER]**. As you can see, a repeating label expands to fill a column regardless of its width. Go back to normal column width by typing **/GC9 [ENTER]**.

How can you easily extend the line across all 12 columns? The ever-useful Replicate command also replicates labels. Type **/R [ENTER]**. For the target range, type **B3.M3 [ENTER]**. It's that simple. You now have a line of hyphens extending from column A to column M. This line is unbroken regardless of the column width.

Using Formulas for Flexibility

Before going further, think about what you've done. To save the trouble of typing 1800 for each period, you replicated it. That was fast, but is it the best way to handle income? It would be better if the income figure for all 12 months could be changed just by typing a new figure for the first month and letting the VisiCalc program recalculate the rest. You can set up the worksheet to do this by replicating a formula instead of a number. Type the following:

>C2 [ENTER]
+B2 [ENTER]

The second month's income is now defined as the income for the first month. Let's replicate this formula. Type **/R [ENTER]** and give the target range as **D2.M2 [ENTER]**. The prompt line reads:

Replicate: N = No Change, R = Relative

Should the same formula (+B2) be in all the remaining locations, or should the formula be relative (+B2, +C2, +D2, etc.)? Either way, the income for all 12 months could be changed simply by typing the new number at B2. But what if the salary increases in the sixth month? If every formula is +B2, the only way to change the value is to change the first month (B2). If the sixth month is changed, only that value changes; the remaining months still have the same value as B2.

On the other hand, if each formula refers to the previous month, when a new number is typed in month 6 the VisiCalc program propagates the change in months 7 through 12. Try it. Type **R** to make coordinate B2 relative. When the Replicate command has finished, use ➡ to move to month 6 (position G2) and type **2000 [ENTER]** to represent a raise at month 6.

Type ➡ a few more times to verify that each succeeding month's income has changed to 2000. Now G2 reads 2000 instead of +F2. H2 reads +G2, so its value is the same as G2 (2000). Likewise, I2 reads +H2, so the value at H2 (2000) is replicated into I2, and so on through M2. If you aren't sure of what you have just done, move the cursor over all 12 income figures and imagine what would happen if all the formulas were +B2.

To emphasize the difference between absolute (No change) and relative coordinates, type the following:

>C2 [ENTER]
+B2 [ENTER]
/R [ENTER]
D2.M2 [ENTER]

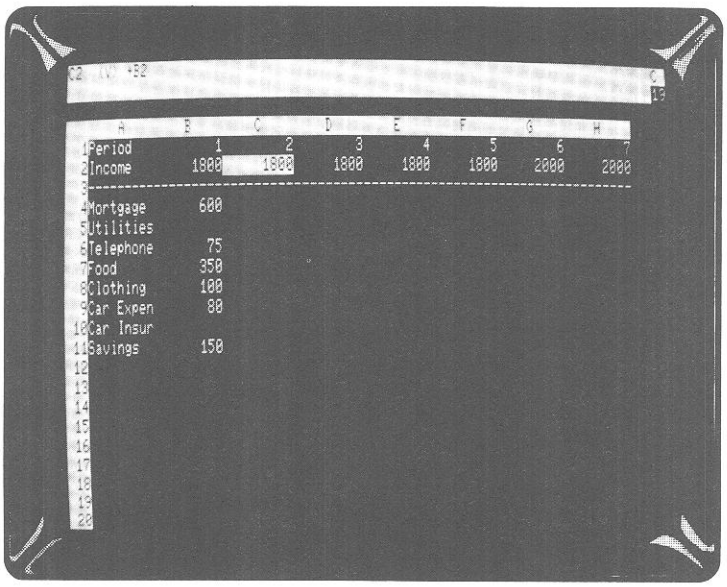
This time type **N** to make B2 absolute instead of relative. Examine C2 through M2 and compare them with the results you got using the relative formula. Repeat the process and make the coordinate relative. Be sure to write 2000 in month 6 (type **>G2 [ENTER] 2000 [ENTER]**) to enter the raise.

The next task is to list expense categories and estimate monthly amounts for each category. Some expenses vary from month to month, and other expenses occur perhaps only every six months. Leave them blank for the moment.

Enter all the labels first and then the values for each label. This is a much quicker way to write lists of labels and values than writing each label and its respective value before going on the the next label and value. Type the following:

>A4 [ENTER]
Mortgage ⬇
Utilities ⬇
Telephone ⬇
Food ⬇
Clothing ⬇
Car Expense ⬇
Car Insurance ⬇
Savings ⬇
> B4 [ENTER]
600 ⬇ ⬇
75 ⬇
350 ⬇
100 ⬇
80 ⬇ ⬇
150 [ENTER]
>C2 [ENTER]

The screen should look like the following photograph:



Next you'll replicate the monthly expense figures in column B across the remaining 11 months. Remember the discussion about the merits of replicating a formula, rather than a number, for monthly income. For flexibility, the formulas for monthly expenses should also be relative. C4 should contain the formula +B4; C6 should contain the formula +B6; C7 should contain +B7; and so on. You'll write figures for utilities and car insurance later.

These formulas are so similar to each other and to the income formula, +B2, that it's tempting to look for a shortcut way of writing them. Once again, the Replicate command comes to your aid. This time, you'll replicate a formula down a column instead of across a row.

Replicating Down a Column

The entry line reads C2 (V) +B2. Just as you copied B2 to C2, now you want to copy B4 to C4, B5 to C5, and so on. B2, therefore, should be relative. Type /**R** [**ENTER**]. The prompt line reads:

Replicate: Target range

The edit line reads:

C2...C2:

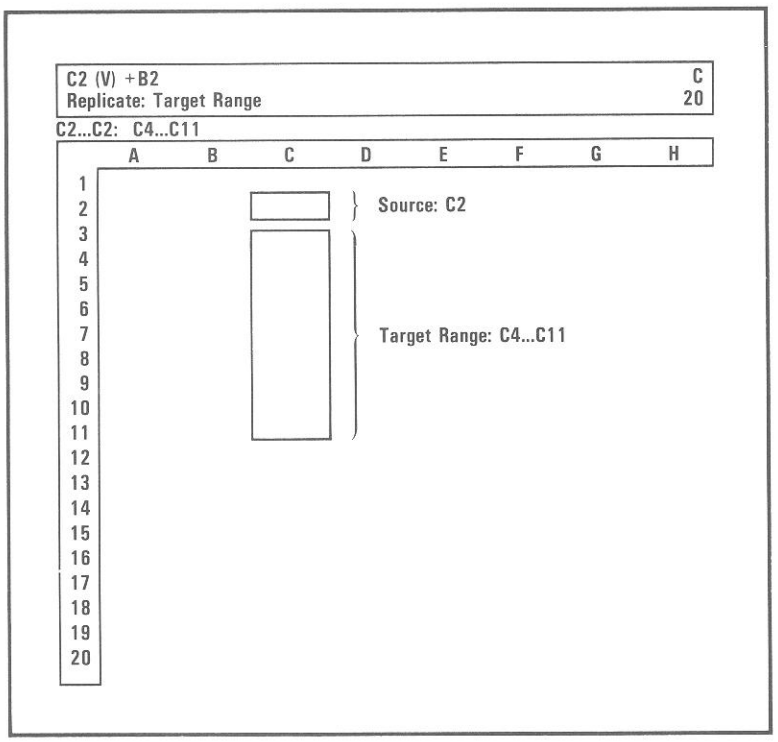
followed by the edit cue. Type ↓ twice to move the cursor down to the first coordinate in the target range.

Now the edit line reads:

C2...C2: C4

Type a period. The cursor jumps back to C2, and the edit line acknowledges that the target range starts at C4. Next type ↓ nine times to point to C11 (next to the figure for savings). The edit line now reads:

C2...C2: C4...C11



Type [**ENTER**]. The formula at C2 is to be replicated across the target range of C4 through C11. The cursor jumps back to C2, and the prompt line reads:

Replicate: N = No Change, R = Relative

The edit line reads:

C2: C4...C11: +B2

The white box is over B2. This coordinate should be relative, so type **R**. A column of numbers, from 600 to 150, appears in column C.

Move the cursor down, looking at the formulas you replicated. You have what you need: C4 reads +B4, C6 reads +B6, and so on. You also have formulas at C5 and C10, but they can be cleared with the Blank command. Type the following:

>C5 [ENTER]
/B [ENTER]
>C10 [ENTER]
/B [ENTER]
>C4 [ENTER]

Replicating a Column Several Times

The worksheet now contains a formula for each expense category. The next step is to replicate these formulas across the rows through month 12. Think back to Lesson Two. Remember how you replicated a source range of formulas across the rows for both cost of goods sold and gross profit? You can do the same thing here.

Type **/R**. The prompt line reads:

Replicate: Source range or ENTER

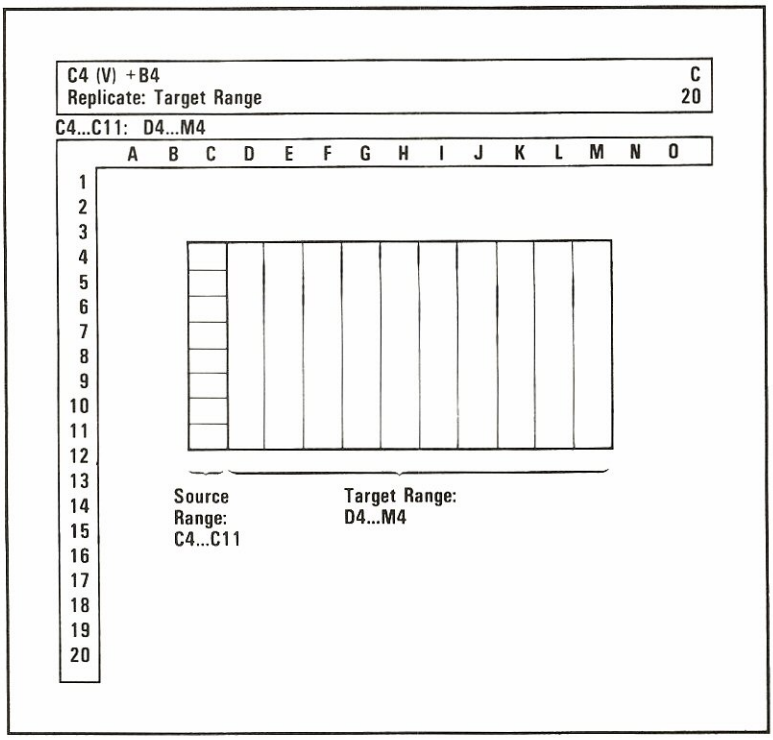
The edit line reads:

C4

followed by the edit cue. This time the source range is an actual range, C4 through C11. Point to each coordinate in that range by typing ↓ seven times to move the cursor down to C11. When it reaches C11, the edit line reads:

C4...C11

Now type **[ENTER]**. The cursor jumps back to C4 and the prompt line asks for a target range. Type **D4.M4 [ENTER]** to tell the VisiCalc program to copy the formula at C4 into positions D4 through M4, the formula at C5 into positions D5 through M5, the formula at C6 into positions D6 through M6, and so on until the formula at C11 is copied into D11 through M11.



The prompt line reads:

Replicate: N = No Change, R = Relative

The edit line reads:

C4: D4...M4: +B4

The white box highlights B4. This is the formula for the first expense, mortgage. Like B2 (income), B4 should be relative, so type **R**. The VisiCalc program replicates the formulas +B4, +C4, +D4, etc., in row 4. It also replicates the blank entry at B5 into C5, D5, E5, etc.

The edit line reads:

C4: D4...M4: +B4

The white box highlights B4. This is the formula for the first expense, mortgage. Like B2 (income), B4 should be relative, so type **R**. The VisiCalc program replicates the formulas +B4, +C4, +D4, etc., in row 4. It also replicates the blank entry at B5 into C5, D5, E5, etc.

When it replicates a formula, the VisiCalc program asks you to specify N (No change) or R (Relative) for each reference to another location. If you replicate a range of formulas, it asks for each reference in each formula. It starts here by asking you to specify N or R for the formula +B6 on row 6.

Each of these formulas should be relative, too. Type **R** five more times. With relatively few keystrokes and the assistance of the Replicate command, you have written 80 numbers and formulas on the worksheet.

Think about how you replicated the expense formulas. Starting with the original formula +B2 at position C2, you created six copies of it by replicating down a column: +B4 at C4, +B6 at C6, etc. Then you used these formulas as the source range to replicate similar columns of formulas across rows 4 through 11.

Each of the resulting monthly expenses can be changed for all 12 months simply by typing a new number for the first month. For example, type **>B8 [ENTER] 120 [ENTER]**. The clothing budget increases to 120 for all 12 months.

To complete the projection of expenses, fill in figures for those expenses that cannot be replicated because they vary from month to month. The utilities bill varies with the season. Car insurance premiums are due every six months, in month 1 and month 7. Type the following:

>B5 [ENTER]
140 ➡ 140 ➡ 80 ➡ 80 ➡ 40 ➡ 40 ➡ 85 ➡
85 ➡ 50 ➡ 50 ➡ 100 ➡ 140 ➡
>B10 [ENTER]
160 ➡
>H10 [ENTER]
160 ➡

You don't have to type zeros for the other 10 months for car insurance, because the VisiCalc program treats any blank entry as zero. In fact, any entry that doesn't contain a number or formula has a value of zero if it is referenced in a formula.

Now is a good time to save your work on diskette. Remove the VisiCalc program diskette and replace it in the pocket on the inside front cover of this manual. Put in an initialized storage diskette. Be sure the label side is to the right and that the oval cutout enters the drive first. Close the drive door and type /**SS** (the Save option of the Storage command) then **budg1 [ENTER]** (the file name for the worksheet). When the file is saved, the prompt and edit lines clear.

You should also make a backup copy of this file. Remove the diskette on which you just saved "budg1/VC," ("/VC" was added to your filename by the program to identify the file as a VisiCalc worksheet) and insert another initialized diskette. (You might label it "BACKUP1" and use it only for saving backup files.) Close the drive door and type /**ssbudg1 [ENTER]**.

Fixing Titles in Both Directions

Again, the titles (Income, Mortgage, etc.) disappear when you scroll horizontally to look at later months. To solve this problem, you can create a border of titles along both the left and top edges of the worksheet. These titles stay in place no matter where the window is scrolled.

Type **>A3 [ENTER]** to move the cursor, then **/T** (the Titles command). The prompt line reads:

Titles: H V B N

(The H, V, B, and N options are described under "Fixing Titles in Place" in Lesson Two and "Titles Command" in Chapter 3.)

Type **B** to fix titles in both directions.

The position of the cursor has a dual significance to the Titles command. If you fix titles vertically, the VisiCalc program fixes the column in which the cursor rests and all columns to the left of the cursor. If you fix titles horizontally, the VisiCalc program fixes the row in which the cursor rests and all rows above the cursor.

If you fix titles in both directions, the VisiCalc program fixes the column in which the cursor rests and all columns to the left of the cursor, plus the row in which the cursor rests and all rows above the cursor.

The screen now has a border consisting of column A along the left edge, and another border consisting of rows 1, 2, and 3 along the top edge. To check this, move the cursor down until the window scrolls. Rows 1, 2, and 3 remain in place. Now type **>B4 [ENTER]** and scroll horizontally. Column A remains in place.

Only the period and income figures in rows 1 and 2 seem to change, because the other numbers are the same from column to column. Continue scrolling until column O is at the right side of the window. Columns N and O will be used to calculate totals and percentages for income and expenses.

The @SUM Function

Type the following:

>N1 [ENTER]
Total ↓

The cursor is at N2. How can you calculate the total income for 12 months? You could type +B2+C2+D2+E2+F2+G2+H2+I2+J2+K2+L2+M2, but there's a simpler way. Type **@sum(**. The prompt line reads:

Value

The edit line reads:

@SUM(

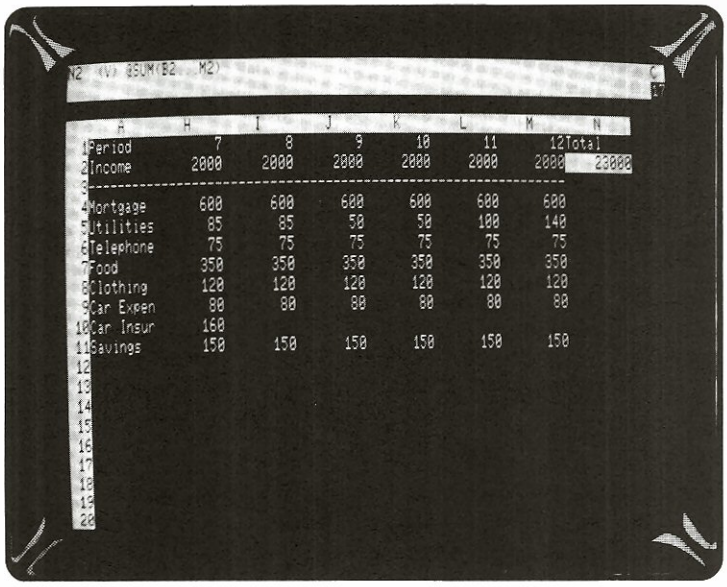
To specify the numbers to sum, scroll to the left border. The cursor is at B2 and the edit line reads @SUM(B2. Now type . (a period). The cursor moves back to N2 and the edit line reads:

@SUM(B2...

You are specifying a range of entries, just as you did for the Replicate command. To finish the range, type ←) **[ENTER]**. The entry line now reads:

N2 (V) @SUM(B2...M2)

N2 reads 23000, the total income for the year.



The @ begins the name of a VisiCalc *function*. When you type @ to start an entry, the VisiCalc program immediately knows two things:

- The entry is going to be a Value.
- The next few letters must be the name of a function.

Each function, such as @SUM, performs a calculation on the value or list of values specified with it and produces a numeric result. Functions perform arithmetic calculations more complex than simple addition or multiplication, such as average of a range, minimum or maximum of a range, and trigonometric functions. See "Functions" in Chapter 3 and the *VisiCalc Pocket Reference* for a complete description of all the functions.

The VisiCalc functions accept one of the following types of arguments:

- A coordinate or range of coordinates, such as @SUM(B2...M2).
- A list of specific coordinates, such as @SUM(B2,C3,D8).
- A list of ranges, coordinates, numbers, or formulas, such as @SUM(B2...B7,C3...C6,25,D8,4*C8).

You can use a function anywhere you can use a number.

Now to calculate totals for each expense category. With the cursor at N2 type **/R [ENTER]**. To specify the target range, type **N4.N11 [ENTER]**. The prompt line reads:

Replicate: N = No Change, R = Relative

The edit line reads:

N2: N4...N11: @SUM(B2

The white box highlights B2.

Consider what happens if you make B2...M2 relative. Because you are replicating down a column, the copies of the formula will be in positions N4, N5, N6, etc. The value at N4 should be the sum of B4...M4, the value at N5 should be the sum of B5...M5, and so on. The reference to B2, therefore, should be relative, so type **R** twice (for B2 and M2). The expense totals, from 7200 to 1800, appear in column N.

To calculate the percentage of income represented by each expense total, type the following:

>O1 [ENTER]
Percent ↓ ↓ ↓

The formula for calculating the percentage of income represented by the mortgage payment divides total mortgage payments by total income. The VisiCalc program already has those totals—mortgage at N4 and income at N2. To find the percentage, all you need do is divide N4 by N2. Type **+N4/N2 [ENTER]**. O4 reads .3130435, or slightly more than 31%.

Formatting a Single Entry

The VisiCalc program's General format displays numbers to the maximum number of significant digits permitted by the current column width, unless you specify a different display format. For percentages, two decimal places are enough. The Dollars-and-cents format displays values to two decimal places.

Type /**GF$** (specifying the Dollars-and-cents format as global). The mortgage percentage at position O4 now reads 0.31. All other numbers are also displayed to two decimal places. Even the month number at M12 reads 12.00; not quite what you want. Change the global format back to general by typing /**GFG**.

Just the number at O4 should be displayed with two decimal places. With the cursor at O4, type /**F$**. By using the Format command to assign a local format (instead of the Format option of the Global command, which assigns a format to the entire worksheet), just the entry at the cursor location is formatted.

Now that the percentage reads 0.31, look at the label Total at the top of column N. It's hard to read because it's too close to the 12 in column M, and it doesn't line up with the numbers below it.

The VisiCalc General format—which currently applies to all entries not individually formatted—starts a label at the left side of its entry position, and lines up the last digit of a number with the right side of its entry position. Type >**N1** [**ENTER**] to move the cursor to the label Total, then /**F** (the Format command). The prompt line reads:

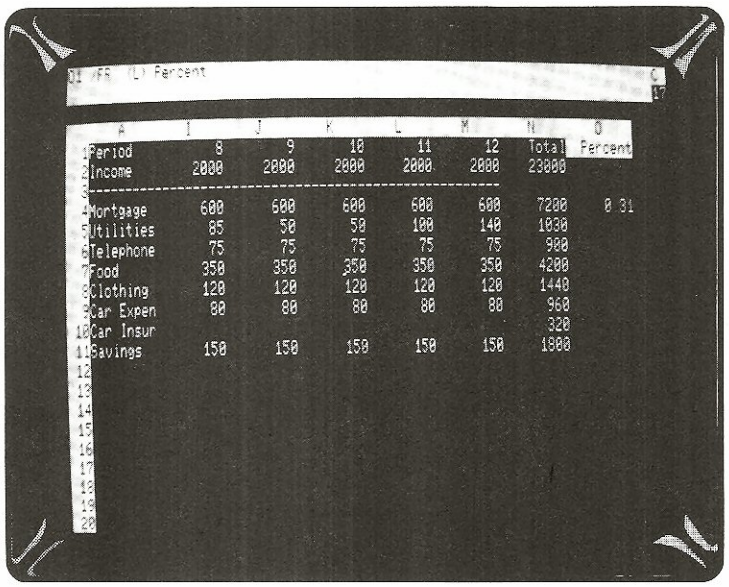
```
Format: D G I L R $ *
```

The characters following Format: are Format command options:

- D — Default. Reverts to the global format. If a global format is not specified, reverts to the General format.
- G — General. Displays a number to maximum precision.
- I — Integer. Displays a number as an integer, rounding if necessary.
- L — Left-aligned. Lines up the first letter or digit of the entry at the left edge of the entry position.
- R — Right-aligned. Lines up the last letter or digit of the entry at the right end of the position.
- $ — Dollars-and-cents. Displays two decimal places.
- * — Graph. Displays asterisks to build bar graphs.

For more details plus examples of the Format command, see "More on Numbers and Formats" and "Transcendental Functions and Graphing" in Lesson Five, "Format Command" in Chapter 3, and the *VisiCalc Pocket Reference*.

To improve this format, type **R**. Now Total is lined up with the column of numbers below it. Type ➡ to move the cursor to O1, then **/FR** to line up Percent with the right edge of its entry location. The screen should look like the following photograph:



Replicating a Format Specification

Now that you have a formula for describing an expense as a percentage of income (+N4/N2), you can replicate it down column O for the other expenses. Type **>O4 [ENTER]** to move to the formula for mortgage expense as a percentage of income. Now type **/R [ENTER]** (the Replicate command), then **O5.O11 [ENTER]** as the target range. The edit line reads:

O4: O5...O11: +N4

The white box highlights +N4. The prompt line reads:

Replicate: N = No Change, R = Relative

How should the reference in this formula (+N4/N2) be replicated? At O5, utilities should be divided by income +N5/N2. The first coordinate should change, but the second (N2, or income) should not. The VisiCalc program asks you to specify whether each reference in a replicated formula should be relative or absolute.

Type **R** to make N4 relative. The edit cue moves to N2 on the edit line. Type **N** for No change. It takes the VisiCalc program only a moment to display all the expense percentages, from 0.31 for mortgage to 0.08 for savings. All percentages are displayed to two decimal places.

Type ↓ a few times, watching the entry line. At O5, it reads:

```
O5 /F$ (V) +N5/N2
```

The format specification (/F$) has been replicated along with the formula. In fact, it's possible to replicate a format specification even if the entry being replicated is blank. This technique will be used later.

Using Replicate to Copy a Row or Column

To separate different areas of the worksheet, you can draw a line under the list of expenses. You already know one relatively easy way to draw a line of hyphens, by typing /– (the Repeating Label command) at A12 and replicating the hyphens across. Now to use the Replicate command a little differently.

Type **>A12 [ENTER] /R**. The prompt line reads:

```
Replicate: Source range or ENTER
```

The edit line reads:

```
A12
```

followed by the edit cue. Type **[BACKSPACE]**. A12 disappears from the edit line, leaving only the edit cue. Now type a new source range: **A3.M3 [ENTER]**. As usual, the prompt line reads:

```
Replicate: Target range
```

Type **A12.A12**.

The source range (A3...M3) is the line of hyphens on the worksheet. You're telling the VisiCalc program to replicate A3 into A12, B3 into B12, and so on. Type **[ENTER]**. There's the line. It would be sufficient to type A12 [ENTER] for the target range; the VisiCalc program takes this to mean A12...A12.

Finally, add an entry for leisure. The money available for leisure is simply income minus the sum of expenses. Type the following:

>A13 [ENTER]
Leisure ➡ +B2–@SUM(B4.B11) [ENTER]

B13 displays the result of the formula for leisure, 125. Replicate this formula across row 13 to get the leisure money for each month. Type **/R [ENTER] C13.M13 [ENTER]**, then type **R** three times to make the references relative. Scroll the window to the right and look at the results.

The leisure money starts at 125 the first month and increases fairly steadily thereafter. There is no car insurance premium after the first month, and the utilities bill goes down in months 3, 4, and 5. In month 6 there is a salary increase, which increases the figures for both income and leisure.

Continue scrolling until columns M, N, and O are on the screen, showing Total and Percent, then place the cursor at N13.

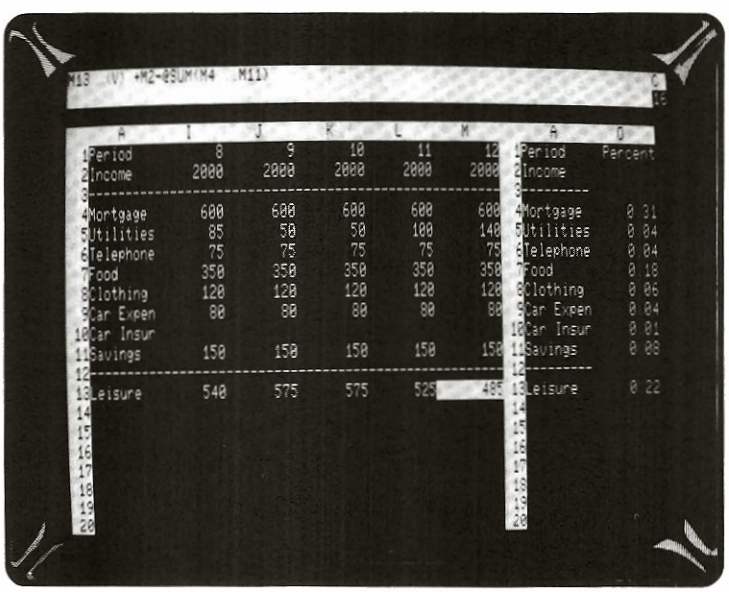
To obtain a total and percentage of income for leisure, use the same method you used earlier to copy the line of hyphens. To allow you to type in formulas in the same form they take on the edit line, the VisiCalc program lets you substitute a colon (:) for [ENTER]. Watch the edit and prompt lines while you type the following:

/R [BACKSPACE] N11.O11:N13 [ENTER] RRRN

The screen shows 5150 for the total and 0.22 for the percentage.

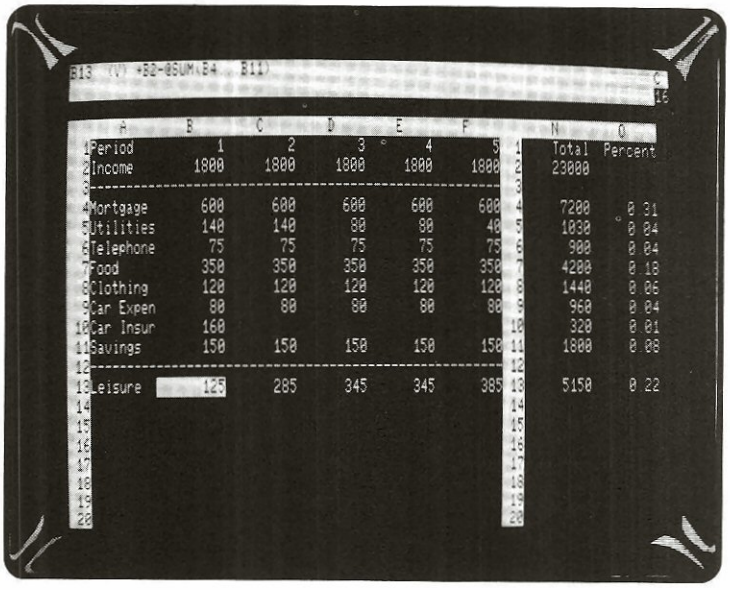
Changing Windows and Titles

As you found in Lesson Two, the screen cannot display both the starting expense figures in month 1 and the calculated totals and percentages in columns N and O. You can see them both by splitting the screen. With the cursor still at N13, type **/WV**. The titles in column A and rows 1-3 are fixed in place in both windows. The screen should look like the following photograph:



Type ; to move the cursor to the right window, bringing columns A and N into view. Now type **/TN** to eliminate the fixed titles from the window. The title (column A) disappears, exposing column M. Finally, type ➡ to display columns N and O (Total and Percent).

Type ; to move the cursor back to the left window. Scroll this window back to the first month (column B); you bump into column A because the fixed titles are still in effect in this window. The screen should look like the following photograph:



To see how the VisiCalc program recalculates the totals and percentages, change an expense: type **>B9 [ENTER] 100 [ENTER]**. An exclamation point appears to the right of the C in the upper-right corner, telling you that the VisiCalc program is recalculating all values. The available leisure money decreases by 20 each month. The car expense total increases from 960 (4% of income) to 1200 (5% of income), and the leisure total decreases from 5150 (22% of income) to 4910 (21% of income).

Now is a good time to save the worksheet again. Put the diskette you're using for worksheet storage in the disk drive. Type **/SS** and, in response to the prompt Storage: File for Saving, type **➡**.

The disk drive whirs and a file name appears on the edit line. Continue typing **➡**, if necessary, until budg1/VC:0 is on the edit line. Then type **[BACKSPACE]** six times until you have erased 1/VC. Now type **2 [ENTER]**;the file name reads budg2, and the VisiCalc program adds /VC to identify the file as a worksheet. You are saving the worksheet with a revised name so you can distinguish it from the first version you saved. As you see, it takes only a few keystrokes to protect yourself from loss of time and data.

Summary

The flexibility and usefulness of the VisiCalc program should now be apparent. This lesson showed how quickly you can set up a worksheet that includes a full year of expenses and formulas to keep all calculations up to date. By eliminating the need to erase or throw away a paper worksheet after some changes, the VisiCalc program not only makes planning and calculating more accurate and efficient, it encourages you to set up planning or budgeting procedures you might otherwise not attempt.

Lesson Four

Lesson Four

This Lesson describes several ways to change and calculate with the worksheet after you have written on it. Continuing the personal budget example started in Lesson Three, it covers inserting, deleting, and moving rows and columns, controlling recalculations of the worksheet, and printing the worksheet.

Displaying Unknown or Invalid Entries

Sometimes you must write entries on the worksheet before you know their exact value. Suppose the car insurance premium isn't known. The VisiCalc program has a function to help you deal with just such a problem: @NA (for Not Available). When you write this function at an entry position, that entry takes on the special value NA. Any formula that refers to an entry containing NA has a value of NA itself.

Replace 160 at B10 by typing **>B10 [ENTER] @NA [ENTER]**. The car insurance premium for month 1 at B10 now reads NA. Because of this, a number for the leisure balance (income minus the sum of expenses) for month 1 cannot be calculated. Position B13 (for leisure) becomes NA. Moreover, the total car insurance expense for the year and the corresponding percentage of income also become NA.

Change B10 back by typing **160 [ENTER]**; all the values are restored.

Here's a related issue. Suppose you make a mistake in typing the formula for percentage and try to divide by zero. Type **>O11 [ENTER] +N11/0 [ENTER]**. Position O11 changes to ERROR, a message that tells you that the value cannot be calculated. The most common cause is division by zero; other causes include taking the logarithm of a negative number and making an error while typing a formula.

If you save a worksheet with forward references, the locations that contain them display ERROR when you reload the worksheet. To restore values to these ERROR positions, type ! to force a recalculation.

If you save a worksheet with circular references, the locations that contain them display ERROR when you reload the worksheet. You cannot clear these values; you must replace the circular references with valid entries.

Like NA, the value ERROR propagates. Any formula that refers to an entry with the value ERROR itself has the value ERROR. You can also deliberately obtain the value ERROR by typing @ERROR. For now, change O11 back by typing **+N11/N2 [ENTER]** so the totals and percentages can be calculated.

Type ; to move the cursor to the right window, then **/W1>A7 [ENTER]** to return to a single window and scroll back to the left edge of the worksheet. The cursor should be on the label Food.

Inserting and Deleting Columns and Rows

Suppose you want to add a life insurance policy with monthly premiums of $115. If you were working out this budget on a sheet of paper, you'd have to erase something or write in tiny letters off to the side. But the VisiCalc worksheet is more flexible; it allows you to insert rows and columns.

Type **/I** (the Insert command). The prompt line reads Insert: R C; type **R** for Row. The VisiCalc program opens a blank line at row 7 by pushing down the rows that were at or below the cursor. You can enter the life insurance figures in this new row.

Look more closely at what the Insert command has done. Has moving savings from B11 to B12 invalidated the formula for leisure, +B2−@SUM(B4 ... B11)? Type **>B14 [ENTER]** to check it. The entry line reads:

B14 (V) +B2−@SUM(B4 ... B12)

Whenever you insert, delete, or move a row or column, the VisiCalc program adjusts all formulas on the worksheet.

Now write the life insurance entries on the worksheet. You'll write the basic amount, make a formula based on it, replicate that formula across row 7, then create and replicate formulas for total expense and percent of income figures. Type the following:

>A7 [ENTER]
Life Ins ➡ 115 ➡ + ⬅ [ENTER]
/R [ENTER]
D7.M7:R
>N6 [ENTER]
/R ➡ :N7:RRRN
>A10 [ENTER]

The leisure money has decreased by the amount of the life insurance premiums each month. Position B14 reads −10, meaning that spending exceeds income in month 1. To reduce expenditures, eliminate most of the car expense (public transportation and a bicycle can take its place). Type **>B10 [ENTER]** to move to the car expense row, then **/D** (the Delete command). The prompt line reads:

Delete: R C

With the cursor at B10, you can delete row 10 by typing R or column B by typing C. Type **R** to delete row 10.

Note: Once you have deleted a row or column with the Delete command, the locations and data are gone forever; you cannot recover them. Be sure you really want to delete a row or column before you reply R or C to the command prompt.

The label and values for car expense disappear. The rows below the cursor move up one to fill the gap and are renumbered accordingly. Car insurance is now in row 10 and savings is back in row 11. The leisure money at position B13 has increased to 90. Check the formula at B13; the VisiCalc program has readjusted the range:

+B2 – @SUM(B4...B11)

You can also insert columns. Suppose you wanted to show six-month totals for income and expenses. Type **>H4 [ENTER]**. The formula there is +G4; because of relative replication the formula at I4 is +H4. Now type **/IC**. A new, blank column appears; column H and all columns to the right move to the right.

The Insert command inserts a row or column before the cursor (closer to row 1 or column A) and moves everything else down or to the right.

Type **➡** to bring column I (formerly column H) into view. The formula at I4 is +G4, showing that the formulas for income and expense skip over the new blank column. Move back with **>H4 [ENTER]**, and type **/D** (the Delete command). The prompt line reads:

Delete: R C

Type C to delete column H (if you typed R, row 4 would be deleted).

When the blank column is deleted, all columns to the right move left to fill the empty space. If you've made any mistakes in this section, clear the screen and reload the file named BUDG2/VC to restore the worksheet.

To test your understanding of the Insert and Replicate commands, insert abbreviated names of the months (Jan, Feb, Mar, etc.) just below the month numbers 1 through 12.

Here's one way to do it. Type the following:

>A2 [ENTER]
/IR Month ➡ /FR/R:C2.M2 [ENTER]
Jan ➡ Feb ➡ Mar ➡ Apr ➡ May ➡ Jun ➡ Jul ➡ Aug
➡ Sep ➡ Oct ➡ Nov ➡ Dec ➡
>A2 [ENTER]

Calculating Interest on a Savings Account

According to the present budget, $150 is set aside each month for savings. The interest on this money contributes to gross income. The VisiCalc program can project the interest and the accumulated balance.

Assume that interest on a savings account is paid at the rate of 5% per year, compounded monthly. For flexibility, this interest rate will be written in a separate position on the worksheet; that way, the VisiCalc program recalculates the interest and accumulated balance whenever the interest rate is changed. Type the following:

>A15 [ENTER]
Sav Acct ➡
.05 [ENTER]

On the first day of each month the account is credited with interest for the previous month's balance plus the monthly deposit of $150. Type the following:

>A17 [ENTER]
/F$100 ⬆
Interest ➡

The $100 at A17 is the previous balance in the savings account before the budget begins. The interest paid for one month is 1/12 of the yearly rate (.05 divided by 12) times this previous balance. Type:

/F$+B15/12*A17 [ENTER]

The result (at B16) is 0.42. Does this make sense? A year's simple interest at 5% on $100 is $5. One-twelfth of this is 5/12, or .41666 (which rounds to $0.42).

Type ⬇ to move to B17. The new savings account balance is the previous month's balance, plus the interest, plus the savings deposit for this month. Type:

/F$+A17+ ⬆ +B12 [ENTER]

If you like, you can point with the cursor to specify all three coordinates in this formula. The result (under the cursor) is 250.42.

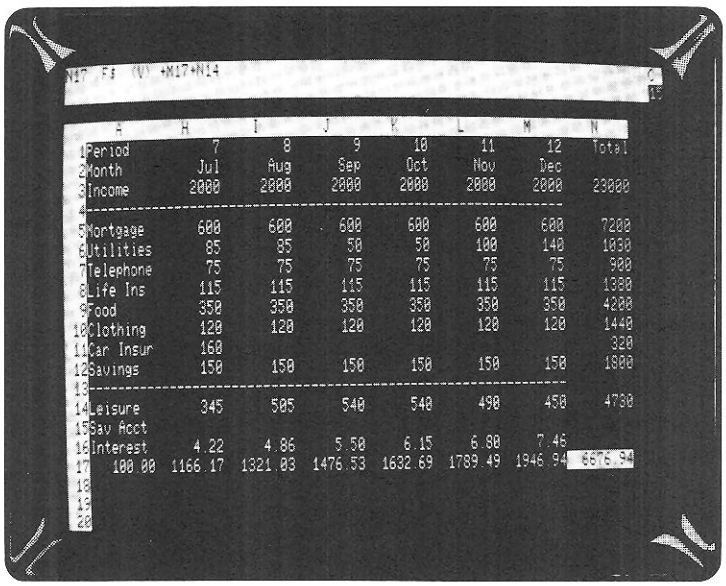
To replicate both the interest and account balance formulas across 12 months, type the following:

>B16 [ENTER]
/R ⬇ :C16.M16:NRRRR

Type ➡ to check the results. The interest paid each month increases as monthly deposits and accumulated interest are added to the balance on which the interest is calculated. Continue scrolling until column N comes into view, and then type:

>N17 [ENTER]
/F$+M17+N14 [ENTER]

This is total discretionary income—the sum of savings and leisure money. It should be 6676.94. The screen should look like the following photograph:



Moving Rows and Columns

Type **>A11 [ENTER]** to move the cursor to car insurance. Paying that insurance premium in month 1 is taking a big bite out of the leisure money in month 1 ($90, compared to $250 in month 2). Why not pay the insurance premiums from the savings account?

On a sheet of paper, more erasures and writing in the margins would be necessary. Not so on the VisiCalc worksheet. Simply move the car insurance expense (row 11) out of the range of expenses used to calculate leisure money, putting it down with the savings account items. Type **/M** (the Move command). The prompt line reads:

Move: From...To

The edit line reads A11. Type ⬇. The cursor moves down to highlight Savings, and the edit line reads A11...A12. Type ⬇ four more times; the edit line changes from A11...A12 to A11...A16, just as it does when you specify a range for the @SUM function or the Replicate command. The cursor highlights Interest at A16. Type **[ENTER]**. It takes the VisiCalc program a few moments to complete its work:

- The car insurance row moves down from row 11 to row 15.
- The rows for savings, leisure, and savings account move up, filling the gap and creating a space for car insurance in its new position just above interest.
- The cursor returns to where it was when you started the Move command at A11, which is now Savings.

The figure for leisure in month 1 has increased from 90 to 250. The car insurance premium has been taken out of the sum of expenses used to calculate leisure. The formula at B13 reads:

+B3 – @SUM(B5...B11)

Car insurance is now unaccounted for. The formulas in row 17 must be revised to take the car insurance premium out of the savings account balance. Type **>B17 [ENTER]**; the entry line reads +A17+B16+B11. The formula defines each month's savings account balance as the previous account balance, plus a month's interest on that balance, plus the current month's deposit. Now you must add "minus the car insurance premium, if any." Type the following:

+A17+B16+B11– ↑ ↑ **[ENTER]**
/R:C17.M17:RRRR

This replicates the new account balance formulas +A17+B16+B11–B15, +B17+C16+C11–C15, etc., across the row.

Now type **>N17 [ENTER]** to check total discretionary income, the sum of savings at M17 and leisure money at N13. It has declined from 6676.94, before we took the insurance premiums out of savings, to 6666.10. Savings has declined (1616.10 versus 1946.94) and leisure spending has increased (5050 versus 4730). About $10 interest has been lost from the savings account. Perhaps the monthly deposit should be increased a bit to replenish the funds taken out to pay the insurance premiums.

Type **>A11 [ENTER]** → to bring the titles back on the screen and highlight the initial savings figure at B11. Because the premium is due every six months, increase the monthly deposit by one-sixth of it. Type the following:

150+(B15/6) [ENTER]

The parentheses tell the VisiCalc program to calculate that portion of the formula first. Thanks to the earlier use of formulas, the VisiCalc program propagates the adjusted savings figure across all 12 months, recalculating leisure and account balance figures for each month.

This recalculation makes the screen a bit messy, because the global format for numbers is still General. Clean up the display by typing **/GFI** (setting the global format to Integer). The interest and savings account figures are still displayed with two decimal places because we specified a local Dollars-and-cents format (/F$) for each of these entries. Now type **>N17 [ENTER]** to check total discretionary income again; it has increased to 6673.53.

Because savings has been increased by about $27 each month, the leisure total has declined to 4730. At the same time, most of the lost interest has been regained.

Before continuing, save your work by typing **/SS** and using → as necessary to bring the file name budg2/VC:0 onto the edit line. Type **[BACKSPACE]** six times, then **3 [ENTER]**.

Reviewing the Replicate Command

This lesson has led you through some fairly sophisticated command combinations. Here's a little project to try on your own—a challenge to test your mastery of the Replicate command. Create monthly percentages for each of your expenses, from mortgage through savings. You can do this by typing just one formula and using the Replicate command three times.

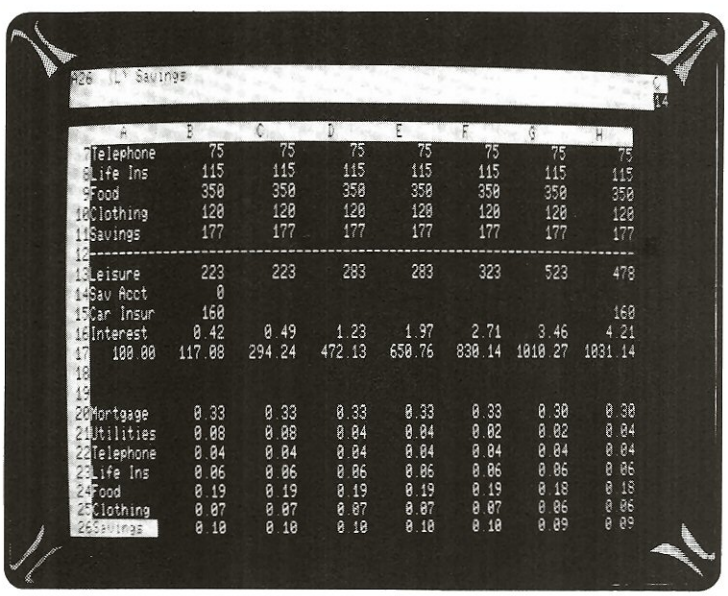
Here are some hints:

- Use the area of the worksheet directly below your list of monthly expenses.
- Remember, you can replicate format specifications.
- You can label each row of percentages with one more use of the Replicate command.

To make sure your worksheet matches the one in this lesson, clear it (**/CY**) and reload the file you just saved with the Load option of the Storage command (**/SL**). Type ➡ until the file name budg3/VC:0 appears on the edit line, then type **[ENTER]**. Now type the following:

>A20 [ENTER]
/R [BACKSPACE] A5.A11:A20: ➡ /F$+B5/B3 [ENTER]
/R:B21.B26:RN /RB26: ➡ .M20:RRRRRRRRRRRRR
(Type **R** 14 times.)
>A26 [ENTER]

The screen should look like the following photograph:



The first replication in this sequence illustrates another use of the Replicate command. You can copy a range of entries into another part of the same column (or to any other area of the worksheet) simply by specifying the starting coordinate of the destination as the target range. Check row 21 (Utilities) to verify that the percentages change from month to month.

Scrolling Split Windows Together

The worksheet now extends beyond the boundaries of the screen in both the horizontal and vertical directions. As you scroll down, the month labels, income, and first few expenses disappear. You can split the screen to see both the expense amounts and percentages at the same time.

Move the cursor up to A19 (just above Mortgage). Now type the Horizontal option of the Window command (/**WH**). The screen splits horizontally, leaving just enough room for the expense percentages in the bottom window.

Type >**A2** [**ENTER**] ↓ ↓. This leaves rows 2 (Month) through 13 (Leisure) in the top window; the cursor is at A4. Next type /**TB** to fix both horizontal and vertical borders. (The column and rows forming the borders do not have to start from the edges of the worksheet.) Finally, type ;>**A26** [**ENTER**] to bring all the expense percentages on the screen and /**TV** to fix the labels Mortgage through Savings in place.

Hold down → and [**REPEAT**] until the bottom window begins to scroll to the right. You can't easily tell which months these expense percentages represent. The month labels are visible only in the top window, which isn't scrolling. If the two windows scrolled together horizontally but remained independent vertically, you could view different areas of the worksheet as you are now. Type /**W** again; the prompt line reads:

```
Window: H V 1 S U
```

The characters following Window: are options:

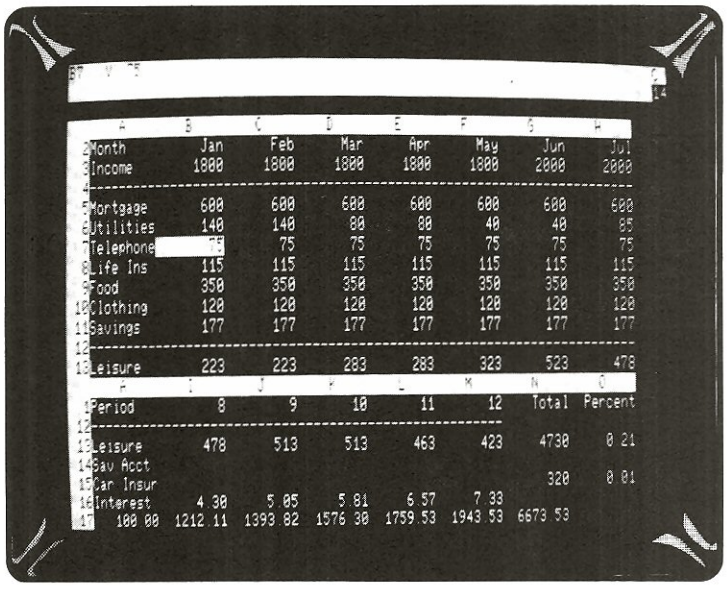
H	Splits the screen horizontally.
V	Splits the screen vertically.
1	Returns to one screen window.
S	Synchronizes scrolling.
U	Unsynchronizes scrolling.

Type **S**. The top window scrolls over so that portions of the same columns are visible through the top and bottom windows. Now type → a few times; the two windows scroll together. Type ; to move the cursor into the top window, then >**B7** [**ENTER**]. Change the telephone expense to 100 and watch the line of percentages opposite Telephone in the bottom window. Notice that the leisure figures in the top window also change.

Now to use the two windows for a different purpose. Type /WU to unsynchronize the windows. Move to the lower window with ; and type >A1 [ENTER] /TB>O17 [ENTER] to display the leisure total and percentage, final savings account balance, and combined discretionary income.

Type ; to move back to B7 in the top window. Change the telephone expense back to 75 and watch how this affects the budget in other ways.

The screen should look like the following photograph:



Month	Jan	Feb	Mar	Apr	May	Jun	Jul
Income	1800	1800	1800	1800	1800	2000	2000
Mortgage	600	600	600	600	600	600	600
Utilities	140	140	80	80	40	40	85
Telephone	75	75	75	75	75	75	75
Life Ins	115	115	115	115	115	115	115
Food	350	350	350	350	350	350	350
Clothing	120	120	120	120	120	120	120
Savings	177	177	177	177	177	177	177
Leisure	223	223	283	283	323	523	478

Period	8	9	10	11	12	Total	Percent
Leisure	478	513	513	463	423	4730	0.21
Sav Acct							
Car Insur						320	0.01
Interest	4.30	5.05	5.81	6.57	7.33		
	100.00	1212.11	1393.82	1576.30	1759.53	1943.53	6673.53

If you would like to use this version of the budget worksheet for your own use, save it by typing /SSbudget [ENTER].

Order of Recalculation

So far, you've seen that the VisiCalc program recalculates the values of all the formulas on the worksheet, but you haven't been told much about how this is done. Some characteristics of recalculation can affect results on a complex worksheet.

The VisiCalc program recalculates by starting at the upper-left corner of the worksheet, working its way down and to the right until it reaches the lower-right corner. Each formula is evaluated only once unless you ask for an extra recalculation by typing !.

As a rule, this means that formulas that reference other entries must be located below and to the right of the referenced entries. An entry at position A1 cannot be a formula that references other positions.

The VisiCalc program evaluates the formulas on the worksheet in one of two orders: down the columns or across the rows. Look again at the letter C in the upper-right corner of the screen. This tells whether the VisiCalc program recalculates by columns (C) or rows (R).

When you load the VisiCalc program or clear the worksheet, it is set to recalculate by columns. It first evaluates A1, then A2, then A3, etc., followed by B1, B2, B3, etc., then C1, and so on to the lower right of the worksheet.

For many problems, column-first and row-first recalculation produce the same results. But there are times when you must use the right recalculation order to obtain correct results, and it's important to recognize these cases when they arise. Here's an example. Clear the worksheet with **/CY** and type the following:

1 ➡ −A2 [ENTER] >A2 [ENTER]
1+A1 ➡ 2*B1 [ENTER]
>C5 [ENTER]
+A1 ➡ 1+C5 [ENTER]
>C6 [ENTER]
−D5 ➡ 2*C6 [ENTER]
>A1 [ENTER]

As you type the formulas, think about how each entry depends on the other entries. The matrix of entries starting at A1 must be recalculated in the order A1, A2, B1, B2 (because B1 depends on A2). The matrix of entries at C5, however, must be recalculated in the order C5, D5, C6, D6 (because C6 depends on D5).

With the cursor at A1, type **2 [ENTER]**. A2 becomes 3, B1 becomes −3, and B2 becomes −6, as expected. But while C5 becomes 2 and D5 becomes 3, C6 remains −2 and D6 remains −4.

The formula at D5 was recalculated, but too late to affect the recalculation of C6 and D6. Now type ! to trigger an extra recalculation. Now C6 reads −3 and D6 reads −6.

Now we'll change the order of recalculation from columns to rows. Type **/G**. The prompt line reads Global: C O R F. Type **O**. Now the prompt line reads Reeval Order: R C. Type **R**. The recalculation order indicator at the upper-right corner of the screen changes from C to R. Now type **1 [ENTER]**.

This time D5 becomes 2, C6 becomes −2, and D6 becomes −4. But while A2 becomes 2, B1 reads −3 and B2 reads −6. The problem with B1 and B2 is similar to the earlier problem with C6 and D6. Again, you can correct the values by typing !.

The moral of this example is that you should lay out your calculations for recalculation either by column or by row, but not both. If possible, you should arrange the worksheet so that the results are correct regardless of the order in which the VisiCalc program recalculates formulas. Then, if you decide to add a formula or otherwise change the worksheet so that a particular order of recalculation is required, you won't have to redesign other parts of the worksheet or type ! one or more times to get the correct results.

The personal budget example we have used is independent of the recalculation order. To change the life insurance policy (and premiums) to provide a benefit of three times annual income, you could switch to row-order recalculation so that the life insurance premium in month 1 is based on the total income calculated in column N.

If you find yourself with conflicting requirements for recalculation order, the problem may be caused by a *forward reference* or a *circular reference* (to be described in a moment). If a reference problem isn't involved, you must force an extra recalculation by typing ! each time you change a value, or change the worksheet to eliminate the conflict.

Forward and Circular References

Clear the worksheet (/**CY**) and type **1 ➡ — ➡ [ENTER]**. The entry line reads:

```
B1 (V) – C1
```

and the entry at B1 is 0, as you might expect. Now type **➡ 1+ ⬅ ⬅ [ENTER]**. The entry line reads:

```
C1 (V) 1 + A1
```

The value at C1 is 2, and the value at B1 has changed to −2.

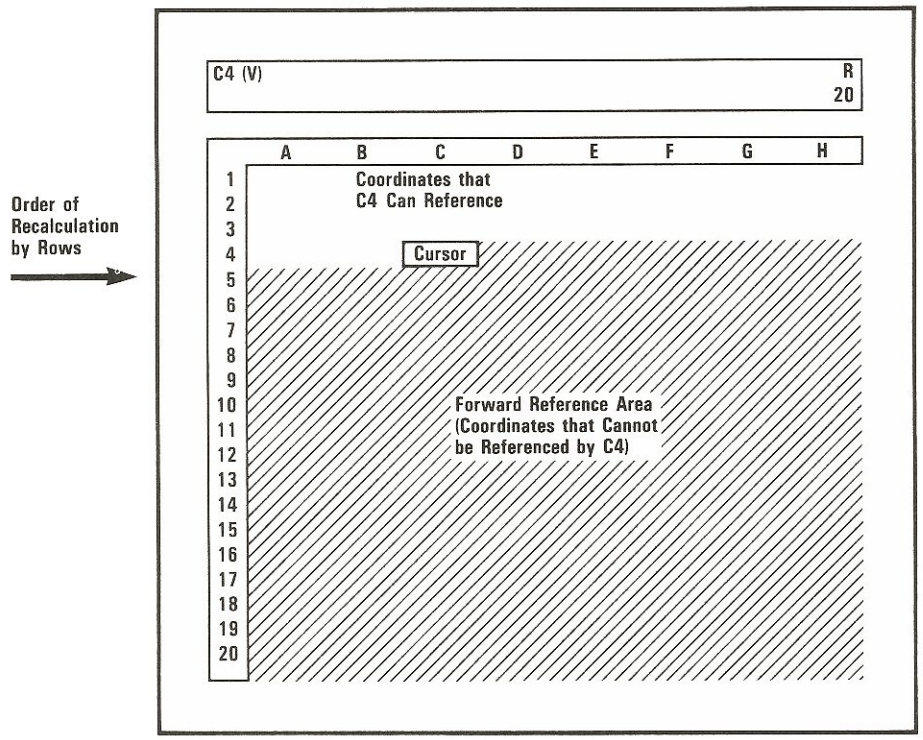
Type **>B2 [ENTER] −C1 [ENTER]**. The same formula, −C1, is at both B1 and B2, and both positions display −2.

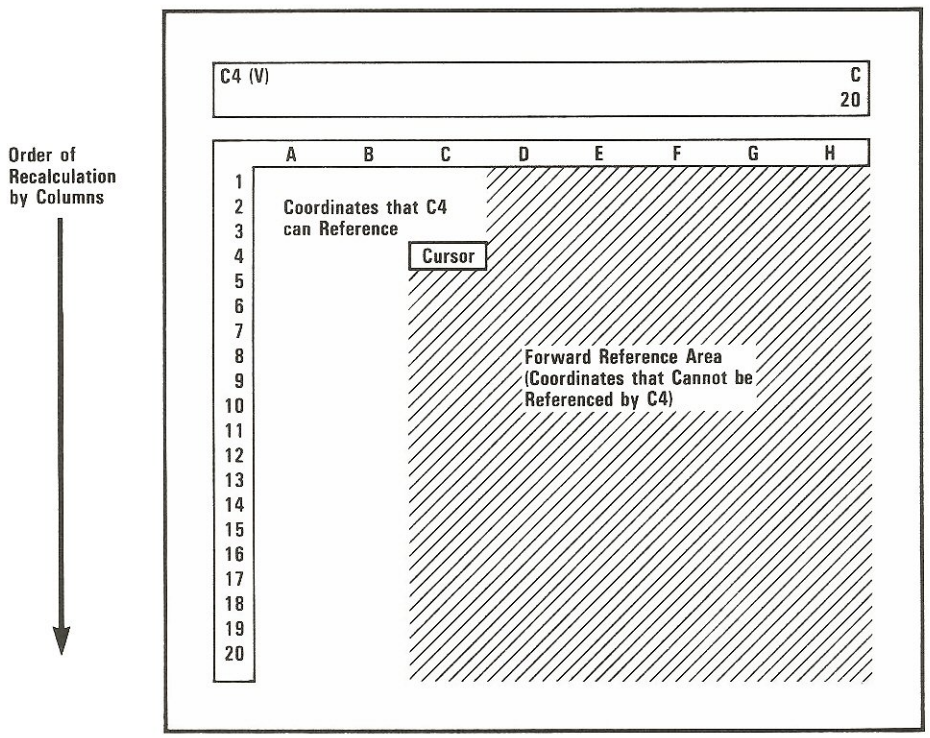
Is there any difference between these two formulas? Indeed there is. One of them recalculates and displays the correct value only if the order of recalculation is by row. The other never displays the correct value after an automatic recalculation.

To see this, type **>A1 [ENTER] 2 [ENTER]**. A1 becomes 2 and C1 becomes 3, but both B1 and B2 remain −2. Type !; both B1 and B2 are updated to −3.

Type /**GOR**; the recalculation order indicator changes from C to R. Now type **3 [ENTER]**. A1 becomes 3, C1 becomes 4, and now B2 becomes −4 but B1 remains −3. You'll have to type ! to update B1 to −4.

When you change A1, B1 displays a value based on the previous contents of C1 and A1. The formula at B1 is an example of a *forward reference*. It contains a reference to an entry that is recalculated *after* B1 is recalculated, regardless of whether you specify row-order or column-order recalculation.


C4 (V)
R
20
A B C D E F G H
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Coordinates that C4 Can Reference
Cursor
Forward Reference Area (Coordinates that Cannot be Referenced by C4)
Order of Recalculation by Rows


C4 (V)
C
20
A B C D E F G H
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Coordinates that C4 can Reference
Cursor
Forward Reference Area (Coordinates that Cannot be Referenced by C4)
Order of Recalculation by Columns

In extremely difficult cases, forward references may refer to other forward references, so that correct results can be obtained only with several recalculations. If the cursor is not on A1, move there. Now type ➡ /IC− ➡ [ENTER].

At the moment, A1 is 3, the new B1 is 4, C1 is −4, and D1 is 4. Type ⬅ 1 [ENTER]. A1 becomes 1, D1 becomes 2, but B1 and C1 are unchanged. Type !. Now C1 is −2, but B1 is still 4. Only after you type ! again is B1 updated to 2.

An even more startling effect is caused by a *circular reference*. The value of such a formula cannot be settled with any number of recalculations! Clear the worksheet and type 1+ ➡ [ENTER]. The entry line reads:

A1 (V) 1 + B1

and the value under the cursor is 1, as expected.

Now type ➡ 1+ ⬅ [ENTER] and watch carefully. What happened? The numbers at A1 and B1 actually changed *twice*. When the formula 1+A1 was calculated at B1, it yielded 1+1, or 2. Then, because the value of B1 changed, an automatic recalculation occurred. A1 (1+B1) became 1+2 or 3, and B1 (1+A1) became 1+3, or 4.

Now type !. A1 increases to 5, and B1 becomes 6. These values change every time you type !.

The foregoing examples are somewhat artificial; you probably recognized the forward and circular references as soon as you typed them. If you plan your work carefully, you probably won't write such a formula.

Some forward or circular references, however, are not so obvious. Suppose you set up a worksheet projecting profit, taking into account various revenues and expenses. One of the expenses is employee salaries, which includes profit-sharing. Unless you're careful, you might create a circular reference: salaries depend on profit, but profit depends on salaries. To resolve this circularity, you must calculate a figure for profit before profit-sharing is taken out (a subtotal, in effect), use this figure to calculate profit-sharing, then calculate final profit by subtracting profit-sharing.

Once you understand the issues involved in recalculation, it isn't difficult to avoid recalculation-order conflicts or forward and circular references. These problems usually arise when you must work too quickly to properly plan the worksheet, or hastily modify an existing worksheet. If you have time to approach the problem in an orderly fashion, it is unlikely that you will encounter any problems with recalculation.

The Print Command

Sometimes you need a printed copy of the worksheet. The VisiCalc Print command lets you print any part or all of the worksheet. If you have a printer connected to your computer, you can try it out by printing a copy of the personal budget we've just created.

See "Print Command" in Chapter 3 for a description of how to print the worksheet.

You can also use the Save option of the Storage command (/SS) and specify the printer, rather than a file name, to print the VisiCalc formulas and formats that produce the worksheet. This doesn't print the values on the worksheet, but it is a permanent record of the structure of the worksheet; you can use it to reconstruct the worksheet if the diskette it is stored on is damaged. It is also a good troubleshooting tool, particularly for finding circular references.

Summary

Once again, this lesson covered a great deal of ground. It reviewed several techniques for using the Replicate command as effectively as possible. It also described a number of new VisiCalc features: the order in which the VisiCalc program calculates and recalculates; functions such as @SUM, @NA, and @ERROR; the Insert, Delete, and Move commands that let you rewrite the worksheet and manipulate entire rows or columns; and synchronized scrolling of the two screen windows.

Most of the important concepts and features of the VisiCalc program have been covered. With what you have learned, this is an excellent time to test your understanding by setting up a worksheet to solve a problem of your own. In this way, you will consolidate your knowledge of the VisiCalc commands and features and develop your own ideas about how they can be used. This will enable you to approach new problems and solve them even more rapidly with the VisiCalc program.

Lesson Five

Lesson Five

If you have scientific or engineering applications in mind, Lesson Five is particularly relevant to your needs. It concentrates on features that extend the VisiCalc program's usefulness to applications requiring complex or lengthy formulas, numbers with very large or small magnitudes, more sophisticated arithmetic operations, and drawing simple graphs.

More on Numbers and Formats

Earlier lessons illustrated some of the ways you can control the display with formatting commands such as /GFI and /F$. This lesson examines the formatting options more closely.

Load the VisiCalc program (as described under "Loading the VisiCalc Program" in Chapter 1) or, if you already have the program running, clear the worksheet with /**CY**. When you clear the worksheet, the global format is set to General, just as if you had typed /GFG. Each entry is controlled by the global format unless you specify a different local format. Type the following:

123.456 [ENTER]
/R: ➡ . ➡ ➡ :

The same number, 123.456, is displayed at A1, B1, and C1. Because you have not yet set any local formats, all three entries assume the global format—General, which displays numbers with the the greatest precision. As you have seen, however, this is not always the most readable way to display a column of numbers.

Type /**FI** ➡ /**F$** ⬅. This sets the local format of A1 to Integer and B1 to Dollars-and-cents (two decimal places). The entry line displays the local format setting for A1:

A1 /FI (V) 123.456

The entries whose local formats you just specified are displayed in rounded form. At A1, 123.456 is rounded down to 123.46 because the last digit (.006) is greater than .005. C1 is controlled by the general format; it still reads 123.456.

Type /**GFI** to change the global format from General to Integer. Entries A1 and B1 are unaffected because they have explicit local formats. C1, however, now reads 123. With the cursor still at A1, change the local format by typing /**FG**. A1 now reads 123.456, and the entry line reads:

A1 /FG (V) 123.456

The local format (General) overrides the global format (Integer).

Type ➡ to move to B1 and erase the local format there by typing /FD. This causes the format of B1 to default to the global format, which is currently Integer. B1 now reads 123, and the entry line reads:

B1 (V) 123.456

The local format /F$ is gone.

Finally, type /**GFG** to set the global format back to General. Now all three entries display 123.456. Position A1 has a local format that overrides the global setting, but the local format is also General. Positions B1 and C1 have no local format, so they are controlled by the General format.

The way numbers are displayed in the General format depends on the column width. Type /**GC7** [**ENTER**]. Now all three entry positions read 123.46. The VisiCalc program leaves one blank at the left edge of each entry position, then displays as many significant digits as it can.

To compare the flexibility of the global format to a local format, move the cursor to position B1 and type /**F$** to set Dollars-and-cents format, then /**GC6** [**ENTER**] to change the column width to six. Positions A1 and C1 now display 123.5, but B1 reads > > > > > (an effect you saw earlier), telling you that a number as large as 123.456 cannot be displayed with two decimal places in a column only six characters wide. Type **12.34** [**ENTER**] and the VisiCalc program displays it.

Scientific Notation

Type /**CY** to clear the worksheet. At position A1, type 8 nines (**99999999**) followed by ➡. This is the largest number that can be displayed in a nine-character column. Type **1+** ⬅ [**ENTER**] ➡.

The calculated result—1+99,999,999, or 100,000,000—is too large to display in ordinary form at B1. To handle this problem, the VisiCalc program switched to scientific notation. B1 now reads 1E8, which means 1 times 10 to the 8th power (or 1 followed by 8 zeros).

The E stands for Exponent because the number following it is the exponent of the implied 10. Scientific notation is also used to display very small numbers. At C1 type **.000000001** (that's eight zeros) followed by ➡. The result, 1.E−9, means 1 times 10 to the −9th power (or 1 with the decimal point moved left 9 places). Now at D1 type **−** ⬅ [**ENTER**]. The result is −1.E−9 (or −.000000001).

When a number is displayed in the General format, the VisiCalc program shifts between conventional and scientific notation as required to display the calculated value with the greatest precision. Type /**GC12** [**ENTER**]. Now all values are displayed in conventional form because the columns are wide enough to show all the required digits. D1, for example, now reads −.000000001.

Next type /**GC7** [**ENTER**] >**A1** [**ENTER**]. The 99999999 at A1 is displayed as 10.0E7, which means 10.0 times 10 to the 7th power. (The rounded value of 10.0 is only displayed; the accurate version, 99999999, is retained in memory.)

Finally, type /**GC5** [**ENTER**]. To display the numbers in these narrow columns, the VisiCalc program has rounded to eliminate all decimal points, displaying A1 as 10E7 and C1 as 1E−9. But D1 shows > > > > because there's not enough room in a five-character column to display −1E−9 (remember, it leaves one blank at the left of the entry position).

More on Value References

The VisiCalc program allows you to enter the value—rather than the coordinates—of an entry location in a formula. Clear the worksheet with /CY and type the following:

1 ➡ 2 ➡ + A1/B1 [ENTER]

The entry line reads:

C1 (V) +A1/B1

and C1 reads .5. We know that if the number at either A1 or B1 is changed, the formula at C1 is recalculated. Now type ➡ to move to D1. Watch the edit line as you type **+A1/B1#**. As soon as you type the # after B1, the reference to B1 is replaced by its current value of 2. The edit line now reads:

+A1/2

Type **[ENTER]**. The entry line reads:

D1 (V) +A1/2

C1 still reads .5. The difference is that the value of B1 is entered into the formula at D1, but the coordinate B1 is entered at C1. When a different value is entered at B1, the formula at D1 is unchanged but the reference to B1 yields a different result at C1. To verify this, type ⬅ ⬅ **4 [ENTER]**; C1 changes to .25, but D1 still reads .5.

The effect of # after a value reference on the edit line is similar to the effect of typing ! after a formula, as described in Lesson One. The difference is that ! evaluates the entire formula on the edit line, replacing it with a single number, but # evaluates and enters the value of a single coordinate, so that the rest of the formula can contain changeable elements.

If # is not preceded by a coordinate (such as B1), it is replaced by the current value of the entry where the cursor lies, i.e., the entry you are changing. You can use this feature to take a look at the precise value of a formatted entry on the edit line. For example, set the global format with **/GFS** and type **6 [ENTER]**. C1 reads 0.17. Type ➡ to move to C1, then #. The # is immediately replaced on the edit line with the current value of C1 to maximum precision: .166666666666. After checking the number, type **[BREAK]** to cancel the entry.

A word on precision is in order here. The VisiCalc program maintains numbers internally in decimal form. To accommodate large financial figures and high-precision engineering or scientific values, it guarantees precision to 11 digits (and sometimes 12) in base 10.

Certain fractions (such as 1/6) cannot be expressed exactly with any fixed number of significant digits. The twelfth digit (the final 6 in the preceding result) is a guard digit that allows the VisiCalc program to determine which way to round the eleventh digit when a calculation is completed.

More on Formulas

In previous lessons you used only simple formulas. As you begin to write more complex formulas involving several arithmetic operations, the way the VisiCalc program evaluates them may not be so obvious.

For example, to evaluate 9+6/3, does it first add 9 to 6 giving 15 and then divide by 3 to obtain 5, or does it first divide 6 by 3 giving 2, and then add 9 to obtain 11? Try it. Clear the screen and type **9+6/3 [ENTER]**. The answer (at A1) is 5. The VisiCalc program, like many hand calculators, evaluates formulas left to right. No arithmetic operator takes precedence over any other.

You can enclose part of a formula in parentheses to force the VisiCalc program to evaluate it first. Move to A2 and type **9+(6/3) [ENTER]**. The answer is 11.

You can put parentheses inside other sets of parentheses up to nine levels. Type the following:

↓ − (↑ ↑ +((A2−1)/A1) [ENTER]

The entry line shows the resulting formula: −(A1 + ((A2 − 1)/A1)). The answer (at A3) is −7. The VisiCalc program first calculates A2−1 (10), divides it by 5 (2), adds A1 to the result of the earlier calculation (7), then multiplies the whole thing by −1 (−7).

More generally, a formula consists of a series of operands separated by arithmetic operators. An operand can be one of the following:

- A number, with or without a decimal point, minus sign, or exponent:

  25 .05

  −1267 3.14159

  8E6 −.45E−3

- A coordinate or range of coordinates:

  A12 B8

  B14...M14 H1...H5

- A function:

  @SUM(D3...M3,O14)

  @MIN(10,B2,B1)

  @AVERAGE(C3...M3)

An operator can be one of the following:

+ Addition

− Subtraction

* Multiplication

/ Division

∧ Exponentiation

Raising a Number to a Power

The exponentiation operator is the caret (∧), above the 6. It raises numbers to a power. Type ⬇ 2∧3 **[ENTER]** to calculate 2 to the 3rd power, or 8.000000. Try another example: type ⬇ 2∧.5 **[ENTER]** to calculate 2 to the 1/2 power, or the square root of 2; the result (at A5) is 1.414214. To find the cube root of 5, type ⬇ 5∧(1/3) **[ENTER]**; the result is 1.709976.

More on Functions

Functions were introduced in Lesson Three, where you used @SUM to find yearly totals for income and expenses and to calculate available leisure money as +B2−@SUM(B4...B11), or income minus the sum of expenses. As mentioned earlier, a function can appear in a formula wherever a number or coordinate could appear. Similarly, a formula can be used as an argument in a function.

A function starts with the @ sign followed by the name of the function. Most functions also require a list of arguments; the arguments are separated by commas and enclosed in parentheses. Each argument can be:

- A formula (a series of numbers, values, references to other locations, and functions, separated by arithmetic operators and/or parentheses).

- A range of entries (a series of contiguous locations in a row or column, such as B2 through B7 or D12 through H12). A range is specified by typing or pointing with the cursor to the first location, typing a period (displayed on the edit line as an ellipsis), and typing or pointing to the last location. On the edit line, these ranges would be displayed as B2...B7 and D12...H12.

The number and type of arguments vary from function to function. For example, @PI and @NA require no arguments. Some functions require exactly one or two arguments, while others, such as @SUM, can take any number of arguments.

The @SUM function accepts a variety of arguments. Move to A7 and type:

@SUM(A1.A4,A5*A5,A6∧3,11) [ENTER]

The result is 5+11−7+8+2+5+11, or 35.00000.

Finding Minimum and Maximum Values

The @MIN and @MAX functions accept a list of arguments, just like @SUM. The result is the Minimum or Maximum value in the list. If the list of arguments includes negative values, the minimum is the negative value with the greatest absolute value—that is, −4 is less than −3; the maximum is the negative value with the smallest absolute value.

Type the following:

↓ @MIN(A1.A7)
↓ @MAX(A7,@SUM(A1,A2,A4.A6)) [ENTER]

The result is −7 at A8 (the minimum) and 35.00000 at A9 (the maximum).

Counting Non-Blank Entries

@COUNT determines the number of nonblank entries in a list of arguments. Any argument that is not a range of coordinates counts as a nonblank entry. This can be puzzling if you include a single coordinate, such as B1, in the argument list; @COUNT counts it as a non-blank entry even if it is blank. To include a single coordinate in the argument list for @COUNT, specify it as the beginning and end of a range entry (for example, B1...B1).

Calculating the Average of Several Values

@AVERAGE finds the arithmetic mean of the list of arguments; it is equivalent to:

@SUM(arguments)/@COUNT(arguments).

Clear the worksheet and type the following:

1 ↓ ↓ 3 ↓ 4 ↓ ↓ 6 ↓ ↓ 8 ↓ /−− ↓

With the cursor at A10 type **@COUNT(A1.A8) [ENTER]**. A10 contains the count of nonblank entries, or 5. Now type **↓ @AVERAGE(A1.A8) [ENTER]**. A11 contains the average of 1, 3, 4, 6, and 8, or 4.4.

To check that @AVERAGE is equivalent to @SUM/@COUNT, type

↓ @SUM(A1.A8)/A10 [ENTER].

This result, too, is 4.4.

Finally, let's change one of the blank entries to a number. Type **>A5 [ENTER] 5 [ENTER]**. The count of nonblank entries at A10 increases to 6; both A11 and A12 increase to 4.5.

Determining the Present Value of Future Cash Flow

The @NPV (Net Present Value) function calculates the present value of future cash flow, based on a specified *discount rate*, or cost of money. @NPV requires two arguments: the first is the discount rate (such as 15%, entered as .15); the second is a range of coordinates that contain the cash flow for the periods in question.

The result of the function is the Net Present Value of the cash flows in the range, discounted at the rate specified by the first argument. If we let DR represent the discount rate + 1, the result of the function is:

(ENTRY1/DR) + (ENTRY2/(DR2)) +
(ENTRY3/(DR3)) + ... (ENTRYn/(DRn))

Suppose a project requires an initial cash expenditure of $5000, and is expected to generate cash over a period of five years. Clear the worksheet and make narrower columns with **/CY/GC6 [ENTER]**, then type the following to write the cash flows:

➡ 1 ➡ 1+ ⬅ [ENTER]
/R:D1.F1:R
>A2 [ENTER]
−5000 ➡ 1000 ➡ 1500 ➡ 2500 ➡ 2000 ➡ 1000 [ENTER]
>A3 [ENTER] .15 ⬇

Type the @NPV function at position A4:

+A2+@NPV(A3,B2.F2) [ENTER]

The $1000 cash flow in the first year is discounted by 15, the $1500 cash flow in the second year is discounted twice, etc. The result is 288.3.

Now type **⬆** and change the discount rate to 10 by typing **.1 [ENTER]**. The net present value at the lower discount rate (which makes future cash flow worth more today) is 1014.

The internal rate of return of an investment is equal to the discount rate that produces a net present value of 0. You can find this by trial and error. Change the discount rate at A3 until the net present value at A4 is zero (or as close as you can get). When the discount rate is .17, the net present value is 34.81; when the discount rate is .18, the net present value is −85.0.

Looking Up Values in a Table

The @LOOKUP function selects values from a table. It requires two adjacent lists of values (the table) and two arguments. The lists of values must be in consecutive locations across a row or down a column.

The first list, the *search list*, contains the values that the @LOOKUP function searches. This list must be in ascending order for the function to yield a meaningful result. The second list contains the resulting values that correspond to the search list values. The list of resulting values must be across a row or down a column immediately adjacent to the search list.

The first argument, the *search argument*, is the value to be compared to the search list. The second argument is the range of coordinates that contains the search table.

The @LOOKUP function compares the search argument to each successive entry in the search list. If it finds an entry greater than the search argument, it selects the immediately preceding value from the table of resulting values (the one that corresponds to the last value in the search table that was equal to or less than the search argument).

If no entry in the search list is greater than the search argument, the @LOOKUP function takes the value of the final entry in the list of resulting values. If the first entry in the search table is greater than the search argument, the value of the @LOOKUP function is NA (not available).

To illustrate the use of this function, this example lists the first ten entries in the periodic table of the chemical elements, with their atomic weights and atomic numbers. Clear the worksheet with **/CY/GFL** and type the following:

Element → Weight → Number [ENTER]
>A2 [ENTER]
H ↓ He ↓ Li ↓ Be ↓ B ↓ C ↓ N ↓ O ↓
F ↓ Ne ↓ >
B2 [ENTER]
1 ↓ 4 ↓ 7 ↓ 9 ↓ 11 ↓ 12 ↓ 14 ↓ 16 ↓
19 ↓ 20 [ENTER]
>C2 [ENTER]
1 ↓ 1+ ↑ [ENTER]
/R:C4.C11:R
>A13 [ENTER]
10.9 → @LOOKUP(←,B2.B11) [ENTER]

The result of the @LOOKUP function at B13 should be 4. Given an experimental atomic weight of 10.9, the @LOOKUP function compared this value against successive values in column B, stopping at the value 11 at B6 which was greater than 10.9. Thus, the atomic weight of 9 at B5 is the matching value, and the corresponding entry, the atomic number in column C, is 4.

If you change the value to be looked up by typing ← 12.1 [ENTER], the value of the function at B13 changes to 6. If you enter an atomic weight of 0 at A13, the result of the @LOOKUP function is NA, because the first entry in the range of values to be searched is greater than the value being searched for.

Arithmetic Functions

The @ABS function finds the absolute value of its argument. For example, @ABS(1) = 1, @ABS(−1) = 1, and @ABS(0) = 0.

The @INT function finds the integer portion of its argument without rounding. Think of the @INT function as setting every digit to the right of the decimal point to zero. For example, @INT(1.6) = 1 and @INT(−3.37) = −3.

Logic Functions

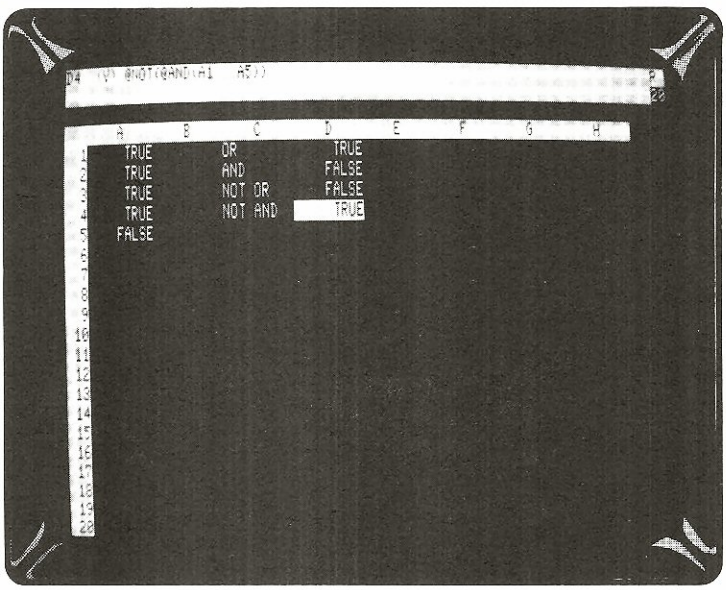
Logic functions deal only with the special values TRUE and FALSE. They include:

- @TRUE and @FALSE, which can be written on the worksheet to produce the logic values TRUE and FALSE. They require no argument.
- @AND and @OR, which test each value specified as an argument. They require a list of one or more arguments.
- @NOT, which negates the logical value of its argument. It requires a single argument.
- @IF, which selects one of two values based on a third, logical value.

The following examples show how the logic functions work together to let you create worksheets that can accommodate different conditions. Type the following:

```
/CY
/GOR
@TRUE ↓ @TRUE ↓ @TRUE ↓ @TRUE ↓ @FALSE ↓
>C1 [ENTER]
OR ↓ AND ↓ NOT OR ↓ NOT AND [ENTER]
>D1 [ENTER]
@OR(A1.A5) ↓ @AND(A1.A5) ↓
@NOT(@OR(A1.A5)) ↓
@NOT(@AND(A1.A5)) [ENTER]
```

The screen should look like the following photograph:



The logic values (TRUE and FALSE) in column A are referenced by the logic functions in column D. The labels in column C identify which function is in the adjoining location in column D. The @OR function in location D1, whose value is TRUE if any of its arguments is TRUE, is TRUE because four of the five referenced locations are TRUE. The @AND function in location D2, whose value is TRUE if all its arguments are TRUE, is FALSE because one of the referenced locations (A5) is FALSE.

Location D3, labeled NOT OR, is FALSE, because the formula at D3 uses the @NOT function to negate (reverse) the value of the @OR function; this value is always the opposite of the value at D1. Similarly, location D4, labeled NOT AND, is TRUE because the formula negates the value at D2. This value is always the opposite of D2.

Change the value at A5 by typing **>A5:@TRUE [ENTER]**. D2 changes to TRUE because now all the values at A1 through A5 are TRUE. D4 changes to FALSE because the @NOT function there negates the value of the same @AND function used at D2. Change A5 back by typing **@FALSE [ENTER]**.

To see how the logic functions can be used to create different numeric values on the worksheet, type **>B1 [ENTER] /FL25 [ENTER]** to write the value 25 at location B1. Now type the following to write a formula whose value depends on the value at B1:

>A7 [ENTER]
@IF(D1,B1,@SQRT(B1)) [ENTER]

If the first argument of an @IF function (D1 in this example) is TRUE, the value of the function is the value of the second argument (B1 in this example). If the first argument is FALSE, the value of the @IF function is the value of the third argument—@SQRT(B1) in this example.

The formula at A7 tells the VisiCalc program that if any of the values in locations A1 through A5 is TRUE (the test made by the @OR function at D1) the value at A7 is to be the value at B1; if none of the values at A1 through A5 is TRUE, the value at A7 is to be the square root of the value at B1. A7 reads 25, the value at B1.

Change A1 through A4 to FALSE by typing the following:

> **>A1 [ENTER]**
> **@FALSE [ENTER]**
> **/R: ↓ . ↓ ↓ ↓ ↓ [ENTER]**

D1 changes to FALSE, and now A7 reads 5.000000, the square root of A1. Change A1 back to TRUE by typing **@TRUE [ENTER]**. D1 changes back to TRUE and A7 changes back to 25. You are changing the value at A7 based on whether any of the values in A1 through A5 is TRUE.

Change the formula at A7 by typing the following:

> **>A7 [ENTER]**
> **/E → → → → → → [BACKSPACE] 2 [ENTER]**

A7 changes to 5.000000, because now it references the @AND function at D2, whose value is FALSE because not all the values at A1 through A5 are TRUE.

A logic function can be used anywhere a formula can be used, so the argument of a logic function can be another logic function. Suppose you wanted to test whether all the values at A1 through A5 are true *and* at least one of the values at D1 through D4 is true; type the following:

> **@AND(@AND(A1.A5),@OR(D1.D4)) [ENTER]**

The outermost @AND function has two arguments: the first is an @AND function that tests the values at A1 through A5, and the second is an @OR function that tests the values at D1 through D4. The value at A7 is FALSE because the first argument of the outermost @AND function—@AND(A1...A5)—is not TRUE.

The @AND function used as the first argument is the same as the formula at D2. You can refer to D2 instead of typing the entire function; type the following:

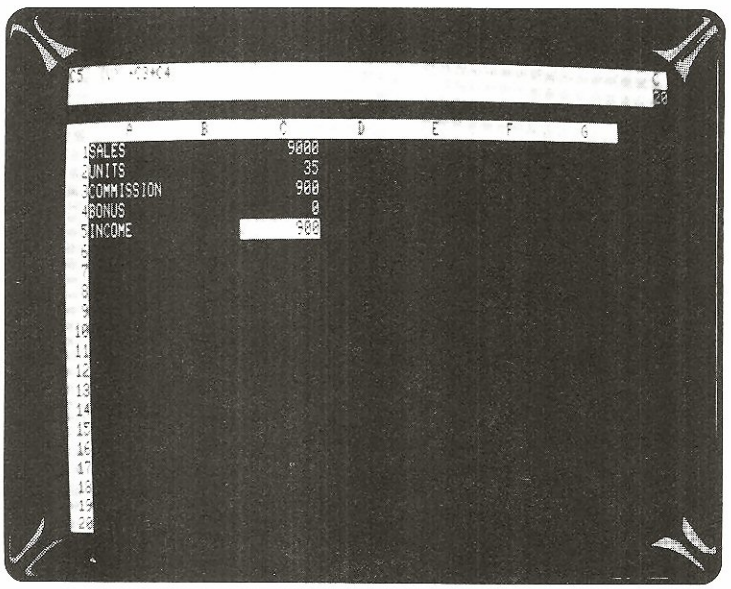
> **@AND(D2,@OR(D1.D4)) [ENTER]**

The value at A7 doesn't change.

There are several other logic functions besides @TRUE and @FALSE. Comparisons such as A>B or C<=D yield either a true or false value depending on the values of the variables. The following examples—describing one way to calculate sales bonuses and discount purchase rates—use conditional logic functions in calculations.

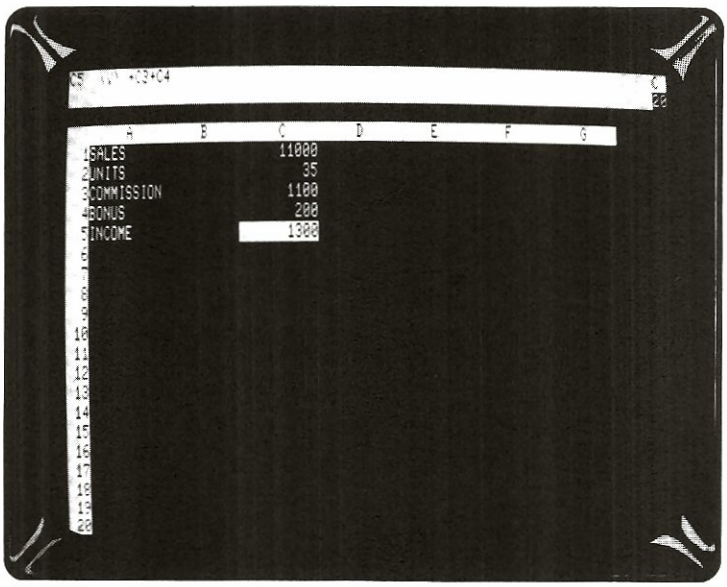
Type the following:

/CY /GC10 [ENTER]
SALES ⬇
UNITS ⬇
COMMISSION ⬇
BONUS ⬇
INCOME [ENTER]
>C1 [ENTER] 9000 ⬇
35 ⬇
+C1*.1 ⬇
@IF(C1>=10000,200,0) ⬇
+C3+C4 [ENTER]



The value at C5 is 900. You received the 10% commission on sales (C3), but did not qualify for the bonus (C4) because sales were less than 10000. The formula at C4 means the following: If C1 (sales) is greater than or equal to 10000 (the quota), then C4 equals 200 (i.e., you get the bonus). Otherwise, C4 equals 0 (no bonus). Since sales are not greater than or equal to 10000, the condition is false. The value assigned to C4 is therefore 0.

Suppose that this month, however, you increase your sales to 11000. Type **>C1 [ENTER] 11000 [ENTER]**. Because of the increase in sales, the commission is now 1100 and the bonus is 200 (since you met your quota); income (C5) becomes 1300. This time, the value assigned to C4, the bonus entry, is 200, because the conditions in the formula were satisfied.



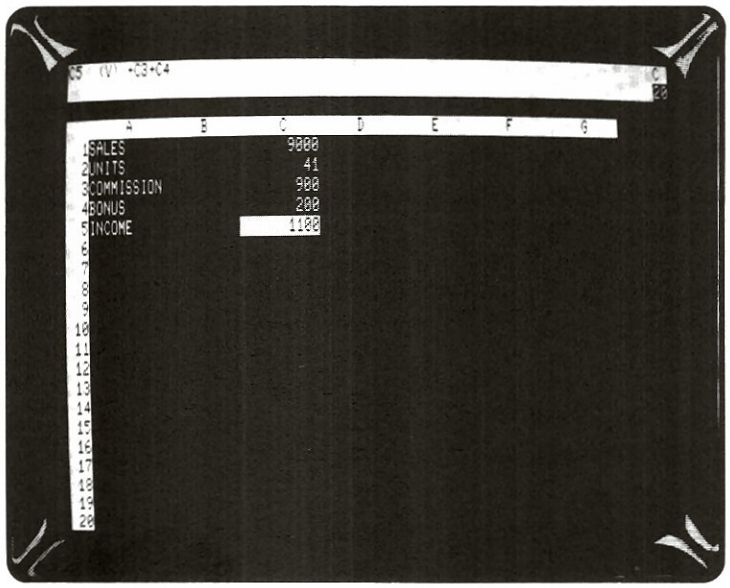
Now suppose that two new conditions are added to the bonus incentive plan: (1) You can earn the bonus by selling $6000 worth of merchandise, but (2) you have to sell more than 40 units. Again, the value assigned to the location C4 depends on whether or not true or false conditions are met.

Let's change our formula to reflect these new conditions. Last month's sales figures will be used. While at location C1, type the following:

9000 [ENTER]
>C4 [ENTER]
@IF(@OR(C1>=10000,@AND(C2>40,C1>6000)),200,0)
[ENTER]

Although two new conditions were added, no bonus was received. Last month's figures don't meet the new conditions, even though sales were more than 6000. According to the formula, either of two conditions satisfy the requirements for a bonus: (1) You sold 40 or more units AND at least $6000 worth, or (2) You sold at least $10000 worth of merchandise.

Assume unit sales are higher this month. Type **>C2 [ENTER] 41 [ENTER]**.



Look at the value in location C4. It is 200, which means that you received the bonus this month. Since you didn't sell $10000 worth of merchandise, you know that both conditions in the @AND part of the bonus formula were met: you sold at least 40 units (in fact, you sold 41) and at least $6000 worth of merchandise.

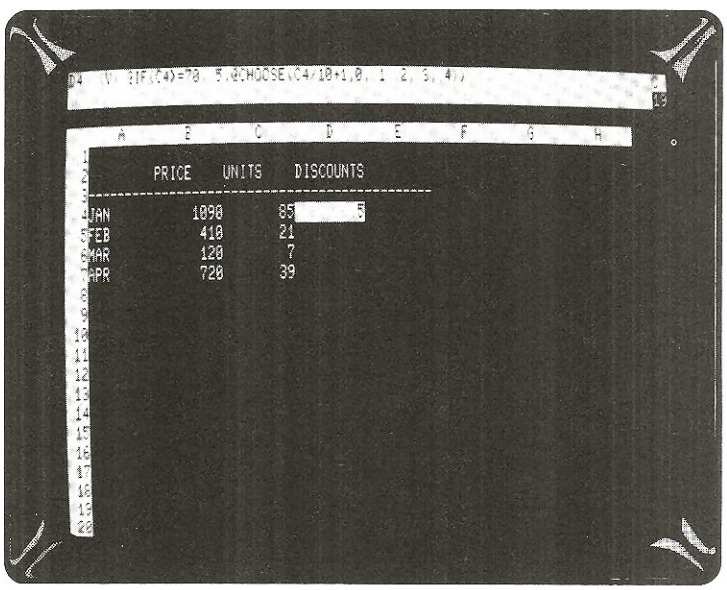
If either condition in a formula with an @OR function is true, the @OR function returns the value true. In this case, the @AND part of the formula containing the @OR was true, so the @OR function returned the value true.

The @IF function has three parts: (1) a conditional formula, (2) a value to put in the location if the conditional formula is true, and (3) a value to put in the location if the conditional formula is false. Formulas that use the @IF function look like this: @IF(conditional formula,true value,false value). That's how the 200 got into location C4; the @IF conditions were met and the true value (200) was put into C4.

The formula for deciding whether or not a bonus was received used three VisiCalc logic functions: @IF, @OR and @AND. Using one function within another function—as in the bonus formula—is called *nesting*. All of the VisiCalc program functions can be nested within logic functions. The following example illustrates the nesting of the @CHOOSE function inside an @IF logic function in a formula that calculates discount rates on volume purchasing. Type the following:

/CY
>B2 [ENTER]
PRICE ➡ UNITS ➡ DISCOUNT% ➡
>A3 [ENTER]
/ — [ENTER]
/R [ENTER]
B3.E3 [ENTER]
>A4 [ENTER]

JAN ➡ 1090 ➡ 85 [ENTER]
>A5 [ENTER]
FEB ➡ 410 ➡ 21 [ENTER]
>A6 [ENTER]
MAR ➡ 120 ➡ 7 [ENTER]
>A7 [ENTER]
APR ➡ 720 ➡ 39 [ENTER]
>D4 [ENTER]
@IF(C4>=70,.5,@CHOOSE(C4/10+1,0,.1,.2,.3,.4)) [ENTER]



The value at D4 equals .5 because the quantity purchased was more than 70. The formula at D4 says that if you buy more than 70, you get a 50% discount. If you buy less than 70, your discount is determined from a discount schedule; this schedule is reflected in the last part of the @CHOOSE function in the preceding example.

Now replicate the formula down column D to find out what the other percentages are by typing /**R** [ENTER] **D5.D7** [ENTER] **RR**.

D5 becomes .2, D6 becomes 0, and D7 becomes .3. In D5, for example, the @CHOOSE function divides the 21 units purchased by 10 and adds 1, which yields 3.1. The @CHOOSE function drops the decimal fraction, and uses the 3 as the index number to pick the third entry in the list, .2.

Transcendental Functions and Graphing

The transcendental functions, such as @EXP, @LN, and @SIN, and the Graph format are described in a single example that produces graphs of the transcendental functions. Clear the worksheet and type the following:

1 ↓ 3 ↓ 6 ↓ 20 ↓ >A1 [ENTER]

The Graph format displays the number of asterisks equal to the integer portion of the value of an entry. Type /**F*** at A1. One asterisk replaces the 1. Now type ↓ /**F***. The 3 is replaced by three asterisks. Continue with ↓ /**F*** ↓ /**F***. A3 shows six asterisks and A4 shows eight.

The maximum number of asterisks that can be displayed at an entry position is one less than the column width (remember, the VisiCalc program leaves a blank at the left of each position). Only eight asterisks are displayed at A4, even though its value is 20, because the column width is 9. Type /**GC12 [ENTER]**; A4 displays 11 asterisks. Type /**GC30 [ENTER]**; now A4 displays 20 asterisks, its full value. Clear the worksheet by typing /**CY**.

To graph a function, you must first supply a series of argument values for the function and calculate the function result for each argument value. For simplicity's sake, begin with a linear function: f(x) = 2.5x. Type the following:

>A20 [ENTER]
.1 ➡ .1 [ENTER]
>A1 [ENTER]
+A20 ↓ + ↑ +B20 [ENTER]
/R: ↓ .A17: RN

A20 is the start value and B20 is the step value for the list of function arguments. A1 to A17 contain the argument values (.1 to 1.7). Next, calculate the corresponding function results. Type the following:

>B1 [ENTER]
2.5*A1 [ENTER]
/R: ↓ .B17:R

The function results are .25, .5, .75, ... 4.25. To graph these results, you must specify the Graph format as the local format for the locations that contain the function results to Graph. Type the following:

/F*/R: ↓ .B17:R

This probably isn't the sort of graph you expected. The problem is that the function results do not fall conveniently in the range 1, 2, 3, etc., which would yield one, two, or three asterisks.

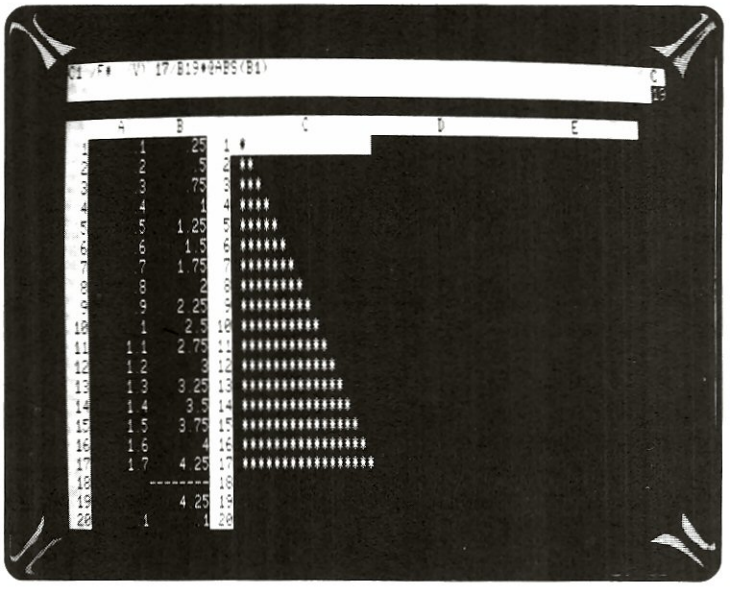
To create a better graph, change the column width to display up to 17 asterisks (to allow a wider range of function results), then scale the function results into the range of 0 to 17. Type **/FD/R: ↓ .B17:R** to return to a numeric display, then type the following:

>B18 [ENTER]
/−− ↓ @MAX(B1.B17) [ENTER]
/GC8 [ENTER]
>C1 [ENTER]
/WV;/GC18 [ENTER]
17/B19*@ABS(B1) [ENTER]
/F*/R: ↓ .C17:NR

At B19 the @MAX function finds the upper limit of the function results. C1 through C17 contain the absolute value of the function results, so the lower limit is zero. The screen is split to display the numeric values in narrow columns and the graph in a wider column.

The formula at C1 multiplies each function result by 17 (the maximum number of asterisks) divided by B19 (the maximum function result). The value of this formula lies in the range of 0 to 17/B19*B19, or 17. The graph format is set at C1 and replicated down column C to C17.

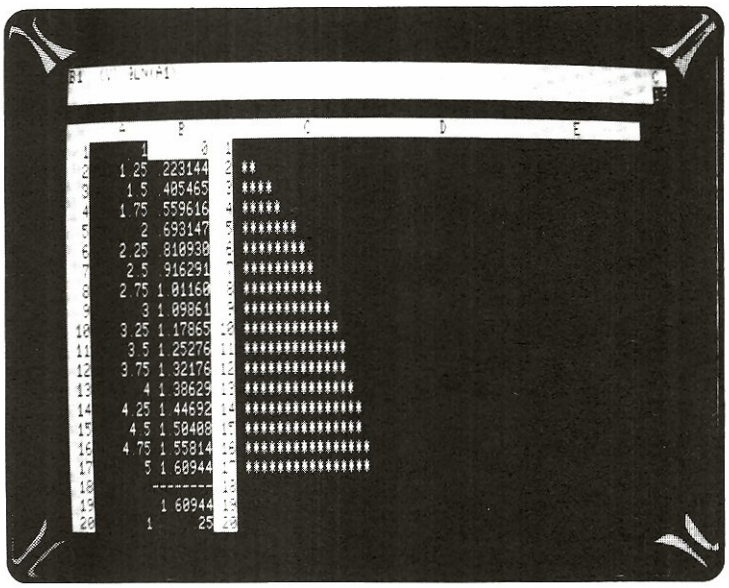
This produces a reasonable approximation of a straight line. Because of the way the worksheet is set up, you can graph any set of function results in column B, not just this linear function. The screen should look like the following photograph:



Now type the following:

;>A20 [ENTER]
1 ➡ .25 [ENTER]
>B1 [ENTER]
@LN(A1) [ENTER]
/R:B2.B17:R

The screen should look like the following photograph:

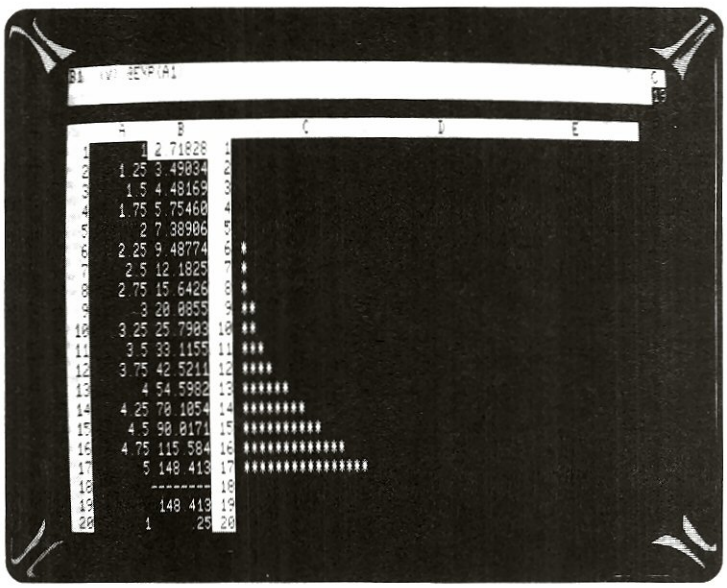


The value of @MAX(B1...B17) at B19 changes to 1.60944. This value affects the formulas in column C so that the results still come out in the range 0 to 17. If the graph of the natural log function doesn't look completely familiar, tilt your head to the right and imagine the X axis on the column and the Y axis on the row.

Now try the exponential function. Type the following:

@EXP(A1) [ENTER]
/R:B2.B17:R

The screen should look like the following photograph:

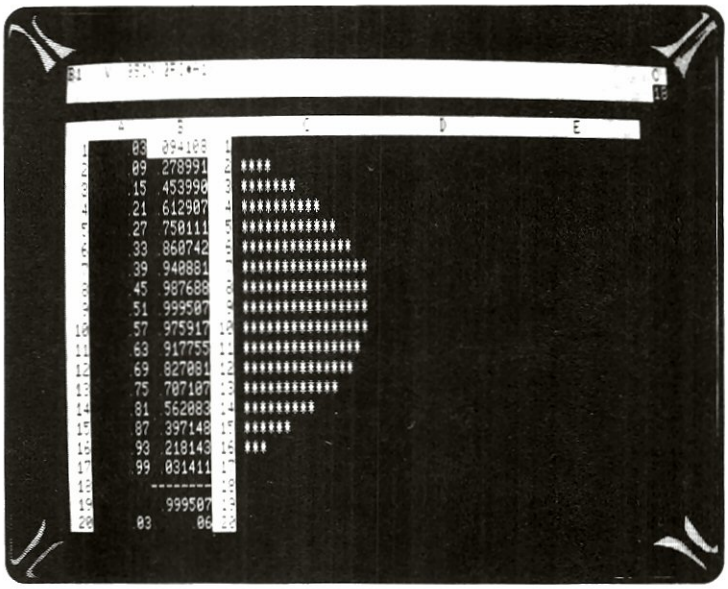


The maximum function result value is now 148.413, and each result is scaled into the range 0 to 17 in column C. Is the graph close to what you expected?

Finally, graph the sine function. Because the VisiCalc program performs its trigonometric calculations in radians, the function is written as @SIN(@PI*A1) and the argument range is changed to obtain a full sine curve in column C. Type the following:

>A20 [ENTER]
.03 ➡ .06
>B1 [ENTER]
@SIN(@PI*A1) [ENTER]
/R:B2.B17:R

The screen should look like the following photograph:



At this point, you may wish to experiment with different argument values and functions. See "Functions" in Chapter 3 for a more detailed description of these and other functions.

Controlling Worksheet Recalculation

You may have noticed some delay when the VisiCalc program recalculates a worksheet, particularly if there are quite a few transcendental functions. Because function results are calculated to 11- or 12-digit precision, each one takes a fraction of a second to evaluate; a worksheet full of function references can take several seconds to recalculate.

When you load the VisiCalc program or clear the worksheet, the entire worksheet is recalculated each time you change an entry. In many cases this isn't necessary. The Recalculate option of the Global command (/GR) lets you specify whether you want this automatic recalculation or whether you want to specify yourself (by typing !) when to recalculate.

Type /**G**. The prompt line reads Global: C O R F. Type **R**. Now the prompt line reads Recalc: A M. The characters following Recalc: are options:

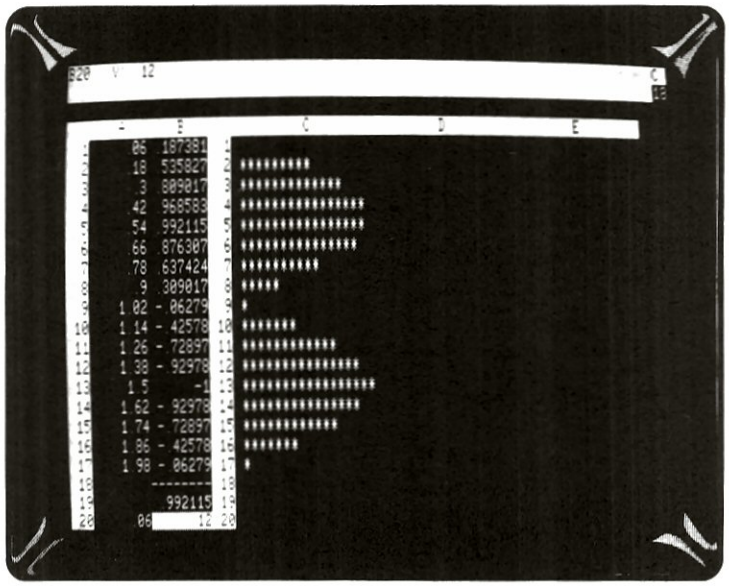
A Automatic

M Manual

Type **M**. You have turned off automatic recalculation. The worksheet is recalculated only when you type !.

Now type >**A20** [**ENTER**] to move the cursor to the starting value, .03. Type **.06** ➡ .12 [**ENTER**]. Now request a recalculation—type !. As you've probably noticed, an exclamation point (!) is displayed next to the C in the upper-right corner of the screen while the recalculation takes place.

The graph changes to display the positive-going portion and the reflection of the negative-going portion of the sine curve. The screen should look like the following photograph:



Now type **.06** ➡ **.54** [**ENTER**]. Specify automatic recalculation by typing /**GRA**. The first thing that happens is a recalculation to update all the figures on the screen.

Summary

This lesson introduced the full range of the VisiCalc program's calculating ability. Besides simple addition, subtraction, multiplication, and division, the VisiCalc program provides exponentiation, transcendental functions, and scientific notation.

You can use functions such as @SUM, @MIN, and @MAX to work with entire rows, columns, or other ranges of numbers. Functions like @COUNT, @AVERAGE, @NPV, and @LOOKUP allow you to quickly handle common problems such as test score averaging, evaluating the terms of a loan, or looking up figures in sales or income tax tables.

You can display the results in a variety of ways, including simple graphs. With practice, you can use the features described in this lesson—in combination with the screen controls and formula replication capabilities—to solve complex problems quickly and easily.

Lesson Five concludes the tutorial chapter of this book. The next chapter is the VisiCalc Reference. It contains an in-depth description of each command you used in the lessons.

We hope you find the VisiCalc program an enjoyable and useful tool.

CHAPTER 3: VISICALC COMMAND REFERENCE

Introduction

Chapter 3 includes a detailed description of each VisiCalc command, plus topics such as the VisiCalc screen, labels, values, and file names.

The commands and topics are listed alphabetically. Command options are presented in the order they appear on the prompt line of the VisiCalc screen. If you have not read Chapter 2 (the Tutorial), turn first to "The Screen" for general information about the VisiCalc program.

This chapter begins with a chart that shows all VisiCalc commands and their options. Each command description begins with a detailed chart that shows its options.

VisiCalc Command Structure Chart

> **Go To: Coordinate**

Enter entry coordinate.
ENTER
Moves cursor to specified entry position.

: Moves cursor between windows when split screen in effect.

→ ← ↑ ↓ Moves cursor in direction of arrow.

Any letter or " **Label**

Type any characters.

- BACKSPACE — Erases last character.
- CTRL-E (see /E) — Allows editing of characters on edit line.
- → ← ↑ ↓ — Does ENTER then moves cursor.
- ENTER — Enters characters on edit line into entry position; displays character and format on entry contents line.

/

! Forces recalculation of entire sheet.

Places value in highlighted entry position on the left side.

Digit (0–9) + − (• @ **Value**

Digit, Value reference, + − / * @ (●) ^

- BACKSPACE — Erases last character.
- # — Replaces immediately preceding entry coordinate with current value on edit line.
- ! — Replaces formula with its numerical value on edit line.
- CTRL-E (see /E) — Allows editing of characters on edit line.
- → ← ↑ ↓ ENTER — Stores formula in memory; displays value in current entry position.

Command: B C D E F G I M P R S T V W −

B **Blank**

ENTER or → ← ↑ ↓
Erases contents of highlighted entry position, leaves formats: Any other key aborts command.

C **Clear: Type Y to Confirm**

Y
Erases entire sheet including formats: Any other key aborts command.

D **Delete: R C**

R
Deletes all entries and formats in row containing cursor.

C
Deletes all entries and formats in column containing cursor.

E **[Edit]: Label** or **[Edit]: Value**

Allows editing of entry contents of highlighted entry positions. Any character inserts character to left of edit line.

- BACKSPACE — Deletes character to left of edit cue.
- → ← ↑ ↓ — Moves edit cue without changing entry.
- ENTER — Enters characters on edit line into entry position; displays character and format on entry contents line.

F **Format: D G I L R $ ***

- D — Defaults to global format of current window.
- G — General format.
- I — Integer displays.
- L — Left aligns entry.
- R — Right aligns entry.
- $ — Dollars and cents displays.
- * — Displays integer value as stars for bar graphs.

G **Global: C O R F**

C **Column Width**
Type any number between 3 and maximum screen width and press ENTER. Changes width of all columns to the number specified.

O **Recal Order: R C**
R
Sets recalculation by rows (A1 to BK1; then A2 to BK2, etc.).
C
Sets recalculation by columns (A1 to A254, B1 to B254, etc.).

R **Recalc: A M**
A
Recalculation proceeds automatically over whole sheet.
M
Recalculation of entire sheet must be manually commanded by pressing !.

F **Format: D G I L R $ ***
(see /F) Changes all unformatted entries in current window to specified format.

I **Insert: R C**

R
Inserts row above cursor.
C
Inserts column left of cursor.

M **Move: From ... To**

From:
ENTER
Accepts coordinate of row/column to be moved.
BACKSPACE
Erases current location and allows new coordinate to be entered, or indicated with cursor keys.

To:
Enter the second coordinate of a parallel row/column and execute with ENTER.

P **Print: File, Printer, RS-232**

F **Print: File Name**
Type printer name, serial communications port name, file name or scroll directory.
ENTER

P or R **Print: Lower Right, "Setup, −, &**

Type coordinate of lower right corner of area to be printed.
ENTER
Sends to output device.

- & — Sends line feed with each carriage return.
- − — Turns off line feed.

Print: Setup or ENTER
Type appropriate setup string; if any, for output device.
ENTER

R **Replicate: Source Range or ENTER**

Current cursor coordinates displayed on edit line.

- BACKSPACE — Clears edit line; enter single coordinate.
- ● — Accepts beginning coordinates of source range.

Enter highlighted position as a single source range.

Replicate: Target Range
Enter single coordinate
ENTER or :
Copies source entry contents into target position.
or
Enter beginning ... ending coordinates from one row.
ENTER or :
Copies source contents into target row.
or
Enter beginning ... ending coordinates from one column.
ENTER or :
Copies source contents into target column.

Enter ending coordinate from same row.
ENTER or :

Replicate: Target Range
Enter single coordinate.
ENTER or :
Copies source row once starting at target coordinate.
or
Enter beginning ... ending target coordinate from same column.
ENTER or :
Copies source row several times, beginning each on target column.

Enter ending coordinate from same column.
ENTER or :

Replicate: Target Range
Enter single coordinate:
ENTER or :
Makes one copy of source column beginning at target coordinate.
or
Enter beginning ... ending coordinates from one row.
ENTER or :
Makes several copies of source column, beginning each one in target row.

T **Titles: H V B N**

H
Fixes all rows (horizontal) in window from cursor up.
V
Fixes all columns (vertical) in window from cursor left.
B
Fixes all columns both in window.
N
Negates all title fixing.

V **© 1980, 1982 Software Arts, Inc. XXX**

Displays copyright notice and version number on prompt line; clears automatically with next keystroke.

W **Window: H V 1 S U**

H
Splits window horizontally at cursor.
: Jumps cursor between windows.
V
Splits window vertically at cursor.
1
Expands window containing cursor to full screen.
S
Initiates horizontal or vertical synchronized scrolling.
U
Stops synchronized scrolling.

− **Label: Repeating**

Type any characters.
ENTER
Character sequence repeated across column width.

S **Storage: L S D Q E #**

L **Storage: File to Load**
Type file name or scroll directory.
ENTER
Loads specified file (in the "sheet format") or displays error message on edit line.

S **Storage: File for Saving**
Type file name or scroll directory.
ENTER
Writes file on to diskette (in "sheet format") under specified file name or displays an error message.

D **Storage: File to Delete**
Type file name or scroll directory.
ENTER

Delete File: Type Y to Confirm
Y
Removes file from diskettes: Any other key aborts command.

Q **Quit: Type Y to Confirm**
Leaves VisiCalc program and returns to operating system: any other key aborts command.

E **Storage: Execute TRSDOS Command**
Type DIR, SETCOM, or FORMS.
ENTER
The command is executed. Any key returns to VisiCalc screen.

**Data: Save, Load**

S **Data Save: File for Saving**
Type printer name, serial communications port name, or scroll directory.
ENTER

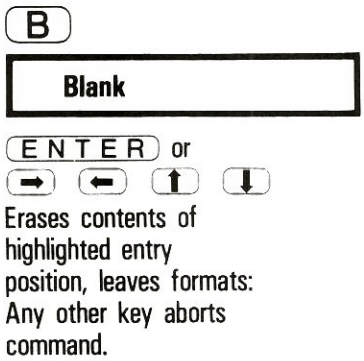
Data Save: Lower Right
Type coordinate of lower right corner of area to be saved.
ENTER

Data Save: R, C or ENTER
R
Writes file by rows beginning at position held by cursor when storage command initiated; uses DIF format with specified file name.
C
Writes file by columns beginning at position held by cursor when storage command initiated; uses DIF format with specified file name.

L **Data Load: File to Load**
Enter name of DIF file by typing or scrolling directory.
ENTER

Data Load: R, C or ENTER
R
Loads file by rows beginning at cursor.
C
Loads file by columns beginning at cursor.

Blank Command

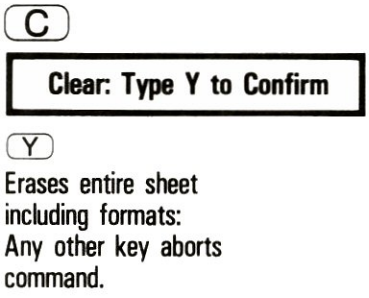


The Blank command *irretrievably erases* anything written (label or value) at the entry position where the cursor rests. It does not affect the local format, if one is specified.

Example

	Type:	**Result:**	
1.	Place the cursor on the entry to be erased.		
2.	/	Prompt line:	Command: BCDEFGIM PRSTVW –
3.	**B**	Prompt line:	Blank
4.	**[ENTER]** or an arrow key	The entry position or highlighted by the cursor clears.	

Clear Command



The Clear command *irretrievably erases* all information on the worksheet, returns the cursor to position 1, and resets all worksheet characteristics to the same status as when the program is loaded.

If you want to save the worksheet, be sure to do it (using the Save option of the Storage Command) before issuing the Clear command.

Example

	Type:	**Result:**	
1.	/C	Prompt line:	Clear: Type Y to confirm
2.	Y	The screen darkens for a moment, then reappears with no entries. The status area displays the copyright and version notices.	

If you type anything other than Y, the Clear command is canceled.

Delete Command

(D)

Delete: R C

(R)
Deletes all entries and formats in row containing cursor.

(C)
Deletes all entries and formats in column containing cursor.

The Delete command *irretrievably erases* the row or column in which the cursor rests. If a row is deleted, all rows below the deleted row move up to fill the gap; if a column is deleted, all columns to the right move left.

The VisiCalc program adjusts all coordinates on the worksheet to correspond to the new coordinates that result when rows or columns are moved after the Delete command, then recalculates the worksheet. Locations that refer to the deleted row or column display ERROR.

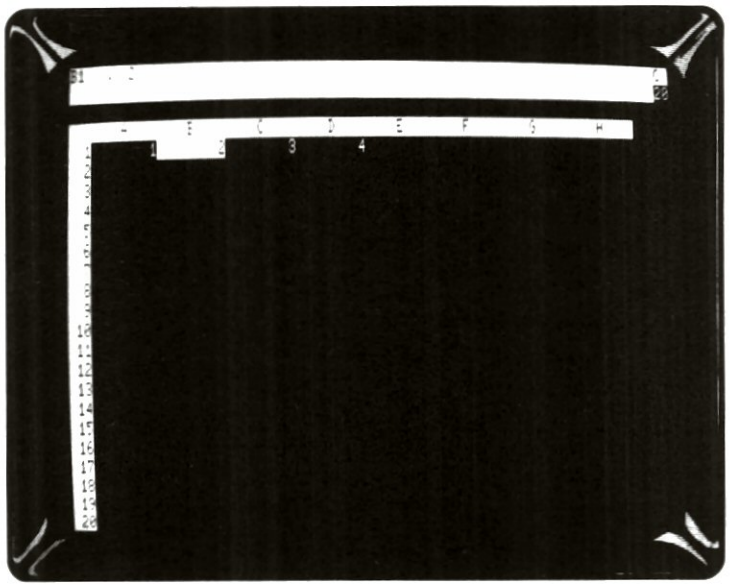
To use the Delete command, place the cursor in the row or column to be deleted and type /**D**. The prompt line reads Delete: R C. Type **R** to delete the row in which the cursor is located or **C** to delete the column.

Example

	Type:	**Result:**
1.	**/CY**	The worksheet clears and the cursor moves to A1.
2.	**1 → 2 → 3 → 1+C1 [ENTER]**	

3. >**B1 [ENTER]**

The screen should look like the following photograph:

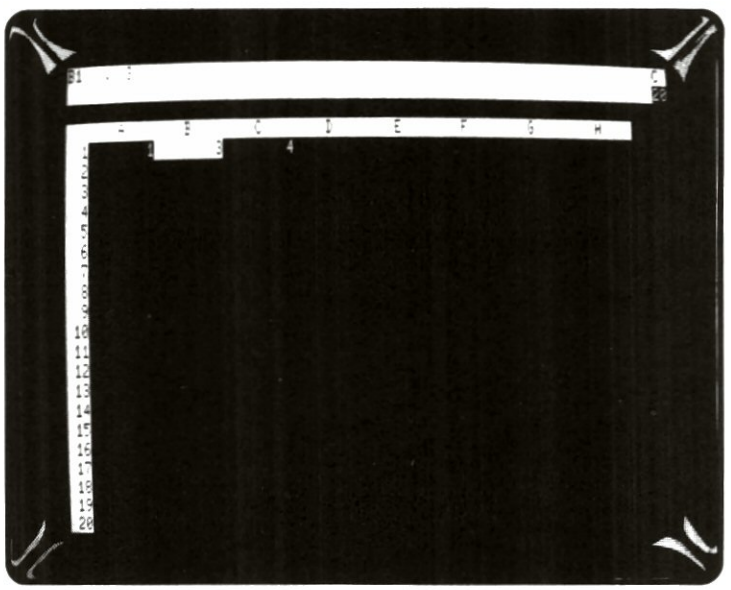


4. **/D**

Prompt line: Delete: R C

5. **C**

The screen should look like the following photograph:



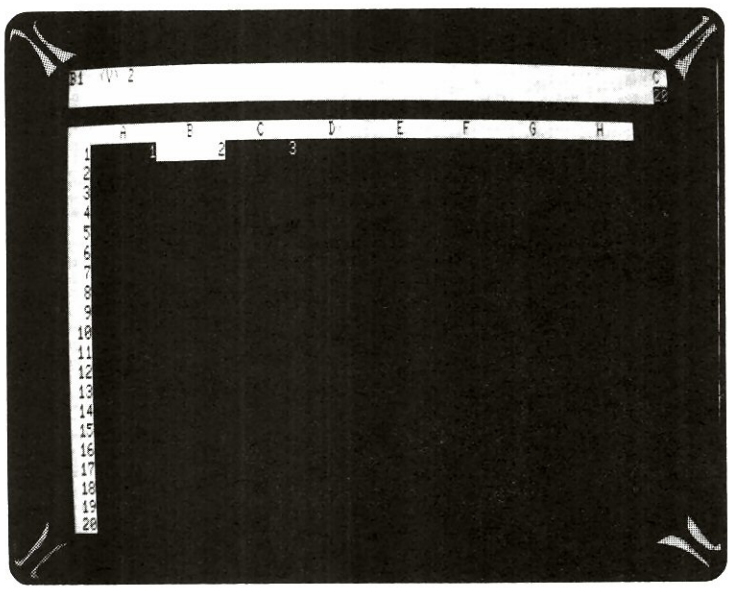
6.	➡	Entry line: C1 (V) 1+B1 When column B was deleted, all columns to the right moved left to fill the gap. This formula has been changed from 1+C1 to 1+B1 so that it still refers to the value you entered at C1 in step 2.

Note: Use the Delete command with care. You cannot recover the information from a row or column once you have deleted it. (The Insert command recreates only the space for a row or column, not the actual entries.)

If you delete an entry that is referenced in a formula at another location, all locations that refer to the deleted entry display ERROR.

Example

	Type:	**Result:**
1.	/CY	The worksheet clears and the cursor moves to A1.
2.	1➡2➡1+B1⬅	The screen should look like the following photograph:

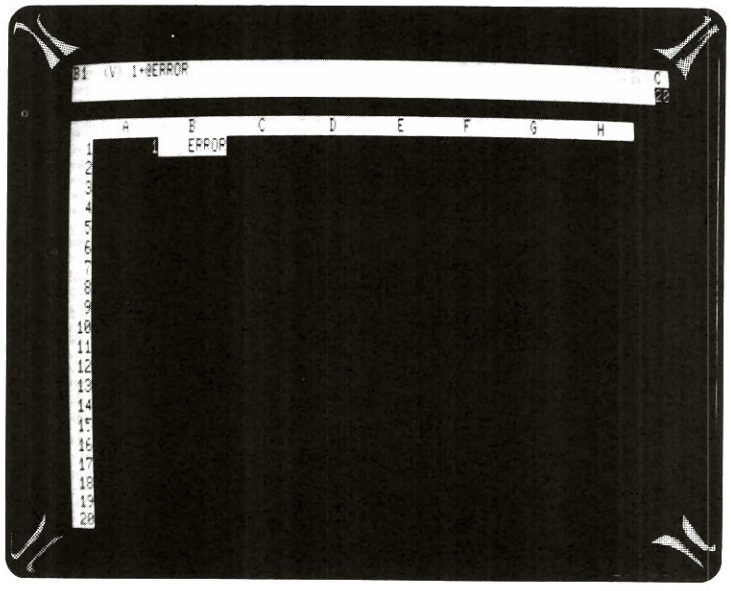


3. /D
4. C

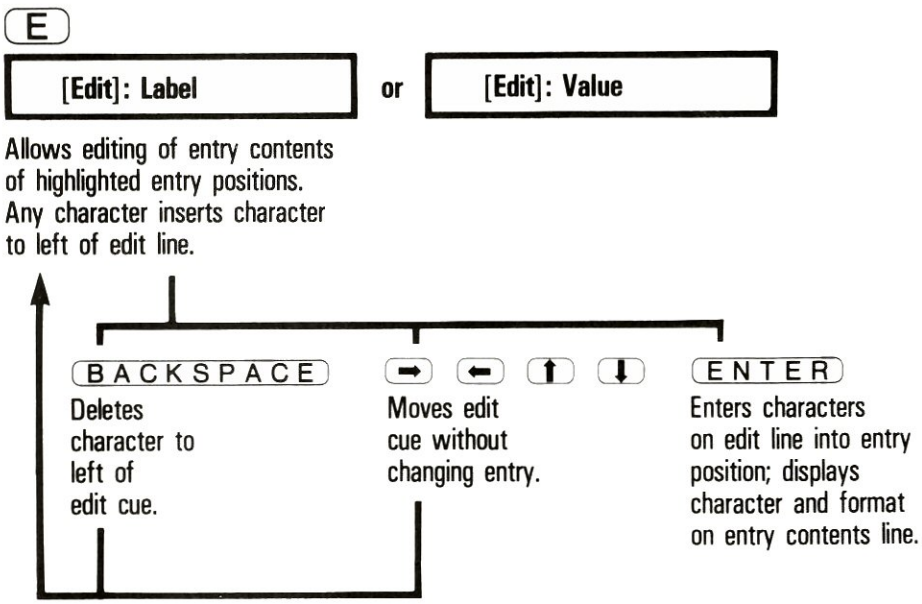
Prompt line:	Delete: R C
Entry line:	B1 (V) 1 + @ERROR
Position B1:	ERROR

Column B was deleted and the contents of Column C moved over. Position B1 (formerly C1) displays ERROR because its formula refers to the row that was deleted. The formula (displayed on the entry line) has changed: the former reference to B1 now reads @ERROR, the Error function.

The screen should look like the following photograph:



Edit Command



The Edit Command lets you change an entry without retyping the entire value or label. You can insert or delete characters anywhere in the entry; this is especially helpful when you must change a long or complex formula. The two forms of the Edit Command can be used either to edit something being typed on the edit line ([CTRL]-E) or to edit an entry already written on the worksheet (/E).

After the Edit command is typed, the entry to be edited is on the edit line. If /E was used, the edit cue is at the beginning of the edit line; if [CTRL]-E was used, the edit cue is at the end of the edit line. The edit cue can be moved along the edit line without affecting the entry. Typing ← moves it left one character, → moves it right; ↑ moves it to the beginning of the line and ↓ moves it to the end. Typing [**BACKSPACE**] erases the character to the left of the edit cue; typing any other character inserts that character to the left of the edit cue.

Type [**ENTER**] to end the edit command or [**BREAK**] to cancel it.

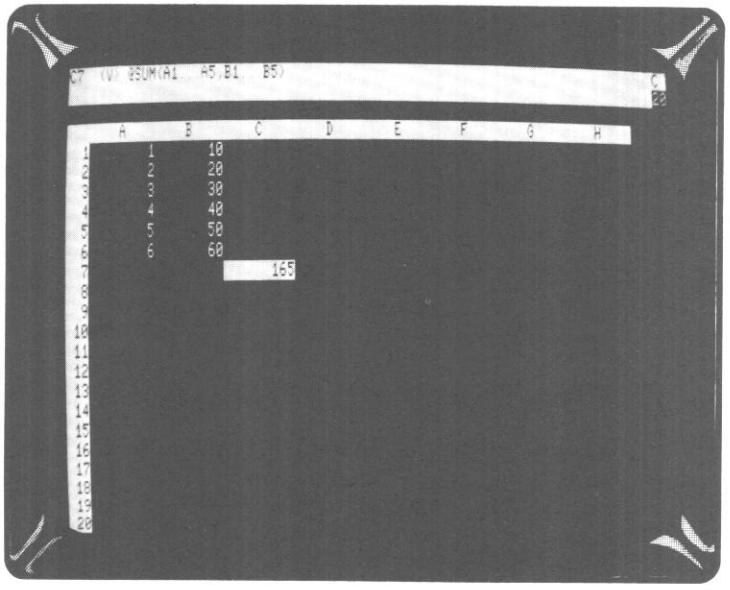
Example: To edit the entry at the cursor location, type /**E**. To edit an entry being typed (not yet written on the worksheet), type [**CTRL**]-**E**.

	Type:	**Result:**
1.	/**CY**	The screen clears and the cursor moves to A1.
2.	**misteak**	Entry line: Label Edit line: misteak The edit cue follows the k.
3.	[**CTRL**]-**E**	Prompt line: [Edit]: Label Edit line: misteak The edit cue follows the k.

4.	← ←	Edit line: misteak The edit cue highlights the a.
5.	[BACKSPACE]	Edit line: mistak The edit cue still highlights the a.
6.	↓	Edit line: mistak The edit cue follows the k.
7.	e [ENTER]	Entry line: A1 (L) mistake Prompt line: clear Edit line: clear A1: mistake

Example: To edit an entry already written on the worksheet, the cursor must be positioned at the location of the entry to be changed.

	Type:	Result:
1.	/CY	The screen clears and the cursor moves to A1.
2.	1↓2↓3↓4↓5 ↓6 [ENTER] >B1 [ENTER] 10↓20↓30↓ 40↓50↓60→↓ @SUM(A1.A5,B1.B5)[ENTER]	The screen should look like the following photograph:



3. /E	Prompt line:	[Edit]: Value
	Edit line:	@SUM (A1...A5, B1...B5)
	C7:	165
	The edit cue highlights the @.	
4. ➡ 12 times	Edit line:	@SUM (A1...A5, B1...B5)
	The edit cue highlights the comma following A5.	
5. [BACKSPACE]	Edit line:	@SUM(A1...A, B1...B5)
	The edit cue remains over the comma.	
6. 6	Edit line:	@SUM (A1...A6, B1...B5)
7. ⬅ ⬇	The edit cue highlights the).	
8. [BACKSPACE]	Edit line:	@SUM (A1...A6, B1...B)
9. 6	Edit line:	@SUM (A1...A6, B1...B6)
10. [ENTER]	Entry line:	C7 (V) @SUM (A1...A6, B1...B6)
	Prompt line:	clear
	Edit line:	clear
	C6:	231

The value at C7 changes to 231 because the @SUM function was changed to add A6 and B6 to the ranges.

File Names

The worksheet is saved in a *file*. Every file on a diskette must have a different *file name* to distinguish it from the other files.

A file name can be up to 8 characters long. The first character must be a letter; the remaining characters can be any letter or number. File names cannot include punctuation, the space character, or any control character or other special characters.

The following file names are invalid:

1budget	Begins with a number.
budget%	Includes an illegal character (%).
budgetone	Too long (9 characters).

Disk Drive Suffix

The file name can be followed by a colon (:) and a number to specify the disk drive (e.g. budget:2). A :4 is used when storing to the hard disk.

File Type Suffix

The VisiCalc program adds a suffix to a file name to identify how a worksheet was saved:

/VC	Normal (Saved with /SS).
/PRF	Print format (Saved with /PF).
/DIF	Data Interchange Format (Saved with /S#S).

See "Storage Command" and "Print Command" in this chapter for a description of these different ways of storing the worksheet. You needn't type the suffix, but the VisiCalc program accepts it if you do.

The suffix distinguishes between file names that otherwise are identical. It's not uncommon to have a file name that differs only in the suffix: "BUDGET/VC," "BUDGET/PRF," and "BUDGET/DIF" are all valid, different file names.

If you save a file with the same name as a file already on the diskette, the file on the diskette is erased and the file you save replaces it. This is fine if you're saving a new version of a worksheet, but could cost you a valuable file if you do it inadvertently. The Storage Command, therefore, asks you to confirm that you want to replace the old version before it stores the new one.

Format Command

(F)

Format: D G I L R $ *

(D)
Defaults to global format of current window.

(G)
General format.

(I)
Integer displays.

(L)
Left aligns entry.

(R)
Right aligns entry.

($)
Dollars and cents displays.

(*)
Displays integer value as stars for bar graphs.

The Format command controls how an entry is displayed or printed. It applies to one location on the worksheet; the effect is called a *local format*.

Note: The Format option of the Global command controls how the entire worksheet is displayed in a window; the effect is called the *global format*. A local format overrides the global format. When the VisiCalc program is loaded (or cleared with the Clear command) the global format is General, which displays values to the maximum precision possible, labels are left aligned and values are right aligned.

Each location on the worksheet can be assigned a local format. The actual entry (whether a label or value) is not affected by the Format command, only the appearance of the entry. The entry line shows the value or label as it was entered; the full precision of a value is used in calculations.

The entry line shows the local format (if any) assigned to a location. The local format is assigned to the entry, not the location; if the entry is moved to another location, the local format moves with it. Erasing the contents of an entry position with the Blank command, however, does not remove a local format. Clearing the worksheet with the Clear command removes all local formats.

To assign a format to a row or column before writing on it, format the first entry and replicate the format with the Replicate command across the row or down the column.

The width (number of spaces) of an individual location or column cannot be changed. The Column Width option of the Global command changes the width of every column displayed in the window; if the screen is split into two windows, each window can have its own column width.

The following example illustrates all the Format command options. Type this example and save it; it is used to illustrate all the options:

Example

	Type:	Result:
1.	**/CY**	The worksheet clears, the cursor moves to A1, and the global format is set to General.
2.	**Label entry➡1.23456789 ➡ 99.999 [ENTER]**	One label and two values are displayed.
3.	**/SSformex [ENTER]**	The example is saved in a file named formex/VC.

Default Format

The Default format is the format last set with the Global command. If no global format is in effect, the Default is the General format, described later in this topic.

This example first uses the Global command to set the global format so that all numbers are displayed with two decimal places (Dollars-and-cents format, specified with $), uses the Format command to set the local format at C1 to Integer, then uses the Format command again to default to the global Dollars-and-cents format.

Example

	Type:	Result:	
1.	Load or type the sample worksheet.		
2.	**/GF$**	Entry line: B1: C1:	C1 (V) 99.999 1.23 100.00
		The worksheet is displayed in Dollars-and-cents format.	
3.	**/FI**	Entry line: B1: C1:	C1 /FI (V) 99.999 1.23 100
		C1 is now displayed in integer format; B1 is unchanged.	
4.	**/FD**	Entry line: B1: C1:	C1 (V) 99.999 1.23 100.00
		The Default format is Dollars-and-cents because that was the last global format set.	

Even though the entry at C1 was displayed in three different formats, the actual value—as shown on the entry line—remained the same.

General Format

The General format is in effect when you load the VisiCalc program or clear the worksheet:

- Numeric values are displayed to the maximum precision possible in the column width, aligned with the right edge of the column. The leftmost position of each column is blank so that values won't run together across the worksheet.
- Labels are displayed aligned with the left edge of the column. The label is displayed only to the right edge of the column, but the full label is kept in memory (and displayed on the entry line).

This example uses the Global command to change the global format to Integer, then uses the Format command to set the local format at C1 to General.

Example

	Type:	**Result:**	
1.	Load or type the sample worksheet.		
2.	**/GFI**	Entry line: B1: C1:	C1 (V) 99.999 1 100
		The Integer format controls the entire worksheet and has rounded both entries.	
3.	**/FG**	Entry line: B1: C1:	C1 /FG (V) 99.999 1 99.999
		The local format at C1 is General, so the value is displayed just as it was when the global format was General. B1, however, is still controlled by the global Integer format.	

Integer Format

Integer format displays all values rounded to the nearest whole number.

Example

	Type:	**Result:**	
1.	Load or type the sample worksheet.		
2.	**/FI**	Entry line: B1: C1:	C1 /FI (V) 99.999 1.234568 100
		C1 is rounded to the nearest integer. B1 is still controlled by the global format (General).	

Left-aligned Format

The Left-aligned format displays a label aligned with the left edge of the entry position, and a value aligned with the second space of the entry position. The first character of each entry position is left blank when a value is displayed to keep columns from running together across the worksheet.

This format causes values to be displayed as in the General format (maximum precision); decimal values cannot be displayed both as rounded integers and left-aligned.

Example

	Type:	Result:
1.	Load or type the sample worksheet.	
2.	**/FL**	Entry line: C1 /FL (V) 99.999 B1: 1.234568 B2: 99.999 The value at C1 moves to the left side of the entry position (the first position remains blank).
3.	**/FI**	Entry line: C1 /FI (V) 99.999 B1: 1.234568 C1: 100 The Integer format rounds the value at C1 to 100 and displays it aligned with the right edge of the column.
4.	**/FL**	Entry line: C1 /FL (V) 99.999 B1: 1.234568 C1: 99.999 The value at C1 is displayed just as it is in the General format (maximum precision) and moved to the left of position C1 (the first position remains blank).

Right-aligned Format

The Right-aligned format displays a label or value aligned with the right edge of the entry position.

Example

	Type:	Result:
1.	Load or type the sample worksheet.	
2.	**>A2 [ENTER]**	Cursor moves to A2.

3. **Label [ENTER]**	Entry line:	A2 (L) Label
4. **/FR**	Entry line:	A2 /FR (L) Label
	Label shifts to the right of entry position A2.	
5. **>A1 [ENTER]**	Entry line:	A1 (L) Label entry
	A1:	Label ent
6. **/FR**	Entry line:	A1 /FR (L) Label entry
	A1:	Label ent
	Because the label fills all of position A1, it can't move to the right. As the entry line shows, however, the Right-aligned format is assigned to the entry location.	
7. **/GC14 [ENTER]**	Now the label is moved in the entry position to be aligned with the right edge because the label is shorter than the column width and can be moved within the entry position.	

Dollars-and-cents Format

The Dollars-and-cents format displays all values rounded to two decimal places; it adds two decimal places (.00) to integers and an extra 0 to values with just one decimal place. A $ is not displayed. The command has no effect on labels.

Example

Type:	**Result:**	
1. Load or type the sample worksheet.		
2. **/F$**	Entry line:	C1 /F$ (V) 99.999
	C1:	100.00

Graph Format

The Graph format displays the number of asterisks equal to the truncated (not rounded) integer value of the entry location. An entry position can display one fewer asterisk than the column width (the first position is blank).

Example

Type:	**Result:**
1. **/CY**	The worksheet clears and the cursor moves to A1.
2. **1↓2↓3↓4↓5 ↓ >B1 [ENTER]**	Puts a column of numbers in column A.

3.	**/F***	Sets the Graph format at B1.
4.	**+ ← [ENTER]**	The formula +A1 sets B1 equal to A1.
5.	**/R[ENTER] ↓ .B5 [ENTER]R**	Replicating the formula with a relative reference to A1 sets B2-B5 equal to A2-A5. Now the values are displayed as numbers in column A and a bar graph in column B.

Any number typed at A1-A5 is displayed as a number in column A and a bar of asterisks in column B. (A number larger than the column width displays the maximum number of asterisks, one less than the column width.) See "Transcendental Functions and Graphing" in Lesson Five for more detailed examples of the graph function.

Functions

Functions perform more complex calculations than simple addition, subtraction, multiplication, or division. Some functions save the effort of typing frequently-used formulas (such as adding the values of a range of locations); some perform calculations that are not otherwise possible (such as trigonometric functions); and some choose alternative values for calculations (such as looking up tax rates from a table).

A function can be used anywhere a formula can be used. It consists of the name of the function (which always begins with @) followed by an argument (or list of arguments) in parentheses. An argument consists of the values (formulas and references to other locations) the function uses to calculate its own value.

The @SUM function, for example, could be written:

@SUM(B1,S2,A4*.23)

This adds the value of locations B1 and S2, and .23 times the value of location A4.

An example of the @SQRT function:

@SQRT(625)

Its value is 25, the square root of 625.

The @CHOOSE function selects one of several alternative values based on the value of the first argument:

@CHOOSE(A4,17,8,23,44)

The value of this function depends on the value of its first argument, A4. If A4 is 1, the value is 17; if A4 is 2, the value is 8; and so forth.

The @ starts a value entry (no preceding + is necessary).

Functions That Use a Single Argument

The arithmetic and trigonometric functions require a single argument.

Arithmetic Functions

The functions in the following table perform the listed arithmetic calculation on a single argument (specified by v in the table):

Function	Result
@ABS(v)	Absolute value of the argument.
@EXP(v)	e (2.71828...) to the power specified by the argument.
@INT(v)	Integer portion of the argument.
@LN(v)	Natural log (base e) of the argument.
@LOG10(v)	Logarithm (base 10) of the argument.
@SQRT(v)	Square root of the argument.

Trigonometric Functions

The functions in the following table perform the listed trigonometric calculation on a single argument. All angles are specified in radians (2 pi radians = 360 degrees):

Function	Result
@SIN(v)	Sine of the argument.
@COS(v)	Cosine of the argument.
@TAN(v)	Tangent of the argument.
@ASIN(v)	Arc sine of the argument.
@ACOS(v)	Arc cosine of the argument.
@ATAN(v)	Arc tangent of the argument.

Functions That Use a List of Arguments

The functions in the following table perform a calculation with a list of arguments (represented by list in the table). The arguments are separated with commas:

Function	Result
@AVERAGE(list)	Arithmetic mean of the values in the list. The result is equivalent to @SUM(list) divided by @COUNT(list).
@COUNT(list)	Number of non-blank entries in the list.
@MAX(list)	Largest value in the list.
@MIN(list)	Smallest value in the list.
@SUM(list)	Sum of each value in the list.

Net Present Value—@NPV

The @NPV function calculates the net present value of future cash flows. It takes two arguments: the discount rate, or cost of money, used to discount the future cash flows, and a range of locations that include the cash flows themselves.

Functions Without Arguments

Several functions do not require an argument.

@PI: @PI is the ratio of the circumference of a circle to its diameter, 3.1415926536.

@NA and @ERROR: @NA (Not Available) is used when a worksheet is set up before the data is written. Because a blank location evaluates to 0, ERROR is displayed at each location where zero appears as a denominator and incorrect or misleading values can be produced at other locations.

Writing @NA at the blank locations causes the VisiCalc program to evaluate all entries that refer to those positions as NA. All formulas on the worksheet are legal.

The result of an illegal calculation is displayed on the worksheet as ERROR. This can be caused by a too-deep nesting of (or +, an error in writing a formula, or deleting a row or column that is referenced in a formula at another location. ERROR is displayed at the entry position that contains the error and all locations that refer to it.

The @ERROR function causes ERROR to be displayed at the location where it is entered and all locations that refer to it.

@TRUE and @FALSE: @TRUE and @FALSE are used with the logic functions described later in this section. They cause TRUE or FALSE to be displayed at the locations where they are entered. The values TRUE and FALSE are also displayed when the comparison operators (<, >, =, <=, >=, and <>) are used.

Logic Functions

A logical value is one whose value is either TRUE or FALSE. A logic function is one that manipulates logical values. Logical calculations are similar to mathematical operations, but operate only on this special set of values.

Comparison Operators: The comparison operators work on two numeric values and evaluate to a logical value. The equal (=) and not equal (<>) operators can be used to compare logical values. For example, the formula 4>1—four is greater than one—evaluates to the logical value TRUE. The formula 5=3—five is equal to three—evaluates to the logical value FALSE.

These comparisons can be used either as entries on the worksheet or arguments in a logic function. If used as entries on the worksheet, they should not be written at a location referenced by a function that does not use logic functions. If this happens, the value of such functions is ERROR.

The following table lists the comparison operators (it assumes the operator is preceded by *value1* and followed by *value2*):

Operator	Logical Value
<	TRUE if *value1* is less than *value2*, FALSE if it is not.
>	TRUE if *value1* is greater than *value2*, FALSE if it is not.
=	TRUE if *value1* is equal to *value2*, FALSE if it is not.
<=	TRUE if *value1* is less than or equal to *value2* , FALSE if it is not.
>=	TRUE if *value1* is greater than or equal to *value2*, FALSE if it is not.
<>	TRUE if *value1* is not equal to *value2* , FALSE if it is equal.

@NOT: @NOT takes a single logical value as its argument (i.e., one whose value is TRUE or FALSE); the function's value is the opposite logical value. The value of @NOT(A1) is FALSE if A1 is TRUE and TRUE if A1 is FALSE. If the value of A1 is NA, the value of @NOT(A1) is also NA. If the value of the argument is anything other than TRUE, FALSE, or NA, the value of the @NOT function is ERROR.

@AND: @AND takes any number of arguments, each of which must be a logical value or a range of logical values. Its value is TRUE if all the arguments are TRUE, FALSE if any of the arguments is FALSE. If any of the arguments is not logical or evaluates to ERROR, the value of @AND is ERROR. If any of the arguments evaluates to NA and all other arguments are TRUE or FALSE, the value of @AND is NA.

@OR: @OR takes any number of arguments, each of which must be a logical value or a range of logical values. Its value is TRUE if any of the values is TRUE and FALSE if all the values are FALSE. If any of the arguments is not logical or evaluates to ERROR, the value of @OR is ERROR. If any of the arguments evaluates to NA and all other values are TRUE or FALSE, the value of @OR is NA.

@IF: @IF takes three arguments. The first must be a logical value; the second and third can be any value. The function evaluates to the value of the second or third argument, depending on the value of the first:

Value of First Argument	Value of @IF
@TRUE	Value of second argument
@FALSE	Value of third argument
@NA	NA
Not logical or @ERROR	ERROR

For example, the value of @IF(D5,2,3) is 2 if D5 is TRUE and 3 if D5 is FALSE. The value of @IF(D5,E1,E2) is the value of E1 if D5 is TRUE and the value of E2 if D5 is FALSE.

@ISNA and @ISERROR: @ISNA takes one argument. Its value is TRUE if the value of the argument is @NA and FALSE if the value of the argument is anything else.

@ISERROR takes one argument. Its value is TRUE if the value of the argument is ERROR, and FALSE if the value of the argument is anything else.

@ISNA and @ISERROR are used to manipulate entries written as @NA or @ERROR and return a value that is not automatically designated NA or ERROR.

Functions That Select Alternative Values

Two functions can be used to select alternative values for calculations. These allow the worksheet to handle different situations or projections.

@CHOOSE: The @CHOOSE function takes one of the values in its list of arguments. The first element in the list is the index to the following arguments.

For example, in @CHOOSE(A4,17,6,33,39), A4 is evaluated first. If A4 is 1, the result is 17; if A4 is 2, the result is 6; and so on.

@CHOOSE evaluates to NA if the first argument is zero or less, or if the value of the first argument is greater than the number of remaining arguments.

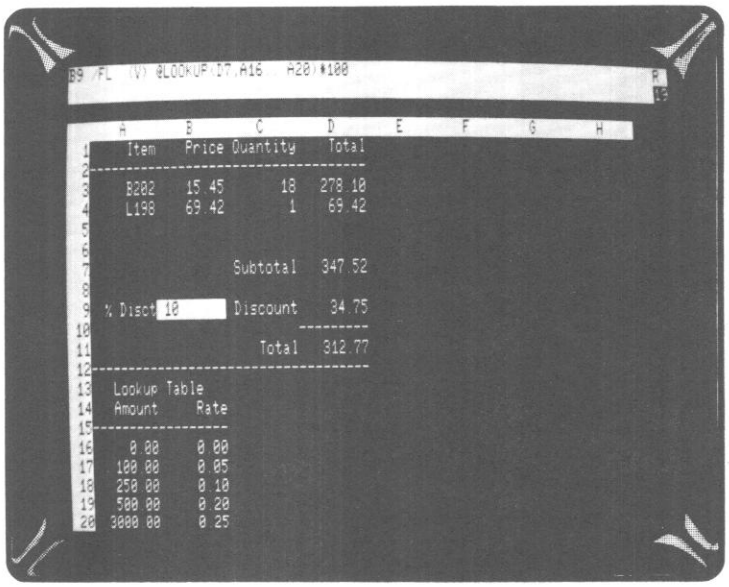
@LOOKUP: The @LOOKUP function looks up a value in a table, a form of calculation frequently used in financial calculations. Tax calculations, for example, require looking up gross pay in a tax table and using the corresponding tax rate.

@LOOKUP searches for a value in a range of locations and evaluates to a corresponding value from an adjacent range. The range to be searched can be in either a row or a column; the adjacent range must be in the column to the right of the range searched or the row below the range to be searched.

The value being looked up is compared to successive values in the range to be searched until a value is found that is larger than the value being looked up (or until the end of the table is reached). The entry in the adjacent range that precedes the match position is the value that the @LOOKUP function assumes.

Two arguments are required: the first is the value to be searched for, and the second specifies the range that contains the table of values to be searched.

The @LOOKUP function can be used to calculate an invoice. The total amount of goods purchased is looked up in a table, and the corresponding value from the adjacent range is used as the discount percentage to calculate the discount, and then the total amount of the invoice is found. Those calculations are shown in the following photograph:



The lookup table is in positions A16-A20. The cost of goods purchased is at D6. The @LOOKUP function is written at B9:

```
@LOOKUP(D7,A16...A20)*100
```

Multiplying the value by 100 makes it a percentage that is later divided by 100 (at D9). Although the lookup range is technically a forward reference, it makes no difference in this case because the values in the table are constants.

The formula at D9 is +D7*B9/100. The value at A20 is 3000.00, corresponding to a discount of 0.25 at B20. If the invoiced items total 347.52, the discount is 10% (the value that corresponds to 250.00). If the invoiced items total 3000.00, the discount is 25%.

The R in the upper-right corner of the screen indicates that the worksheet is recalculated by row because the price-times-quantity calculations are made across rows. The left-aligned format (indicated by /FL in the entry line) is used to improve the readability of the display; for a description of display formats, see "Format Command" in this chapter.

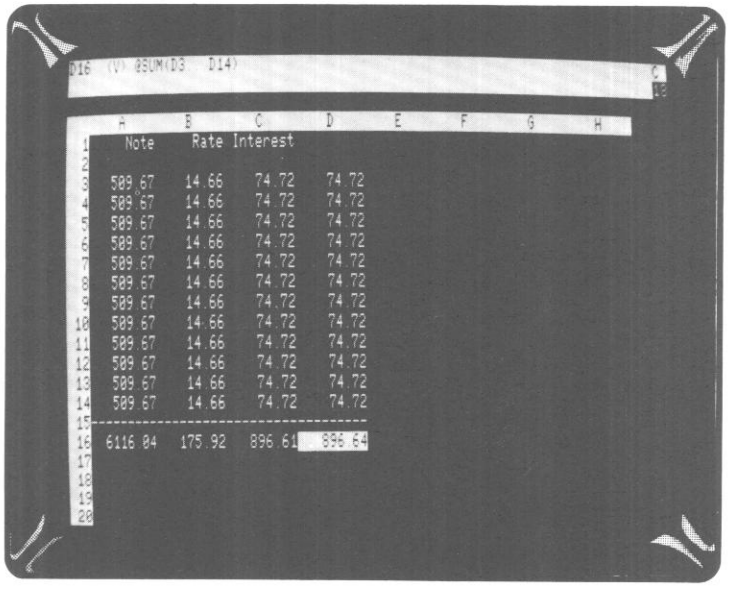
Making the VisiCalc Program Less Precise

Because the VisiCalc program calculates and rounds to 11 (and sometimes 12) decimal places, differences of pennies and even dollars can occur between VisiCalc results and those produced by ordinary 2-place precision calculations. This difference can cause problems when attempting to balance books and during audits.

To solve this problem, you can use the following *rounding formula* to reduce the calculating precision to just two decimal places:

(@INT((*coord*)*100+.5))/100

coord is the location of the original formula. For example, assume there are twelve notes worth $509.67 each. The interest paid on those notes is 14.66%. What will the value of the twelve notes be after one year? The following photograph illustrates the effect of the rounding formula:



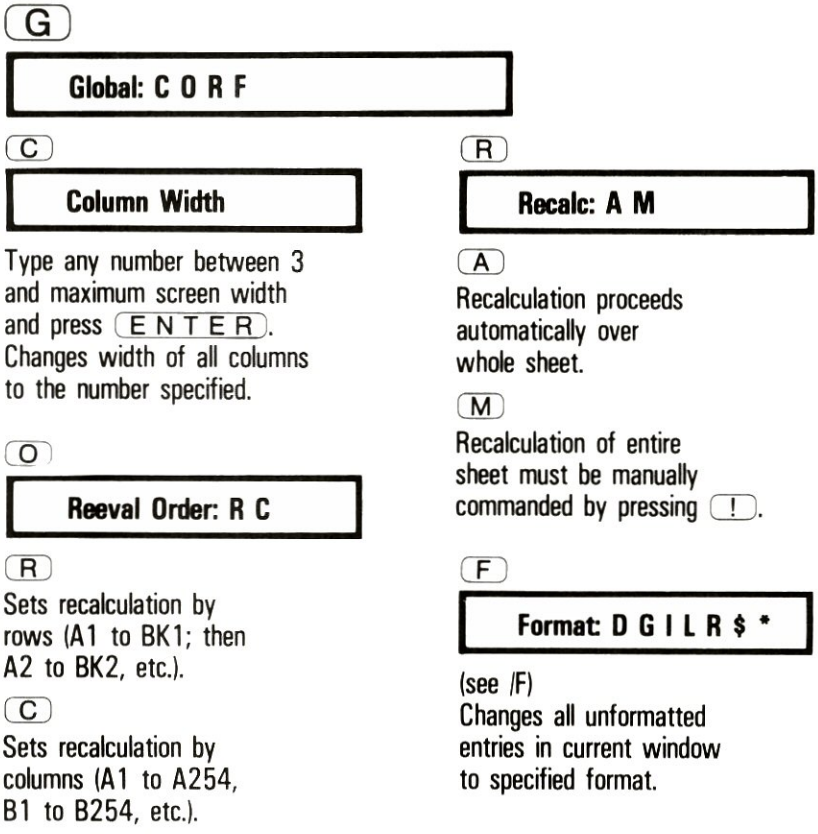
The value 74.717622 is rounded to 74.72 *for display only*. Column C shows the result of multiplying the full precision by twelve: 896.61. Column D shows the result of multiplying the rounded amount by twelve (the result produced by a calculator or paper and pencil): 896.64. If the difference of 3 cents isn't acceptable, a rounding formula can be used.

The formula at C3, which produces the more accurate result, is +A3*B3/100. The rounding formula, at D3, is:

(@INT((C3)*100 + .5))/100

The rounding formula is replicated from D4 to D14; the @SUM function is used at D16 to add D3 through D14. This sum matches the less-precise calculation because the rounding formula has held precision to two decimal places.

Global Command



The Global command affects the entire display in a window. In cases where the window is split into 2 windows, the user may have a different Global format (/GF), or column setting (/GC), in each window. When returning to one window (/W1), the global settings in the window where the cursor lies when the command is given will take precedence.

The command has four options:

C	Column Width
O	Order of Recalculation
R	Recalculation Priority (Automatic or Manual)
F	Format

Column Width—/GC

The Column Width option changes the width of all columns in a window. The minimum width is 3; the maximum is the width of the screen less 3 (for the row numbers down the left side). Individual column widths cannot be set.

As many columns as possible are displayed. Setting the column width to half the maximum or more removes vertical titles.

Changing the column width changes the way some entries are displayed. Labels longer than the column width are truncated. Values can be affected in one of three ways:

- Numbers are rounded when necessary.
- Numbers are displayed in scientific notation if this allows greater precision.
- The entry location is filled with > signs if the number is too large to be represented in any form.

These changes affect only the way entries are displayed. Values and labels are unchanged in memory. The entry line displays the full value or label at the cursor location, regardless of how the entry is displayed.

Example

	Type:	**Result:**	
1.	**/CY**	The worksheet clears, the cursor moves to A1, and the column width is set to 9.	
2.	**This line is too long. [ENTER]**	Entry line:	A1 (L) This line is too long.
		A1:	This line
3.	**/G**	Prompt line:	Global: C O R F
4.	**C**	Prompt line:	Column width
5.	**18 [ENTER]**	Entry line:	A1 (L) This line is too long.
		A1:	This line is too l
6.	**/GC22 [ENTER]**	The entire label is displayed.	

Numbers are rounded as necessary to fit in the entry location. If a number is too large to display in the number of available spaces (the column width less 1), the entry location is filled with > signs.

Example

	Type:	Result:	
1.	**/CY**	The worksheet clears and the cursor moves to A1.	
2.	**123456789 [ENTER]**	Entry line:	A1 (V) 123456789
		A1:	1.2346E8
		The first column position is blank. The number is displayed in scientific notation, with the final digit rounded up.	
3.	**➡ 1.23456789 [ENTER]**	Entry line:	B1 (V) 1.23456789
		B1:	1.234568
4.	**/GC3 [ENTER]**	Entry line:	B1 (V) 1.23456789
		A1:	>>
		B1:	1.
		A1 cannot represent the number in any form. The number at B1 is rounded.	

Order of Recalculation Option—/GO

The Order of Recalculation option tells the VisiCalc program whether it should recalculate the worksheet by rows or by columns. The order of recalculation is noted by the letter in the upper right corner of the screen—C for Column-order recalculation, R for Row-order. When the VisiCalc program is loaded, it is set for column-order recalculation.

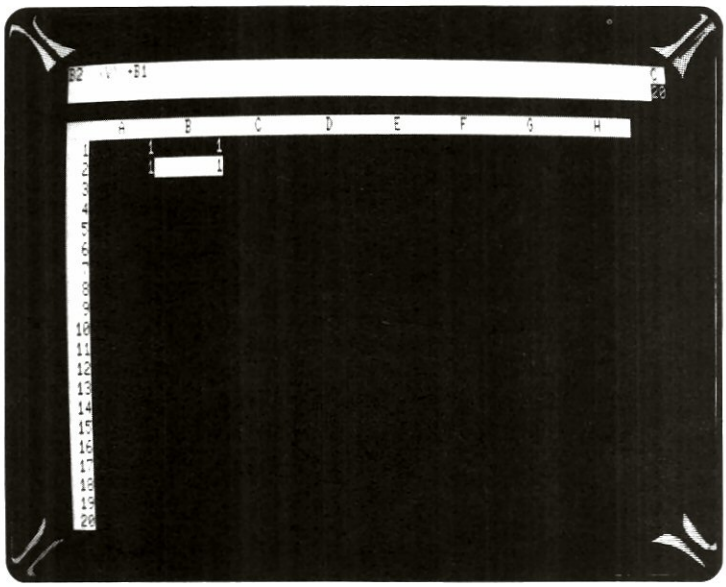
When the VisiCalc program calculates in *column* order, it begins at A1 and works down column A until it comes to the final entry in that column. Then it moves to B1 and works its way down to the last entry in that column. This continues until all values are calculated.

When the VisiCalc program calculates in *row* order, it begins at A1 and works across row 1 until it comes to the final entry in that row. Then it moves to A2 and works its way across to the last entry in that row. This continues until all values are calculated.

If the VisiCalc program appears to evaluate formulas incorrectly, formulas may be written at locations where they are calculated before locations they reference are calculated (a condition called a *forward reference*). Order of recalculation is described in more detail under "Values" in this chapter and "Order of Recalculation" in Lesson Four. "Forward and Circular References" in Lesson Four describes these conditions and how to circumvent them.

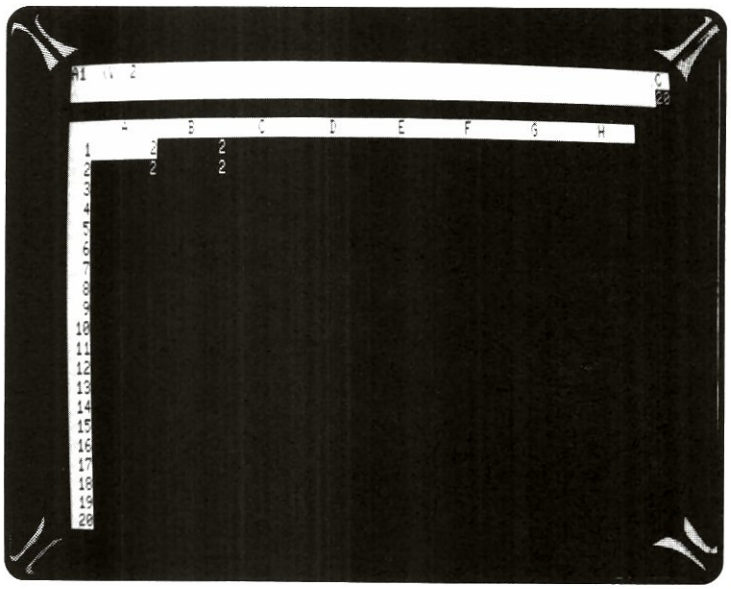
Example: The following example requires column-order recalculation to produce correct results, and shows what happens when the worksheet is recalculated by rows.

	Type:	**Result:**
1.	**/CY**	The worksheet clears, the cursor moves to A1, and column-order recalculation is set.
2.	**1 ↓ +A1 [ENTER]** **>B1 [ENTER]** **+A2 ↓ +B1 [ENTER]**	The screen should look like the following photograph:



3. >A1 [ENTER] 2 [ENTER]

A1 changes to 2 and the other values are recalculated. The screen should look like the following photograph:

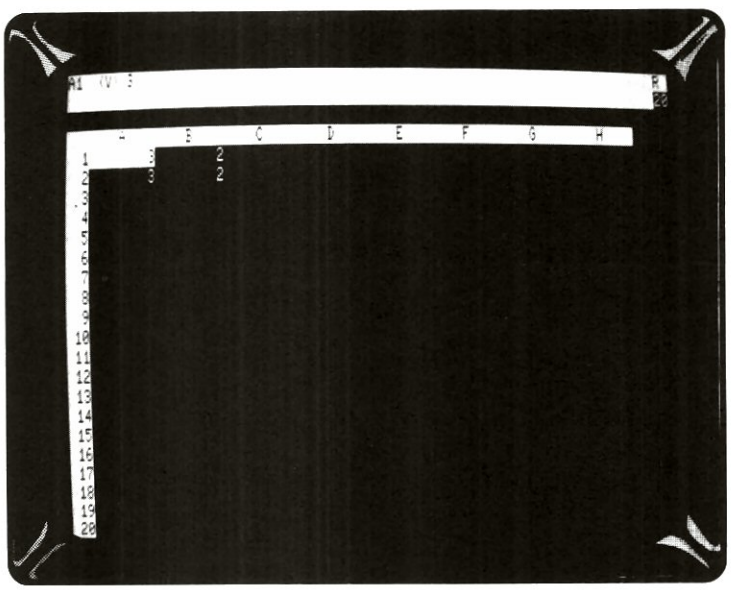


4. /GOR

The order of recalculation indicator changes to R.

5. 3 [ENTER]

The screen should look like the following photograph:



This is incorrect. B1 should be the same as A2, but it displays a different value because B1 was recalculated before A2 was recalculated. To get a correct result in a case like this, you must force a recalculation by typing ! when the prompt line is blank.

The ERROR value isn't necessarily displayed when you create a forward or circular reference. If you save the worksheet and reload it, however, ERROR is displayed at each location that contains a forward or circular reference. In this case, you must also force a recalculation by typing !.

Note: Because forward and circular references can make it difficult to use a worksheet, you should avoid writing them, and correct them when you find them. If you load a worksheet and the ERROR value is displayed at entry positions, check the formulas at those locations for forward or circular references unless you know the ERROR value is caused by division by zero.

Example: The next example requires row-order recalculation to produce correct results, and shows what happens when the worksheet is recalculated by columns.

	Type:	**Result:**
1.	**/CY**	The worksheet clears, the cursor moves to A1, and recalculation is set to column-order.
2.	**/GOR**	Changes to row-order recalculation.
3.	**1 ➡ +A1 [ENTER] >A2 [ENTER] +B1 ➡ +A2 [ENTER] >A1 [ENTER] 2 [ENTER] 3 [ENTER]**	The results are correct.
4.	**/GOC**	Changes to column-order recalculation.
5.	**4 [ENTER]**	These results, as in the previous example, are incorrect.
6.	!	The extra recalculation produces correct results.

Recalculation Priority Option—/GR

The Recalculation Priority option specifies whether the VisiCalc program recalculates the worksheet each time a value is typed, or whether the worksheet is recalculated only when ! is typed. Manual recalculation speeds entry of columns or rows of figures by eliminating the automatic recalculation after each entry.

In response to /GR, the prompt line reads:

```
Recalc: A M
```

The characters following Recalc: are options:

A	Automatic
M	Manual

Under manual recalculation, only the formula at the cursor location is recalculated. To update the worksheet, you must force a recalculation by typing !. This does not restore automatic recalculation; the Global command must be used again (/GRA).

Format Option— /GF

The Format option assigns a format to each entry position on the worksheet that does not have a local format. The formats available are the same as those for local formats; see "Format Command" in this chapter for their description.

If the screen is split into two windows, each can have a different global format.

Go To Command

(>)

Go To: Coordinate

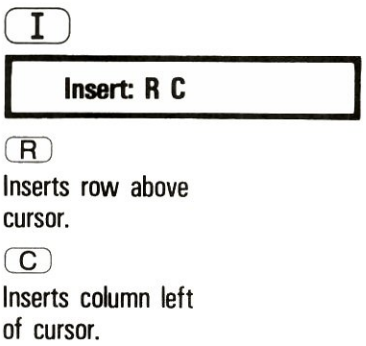
Enter entry coordinate.
(ENTER)
Moves cursor to specified entry position.

The Go To command moves the cursor directly to an entry position. It is invoked by typing >; the prompt line asks for the coordinate of the destination.

Example

	Type:	**Result:**
1.	>	Prompt line: Go to: Coordinate
2.	**B20 [ENTER]**	The cursor moves to location B20 (column B, row 20).

Insert Command



The Insert command places space for an additional row or column on the worksheet.

In response to /I, the prompt line reads Insert: R C. The R and C are options:

R	Insert a Row
C	Insert a Column

An individual entry location cannot be inserted, only an entire row or column.

When a row or column is inserted into the range of a function, the range is expanded to include the insertion. (A row or column cannot be inserted before the first location or after the last location of the range; the point of insertion must lie between the first and last locations.)

Because rows move down and columns move to the right to make space for an insertion, a row cannot be inserted if row 254 contains an entry; a column cannot be inserted if column BK contains an entry. To make an insertion, the entries in these locations must be erased (with the Blank command) or moved (with the Move command) and the worksheet saved and loaded.

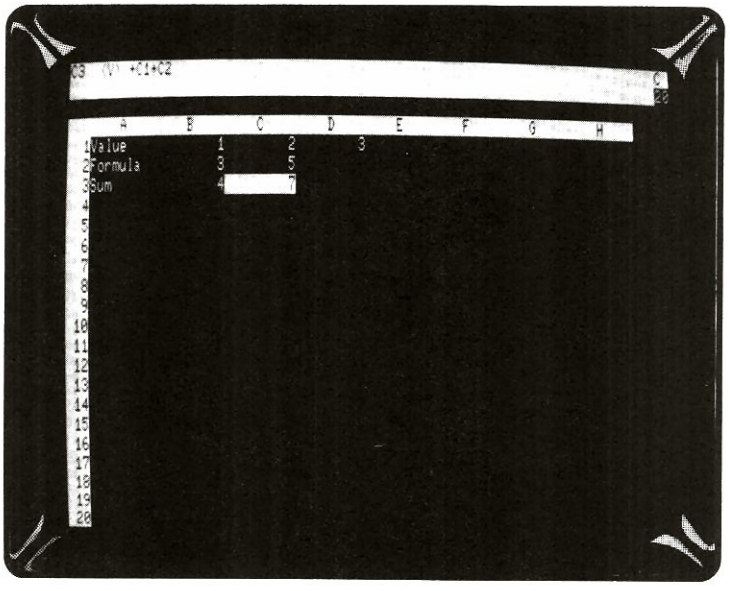
Row Option—/IR

The Row option inserts a blank row immediately above the row that contains the cursor. The row that contains the cursor and all rows below move down one to make room for the new row.

All location references in formulas on the worksheet are changed to correspond to the new coordinates of the rows that moved. For example, if a formula contains the coordinate C2 and a row is inserted above row 2, the coordinate in the formula is changed to C3.

Example

Type:	Result:
1. /CY	The worksheet clears and the cursor moves to A1.
2. **Value ➡ 1 ➡ 2 ➡ 3 [ENTER] >A2 [ENTER] Formula ➡ +B1+C1 ➡ +C1+D1 [ENTER] >A3 [ENTER] Sum ➡ +B1+B2 ➡ +C1+C2 [ENTER]**	Entry line: C3 (V) +C1+C2
	The screen should look like the following photograph:

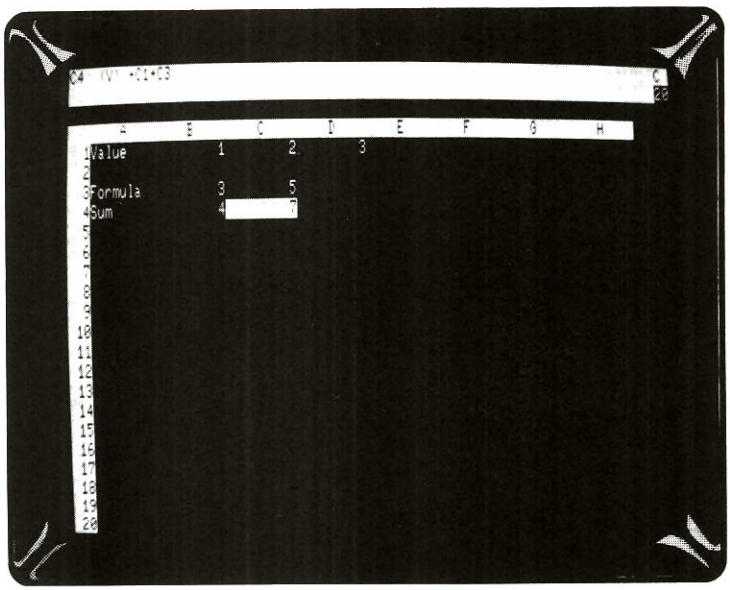


3. ↑	Cursor moves up to C2.
4. /IR	Row 2 moves down (becoming row 3), creating a new blank row 2.

5. ↓ ↓

Entry line: C4 (V)
+C1+C3

The location reference in the formula has changed because of the inserted row—from +C1+C2 to +C1+C3. The screen should look like the following photograph:



6. ↑ ↑ /DR ↓

Entry line: C3 (V)
+C1+C2

The new row is deleted and the formula returns to its original value.

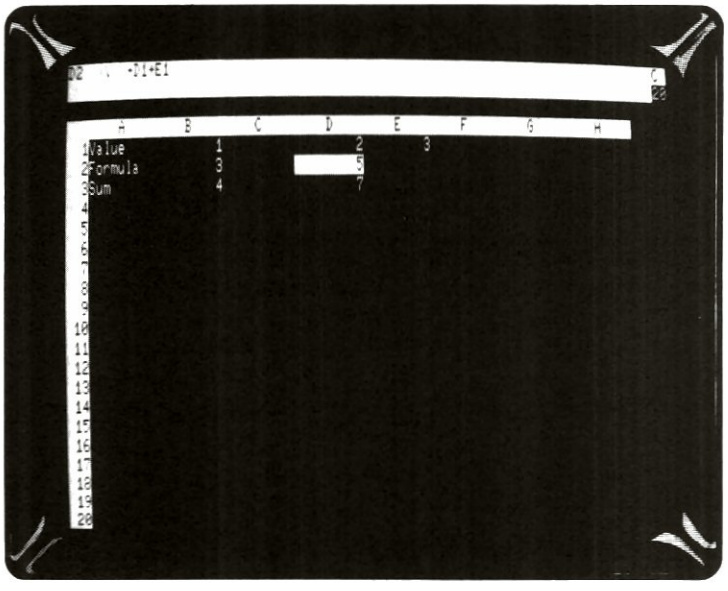
Column Option—/IC

The Column option inserts a blank column immediately to the left of the column that contains the cursor. The column that contains the cursor and all columns to the right move right one to make room for the new column.

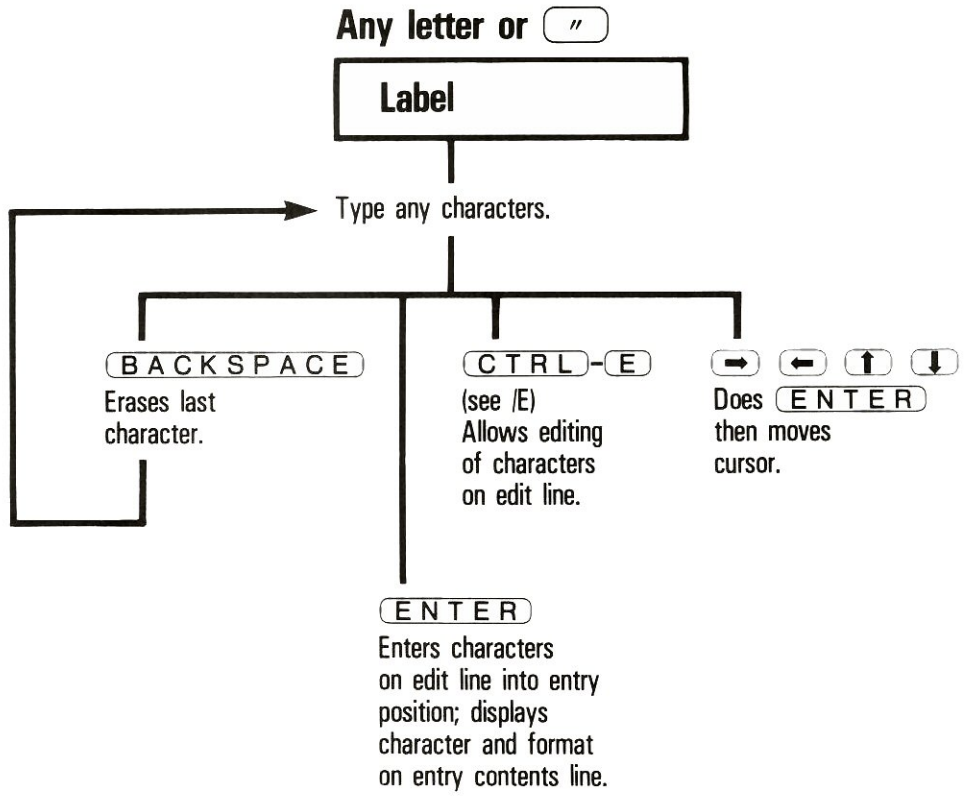
All location references in formulas on the worksheet are changed to correspond to the new coordinates of the columns that moved. For example, if a formula contains the coordinate C2 and a column is inserted to the left of column C, the coordinate is changed to D2.

Example

Type:	Result:
1. If the Row option example isn't on the screen, type steps 1 and 2 from the preceding example.	
2. ↑	Entry line: C2 (V) +C1+D1
3. **/IC**	Column C moves right (becoming column D), creating a new, blank column C.
4. →	Entry line: D2 (V) +D1+E1
	The location reference in the formula has changed to reflect the inserted column—from +C1+D1 to +D1+E1. The screen should look like the following photograph:



Labels



A label is an entry not intended to be used in calculations; it usually gives some information about the entries on the worksheet. All keyboard characters are allowed in a label.

When the prompt and edit lines are clear, the VisiCalc program looks at the first character typed to determine whether the entry is a label or a value. If the character is not a number or arithmetic operator, the entry is assumed to be a label. The prompt line reads Label and the edit line contains the character that was typed followed by the edit cue. As more characters are typed, they appear on the edit line.

The label is displayed at the cursor location as it is typed; it is not permanently written until [ENTER] or an arrow key is typed. If something else is written at that location, the label replaces it. If the label is longer than the column width, it is truncated on the display but the full length is kept in memory. When the cursor is at a location that contains a label, the entry line contains the coordinate, followed by (L) and the full label.

To display a label longer than the column width, write it in consecutive locations across a row. When the first position is filled, type → and the next part of the label; continue this until the entire label is written.

If you make a typing error while typing a label, type [BACKSPACE] to erase the last character typed and continue typing. The Edit command (CTRL-E and /E) can also be used to correct a label.

If a formula references a location that contains a label, the reference has a value of 0.

Example

	Type:	Result:	
1.	**>A1 [ENTER]**	The cursor moves to A1.	
2.	**P**	Entry line: Prompt line: Edit line: A1:	A1 Label P P
3.	**eriod**	Prompt line: Edit line: A1:	Label Period Period
4.	**[ENTER]**	Entry line: Prompt line: Edit line: A1:	A1 (L) Period clear clear Period
		If an arrow key is typed to end the label, the cursor moves to the next location in the direction specified by the arrow.	

To start a label with a character that would normally begin a value—a number, arithmetic operator, (, or @—type a quotation mark (") before you type the first character of the label. The " merely tells the VisiCalc program that the entry is a label; it isn't the first character of the label. The entry is treated as a label and evaluates to 0. You cannot reference a number typed as a label and get correct arithmetic results.

Example

	Type:	Result:	
1.	**>B1 [ENTER]**	The cursor moves to B1.	
2.	"	Prompt line: Edit line:	Label clear
3.	**.575*B2**	Prompt line: Edit line: B1:	Label .575*B2 .575*B2
4.	**[ENTER]**	Entry line: Prompt line: Edit line: B1:	B1 (L) .575*B2 clear clear .575*B2
		The (L) on the entry line identifies the entry as a lable. If the entry were a value, the entry line would contain (V) and B1 would contain the calculated value of the formula.	

Move Command

(M)

Move: From ... To

From:

(ENTER)
Accepts coordinate of row/column to be moved.

(BACKSPACE)
Erases current location and allows new coordinate to be entered, or indicated with cursor keys.

To:

Enter the second coordinate of a parallel row/column and execute with (ENTER).

The Move command moves the entire row or column in which the cursor is located to another position on the worksheet. All location references in formulas are changed to correspond to the new coordinates that result when the rows or columns are moved.

To carry out the Move command, the VisiCalc program asks for the coordinates of the origin (From) and destination (To) of the move. Both the origin and destination locations of the move are specified with coordinates (either by typing or pointing with the cursor). The coordinates are separated with three periods.

In response to M, the prompt line reads From...To and the current cursor location appears on the edit line. The current location is assumed to be the origin of the move. Moving the cursor or typing a period (.) confirms the origin coordinate and causes three periods (...) to appear; the destination coordinate can now be specified either by typing it or moving the cursor.

The VisiCalc program determines whether to move a row or column by the difference between the origin and destination coordinates: if the cursor is moved *horizontally* (or the *letter* is changed in the typed destination coordinate), a column is moved; if the cursor is moved *vertically* (or the *number* is changed in the typed destination coordinate) a row is moved. If *both* the row and column are changed between the origin and destination coordinate (or the cursor is moved to a different row and a different column), the VisiCalc program can't tell whether to move a row or column; the command is canceled.

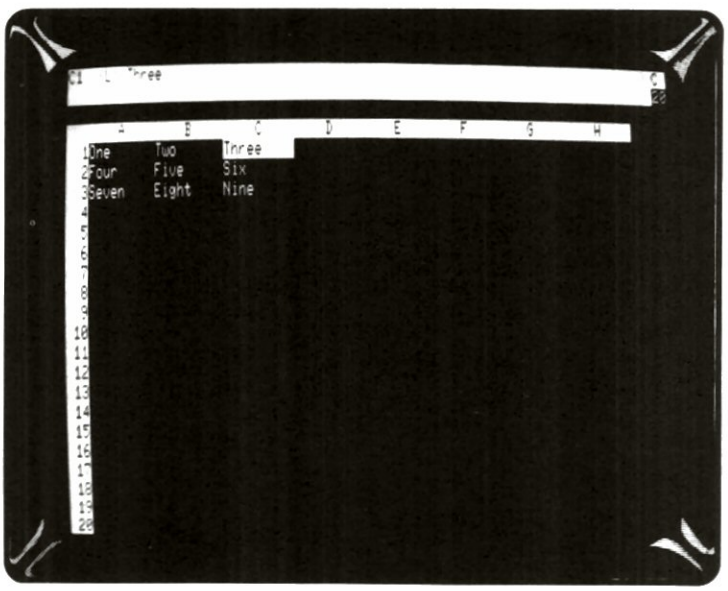
Moving a row or column can create a forward reference or circular reference, requiring extra recalculations or even preventing the VisiCalc program from yielding accurate results. See "Values" in this chapter and "Order of Recalculation" and "Forward and Circular References" in Lesson Four for a description of these conditions and how to circumvent them.

Moving a Row

The Move command deletes the row from the origin, moves all rows below the origin up one to fill the gap, then inserts the row by moving the destination and all rows below it down one to create a gap. Because of this, when moving a row down the destination row is specified as the row below the intended location; when moving a row up the destination is specified exactly.

After the row is moved, the cursor returns to its original location.

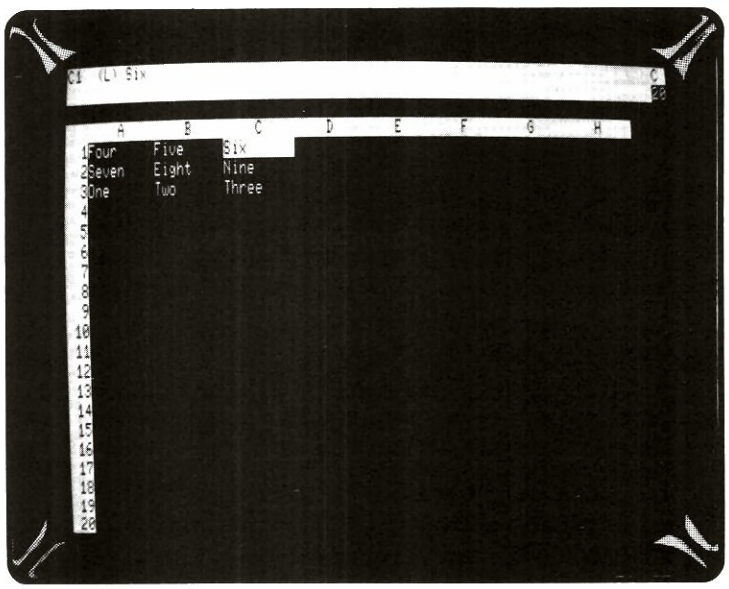
Set up the screen to look like the following photograph:



Example

	Type:	**Result:**	
1.	**/M**	Entry line:	C1 (L) Three
		Prompt line:	Move: From...To
		Edit line:	C1
2.	**↑**	Edit line:	C1...C2
		The VisiCalc program adds the ... to separate the origin from the destination. The cursor has moved to C2.	

3. ↓ ↓	Edit line:	C1...C4
	Because a row is being moved down, the destination is specified as the row below the intended destination. Row 4 is specified; row 1 will move to row 3, because all rows below row 1 move up after it is deleted from its present position.	
4. [ENTER]	Entry line:	C1 (L) Six
	Row 1 moves to row 3. The screen should look like the following photograph:	

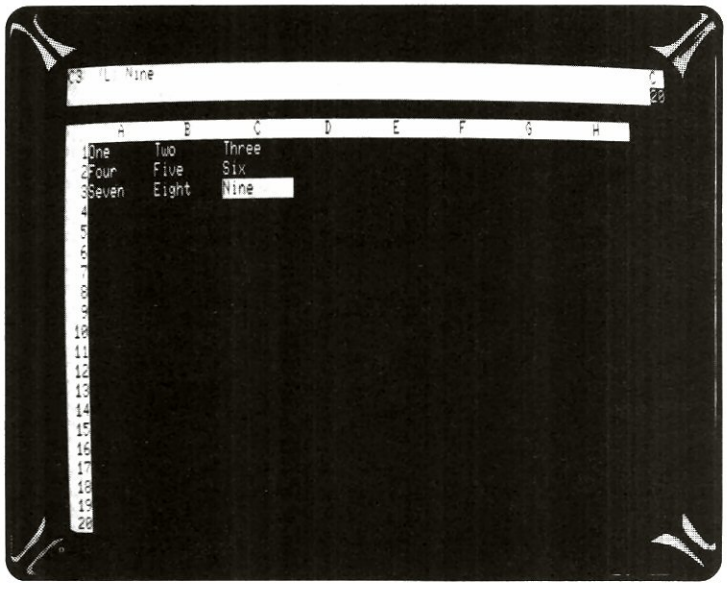


The next example moves row 3 back to its original position. Because it moves a row up, the actual destination row is specified.

Example

Type:	Result:	
1. ↓ ↓	Entry line: The cursor moves to C3.	C3 (L) Three
2. /M	Prompt line: Edit line: C3	Move: From...To
3. .	Edit line: The period confirms the origin location.	C3...

4.	**C1**	Edit line: C3...C1 The destination row is 1.
5.	**[ENTER]**	Row 3 moves to row 1. The screen should look like the following photograph:



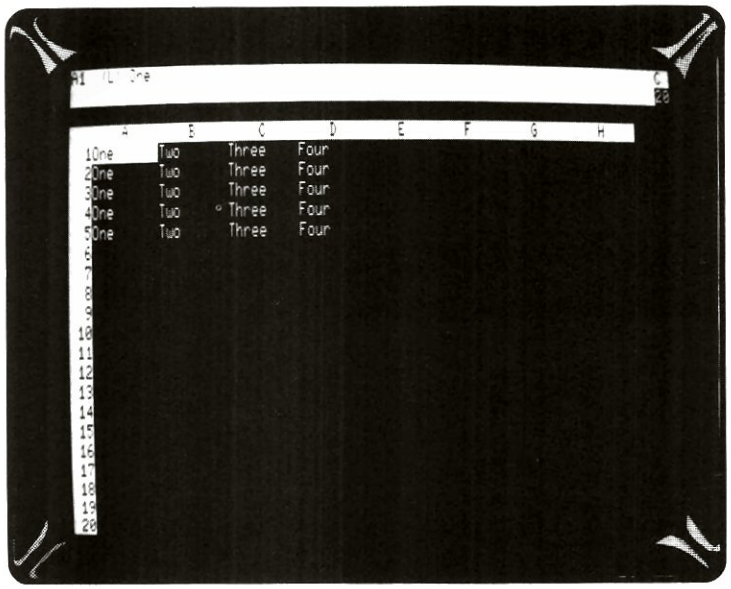
Moving a Column

The Move command deletes the column from the origin, moves all columns to the right of the origin left one to fill the gap, then inserts the column at the destination. Because of this, when moving a column to the right the destination column is specified as the column *to the right of* the intended location; when moving a column to the left the destination is specified exactly.

After the column is moved, the cursor returns to its original location.

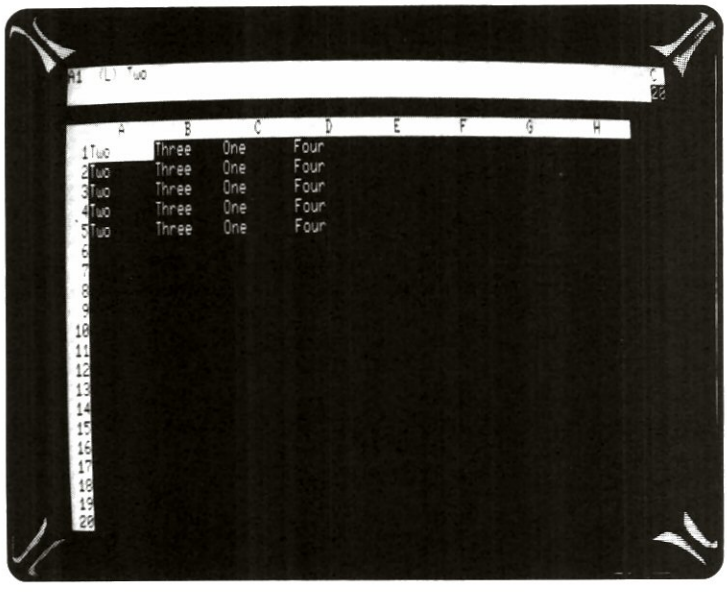
Example

	Type:	**Result:**
1.	**/CY** **One ➡ Two ➡ Three ➡ Four [ENTER]** **>A1 [ENTER] /R.D1 [ENTER]** **A2.A5 [ENTER]**	The screen should look like the following photograph: The screen should look like the following photograph:



2.	/M	Entry line: Prompt line: Edit line:	A1 (L) One Move: From...To A1
3.	➡	Edit line:	A1...B1
		The VisiCalc program adds the ... to separate the origin from the destination. The cursor has moved to B1.	
4.	➡ ➡	Edit line:	A1...D1
		Because a column is being moved to the right, the destination is specified as the column *to the right of* the intended destination. Column D is specified; column A will move to column C, because all columns to the right of column A move to the left after it is deleted from its present position.	

5.	**[ENTER]**	Entry line:	A1 (L) Two
		Column A moves to column C, and the cursor returns to A1. The screen should look like the following photograph:	

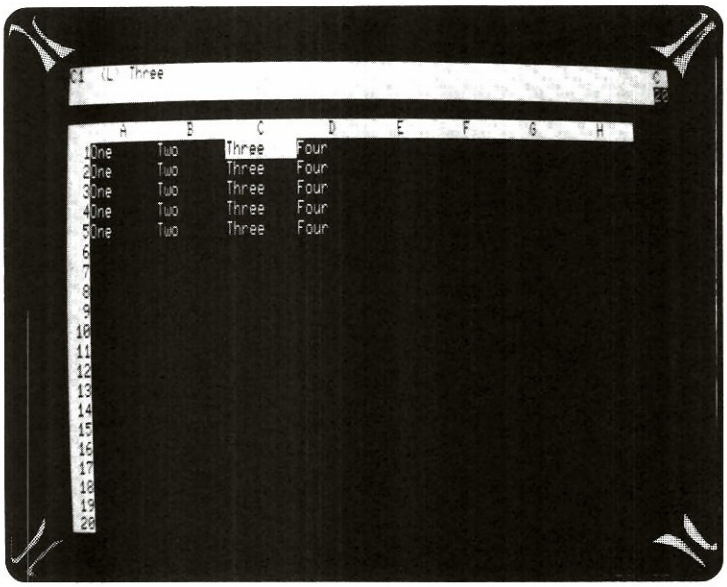


The next example moves column A back to its original position. Because it moves a column to the left, the exact coordinate of the destination row is specified.

Example

	Type:	**Result:**	
1.	**>C1 [ENTER]**	Entry line:	C1 (L) One
		The cursor moves to C1.	
2.	**/M**	Prompt line:	Move: From...To
		Edit line:	C1
3.	**.**	Edit line:	C1...
		The origin column is confirmed.	
4.	**A1**	Edit line:	C1...A1

5. [ENTER] — Column C moves back to column A. The screen should look like the following photograph:



Even though the VisiCalc program assumes the cursor location when the Move command is typed is the coordinate of the row or column to be moved, you can type that coordinate, too. After typing the Move command (/M), use [BACKSPACE] to erase the coordinate on the edit line and either type the origin coordinate or move the cursor to it.

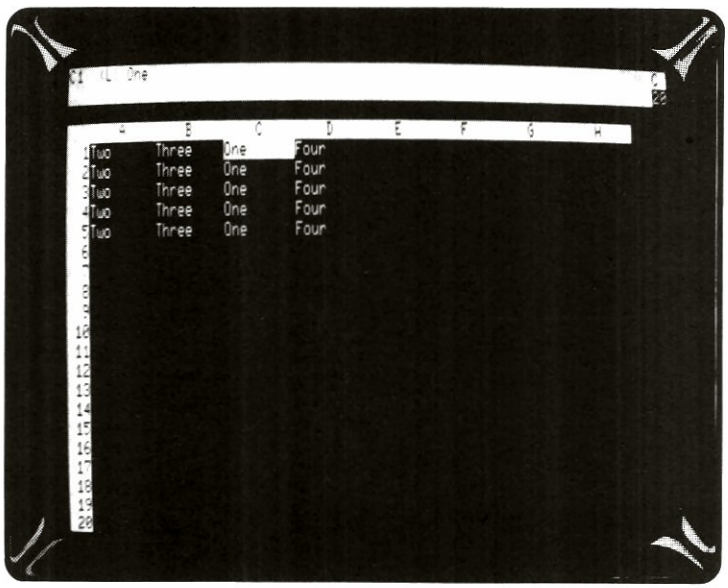
Example

	Type:	**Result:**	
1.	**/M**	Entry line:	C1 (L) Three
		Prompt line:	Move: From...To
		Edit line:	C1
2.	**[BACKSPACE]**	Prompt line:	Move: From...To
		Edit line:	clear
		The origin coordinate is erased but the Move command is still in effect.	
3.	**A1**	Edit line:	A1
		Now A1 is the origin.	
4.	.	Edit line:	A1...
		The origin is confirmed.	

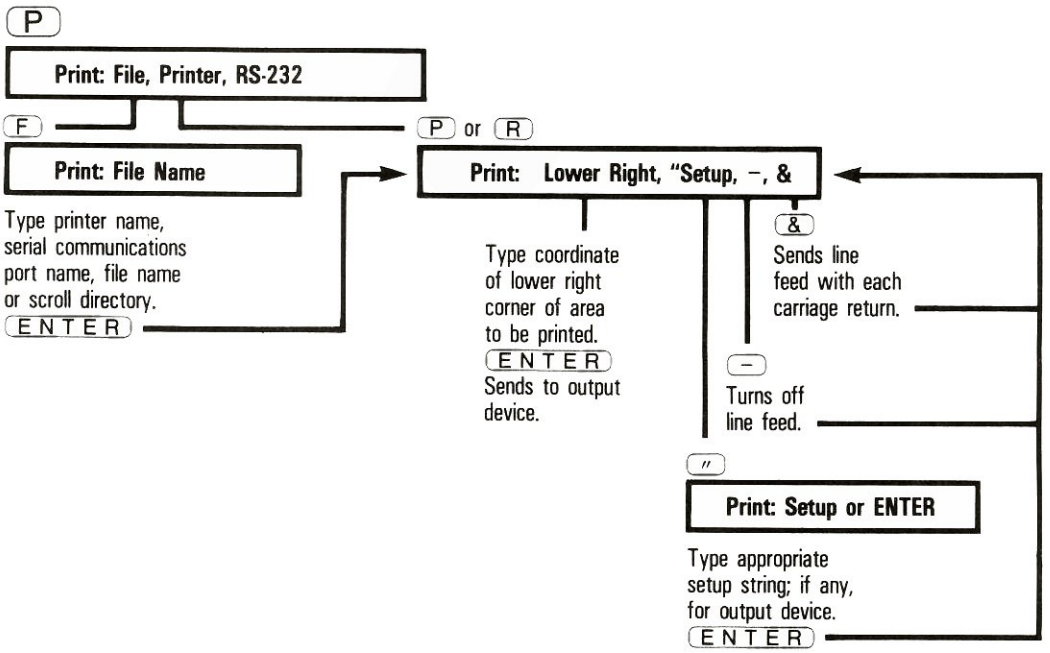
5. **D1 [ENTER]**

Edit line: clear

Column A is now column C. The columns that were B and C have moved to A and B. The screen should look like the following photograph:



Print Command



The Print command produces an image of the worksheet just as it appears on the screen (not the formulas and formats that produce the worksheet, which are saved by the Storage command). This image can be sent to one of several destinations:

- A diskette file.
- A hard disk file.
- A printer.
- An RS-232 port.

The Save option of the Storage command is used to produce a record of the formulas and formats behind the worksheet. An example of its use is included under "Printing Formulas and Formats" in this section.

Printers

This manual describes how to use the VisiCalc program to print worksheets on serial and parallel printers. The VisiCalc program will work with all Radio Shack printers. Before you begin printing, makesure your printer is properly connected, supplied with paper, and turned on. See your operator's manuals for instructions.

You may need to use the TRSDOS FORMS command and SETCOM command before using your printer. If you have a parallel interface printer, you can set paper width and page length with the FORMS command. If you have a serial interface printer, you need to use the SETCOM command to activate the port and to set the parity, baud rate, etc. These commands are described in your *TRS-80 Model II Owner's Manual.*

Your printer should be set up and the appropriate commands issued before you begin using the VisiCalc program. If, however, you find you need to use the TRSDOS FORMS or SETCOM commands while you are in the VisiCalc program, you can use the /SE option of the Storage command to execute a TRSDOS command and then return to the VisiCalc program.

Printing on the Printer—/PP, /PR

The Printer option of the Print command sends the image of the worksheet to a printer. The upper-left corner of the rectangle to be printed is the location of the cursor when the command is entered; the program prompts for the lower-right corner.

If the screen is split when the command is entered, the windows are ignored; only the rectangle specified by the upper-left and lower-right coordinates is printed. If titles are fixed and the upper-left corner of the rectangle to be printed is in a location fixed as a horizontal or vertical title, the Go To command (>) must be used to move the cursor to that location.

Typing [BREAK] stops the printer.

The following example prints the area of the worksheet bounded by A1 on the upper left and J14 on the lower right:

Example

	Type:	**Result:**	
1.	**>A1 [ENTER]**	The cursor moves to A1. This defines the upper-left corner of the rectangle to be printed.	
2.	**/P**	Prompt line:	Print: File, Printer, RS-232
3.	**P**for a parallel printer or **R**for a serial printer	Prompt line:	Print: Lower right, "Setup, –, &
		Edit line:	clear
4.	**J14 [ENTER]**	The printer starts printing the worksheet.	
5.	**[BREAK]**	The printer stops and the status area clears.	

Before entering the lower right coordinate, you may optionally use any of the special setup characters which appear on the prompt line (in step 3, above). Typing a " results in the following prompt

Setup or ENTER

Whatever characters you type next will be transmitted to the printer immediately. End the setup string by pressing [ENTER].

Many printers need the setup string to print in proper format. The setup string is nothing more than a special command to the printer. Setup strings usually begin with an ESCAPE or CONTROL character and are followed by another character or characters.

The VisiCalc program has a way to display these characters on the edit line. This method uses the caret(∧) in combination with other characters. The character(s) following the caret are treated specially. These characters will appear on the edit line, and you can check the setup string before you send it to the printer.

- ∧C Marks the next character as a control character (the ∧C has the same effect as holding down the CTRL key). Only the letters A through Z are valid following ∧C. Typing ∧CE, for example, sends CTRL-E; ∧CC sends CTRL-C. The [CTRL] key cannot be used.
- ∧E Sends an ESC. The [ESC] key cannot be used.
- ∧R Sends a Carriage Return.
- ∧L Sends a Line Feed.
- ∧H Treats the next two characters as hexadecimal digits and sends the single ASCII character whose code is the corresponding hexadecimal number. ∧H1B, for example, also sends the ESC code; ∧H0D sends a Carriage Return.
- ∧∧ Sends a caret character (∧).

Each time you print you may need to reenter the setup string. When [ENTER] is pressed, the previous Print: Lower right, "Setup, −, & is again on the edit line and all three options are available. The setup string may not be printed at this time because some printers wait until receiving a carriage return character before printing.

The & and − characters are complementary. The VisiCalc program sends an automatic line feed with each carriage return. If your printout double spaces, you may want to press − to turn off the line feed sent by the VisiCalc program. The − will stay in effect until you turn off the computer or restore the line feed with &. No indication is given that either the & or the − has been pressed. Most printers will not require the use of & and −. For those that do, it may be possible to reset switches on the printer itself to permanently generate or suppress line feeds, so that you do not have to use the & and − characters. See your printer manuals for more information.

Printing the Worksheet in Sections

If the rectangle to be printed is wider than the number of characters the printer can print on one line, the part of the line beyond the printer limit is printed on a separate line. For example, if your printer prints 80 characters per line, the 81st character may start the next row down or overstrike the row just printed.

To reproduce a worksheet wider than the printer can print, print it in sections. Calculate how many columns of the worksheet can be printed at a time, then divide the worksheet into the number of rectangles required to print the full width. The separate printed copies can be taped together to reproduce the worksheet.

If the printer uses single sheets rather than continuous-form paper, the worksheet may also have to be printed in sections to accommodate the depth.

Creating a Print File—/PF

The File option of the Print command (/PF) sends the image of the worksheet to a diskette file, a hard disk file, or a printer. A print file is a standard text file that contains exactly what is required to print the worksheet, including carriage returns and line feeds. It can be read by other programs, such as a word processor.

The VisiCalc program adds the suffix /PRF to the file name you specify to identify the file as a print file, rather than a worksheet file (which is given the suffix /VC). or a DIF file (which is given the suffix /DIF). Because the file contains only the labels and numbers displayed on the worksheet (not the formulas, formats, etc., used to set up the worksheet), this file cannot be loaded with the Load option of the Storage command.

If you specify the name of a file that exists on the diskette or hard disk, the VisiCalc program prompts you to make sure you want to replace the file: File exists: Type Y to replace. If you type Y, the print file of the worksheet replaces the file with a new file of the same name; if you type anything else, the Print command is canceled.

Diskette Files

Specifying a diskette file causes the image of the worksheet to be saved in a diskette file. See "File Names" in this chapter for a description of file names and how to specify them.

The following example shows how to save the area of the worksheet bounded by B10 at the upper left and F20 at the lower right in a print file named BUDGET/PRF (the VisiCalc program adds the suffix /PRF) on drive 0:

Example

	Type:	Result:	
1.	**>B10**	The cursor moves to B10.	
2.	**/P**	Prompt line:	Print: File, Printer, RS-232
		The upper-left corner of the rectangle to be saved is defined as B10.	
3.	**F**	Prompt line:	Print: Filename
4.	**budget [ENTER]**	Prompt line:	Print: Lower right, "Setup, −, &
		The VisiCalc program adds the suffix /PRF to the file name.	
5.	**F20 [ENTER]**	Edit line:	F20
		The worksheet is saved as a print file.	

Printing Formulas and Formats

The Printer option of the Print command (/PP) prints an image of the worksheet as it is displayed on the screen. But what about the formulas and formats behind the data?

The Save option of the Storage command (/SS) saves a record of the formulas and formats as they were written on the worksheet. Like the other options of the Storage command, this record can be sent to a diskette file, a hard disk file, a printer, or a serial port. The information is so complete the worksheet can be reproduced from it.

The printer or disk file is specified just as in the File option of the Print command (/PF).

The following example prints the formulas and formats of each entry position on the worksheet on your printer (the cursor can be positioned anywhere on the worksheet).

Example

	Type:	**Result:**	
1.	**/S**	Prompt line:	Storage: L S D Q E #
2.	**S**	Prompt line:	Storage: File for Saving
		Edit line:	clear
3.	**:P [ENTER]**	The worksheet is printed entry-position-by-entry-position, from the lower-right entry to the upper-left entry, followed by format information. Each entry position takes one line, so quite a bit of paper is required to print a large worksheet this way.	

Repeating Label Command

Type any characters.
ENTER
Character sequence repeated across column width.

The Repeating Label command fills an entry position with characters. It is commonly used to draw a line across the worksheet to separate titles from columns of numbers, or otherwise distinguish between areas on the worksheet. The entry location is filled with the character regardless of the column width.

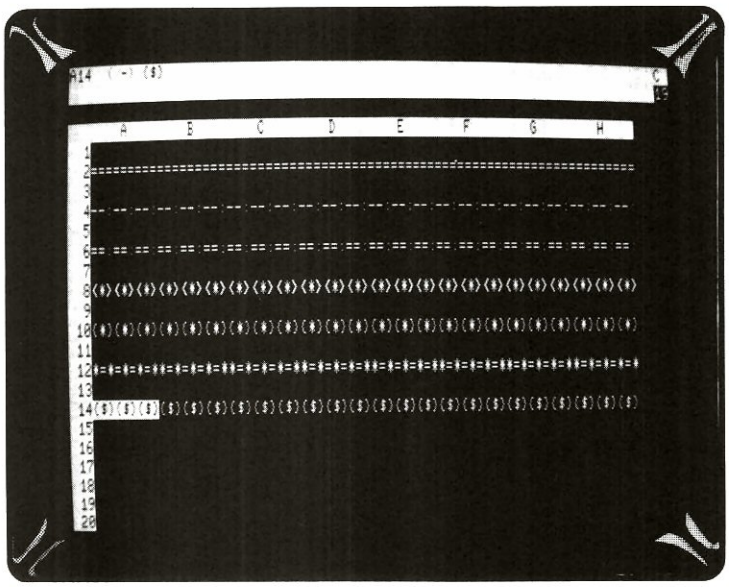
A column filled with characters can be copied across a row (with the Replicate command) to draw a line of any length across the worksheet.

Example

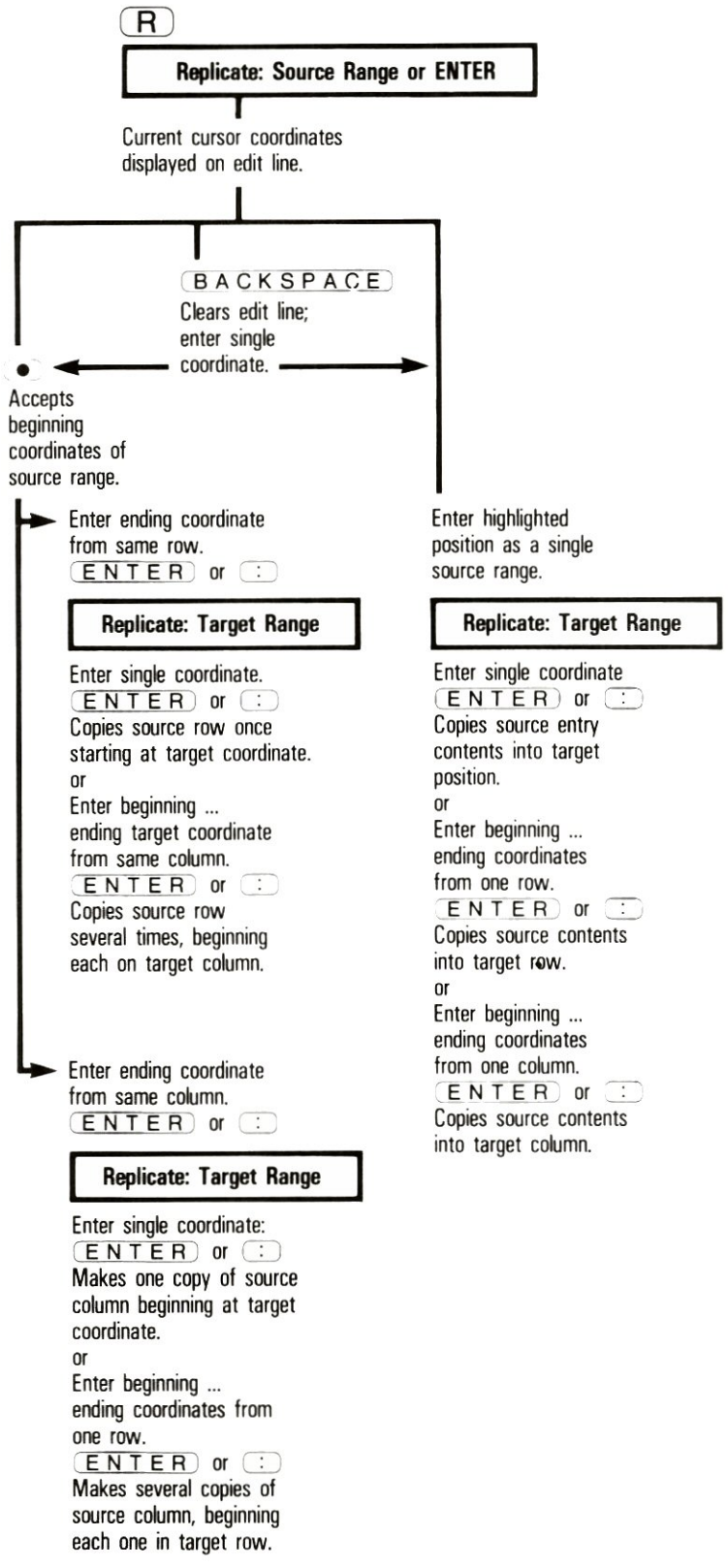
	Type:	**Result:**
1.	**/CY**	The screen clears.
2.	**Jan ➡ Feb ➡ Mar ➡ >A3 [ENTER] 1 ➡ 2 ➡ 3 [ENTER]**	The numbers are separated from the titles by a blank line.
3.	**>A2 [ENTER] /–**	Entry line: A2 Prompt line: Label: Repeating The program is waiting for you to enter the character that is to fill the entry location.
4.	**– [ENTER]**	Entry line: A2 (/–) – A2 fills with hyphens.
5.	**/GC20 [ENTER]**	A2 is still filled with hyphens, even though the column is wider.
6.	**/GC9 [ENTER]**	The columns return to the normal width.
7.	**/R [ENTER] ➡.➡➡[ENTER]**	The line of hyphens extends across the first three columns.

Repeating labels can be drawn with any character or combination of characters. The hyphen can be used to indicate a subtotal, for example, and the equal sign to indicate a total. Decorative borders can be drawn with combinations like <*> and *=.

The following photograph shows different repeating labels across the screen.



Replicate Command



The Replicate command copies an entry position to another location on the worksheet. It can copy a label, value, a blank entry, or just the local format. It can create one copy of a single entry, multiple copies of a single entry, one copy of a range of entries, or multiple copies of a range of entries.

The Replicate command cannot copy a row into a column, a column into a row, or a combination of rows and columns at the same time. Complex copying operations can be performed, however, with several uses of the command.

The Replicate command asks for the following information:

- The source range (location or locations to be copied).
- The target range (location or locations where the source range is to be copied).
- If the source range includes formulas that reference other locations, it asks whether each such reference should be copied with no change at each new location or relative to each new location.

A range can be one location (for example, B5) or a series of contiguous locations across a row or down a column (for example, F9-F12 or B2-M2). A range is defined by the starting coordinate, a period, and the ending coordinate (for example, B2...M2). If the range is a single location, the starting and ending coordinates are the same (for example, B2...B2). The coordinates can be specified by typing them or pointing to them with the cursor.

If the beginning and ending source range coordinates are identical (for example, B5...B5), only the specified location is copied to the target range. If the letters are the same but the numbers are different (for example, B5...B15), a portion of a column is copied. If the numbers are the same but the letters are different (for example, B9...M9), a portion of a row is copied.

To make just one copy of a source range, the target range should consist of a single coordinate (for example, F9). To make more than one copy, the target range should consist of a range of locations (for example, F9...F15).

A colon separates the source range from the target range and is entered by typing either colon or [ENTER].

	Source		Target
To copy one entry once Example:	coordinate A1	:	coordinate D1
To copy one entry several times Example:	coordinate A1	:	range in one row or column D1...D6
To copy a row or column once Example:	row or column range A1...A5	:	starting coordinate D1
To copy a row several times Example:	row range A1...D1	:	range in one column C5...C10
To copy a column several times Example:	column range A1...A5	:	range in one row D6...H6

Copying a Single Entry Position

To copy one entry position, both the source and target coordinates specify a single location.

Example

	Type:	Result:	
1.	**/CY**	The worksheet clears and the cursor moves to A1.	
2.	**100 [ENTER]**	Entry line:	A1 (V) 100
3.	**/R**	Prompt line:	Replicate: Source range or ENTER
		Edit line:	A1
		A1 is assumed to be the source range because the cursor was at that location when the Replicate command was typed.	
4.	**[ENTER]**	Prompt line:	Replicate: Target range
		Edit line:	A1...A1
		The source range is the single location A1.	
5.	**D1**	Prompt line:	Replicate: Target range
		Edit line:	A1...A1: D1
		D1 is the start of the target range.	
6.	**[ENTER]**	The value at A1 is copied to D1. .FI	

Creating a Column of Entries From One Entry

To create a column by making several copies of one entry, the source range is specified as the entry to be copied and the target range is specified as the starting and ending coordinate of the portion of the column to receive the copy.

Example

	Type:	Result:
1.	Type steps 1-5 from the preceding example.	
2.	**.D10 [ENTER]**	The value at A1 is copied from D1 to D10.

Formats can also be replicated (see "Format Command" in this chapter for a description of formats). A format must be replicated *before* anything else is written at the target locations, because the Replicate command copies the entry as well as the format; if you replicate a format into a target location that contains a label or value, the label or value is replaced by the label or value of the source range.

To display a column of sales figures rounded to two decimal places, place the cursor on a blank entry position and type /F$ to specify the Dollars-and-cents format. Then replicate that entry position using the procedure in the preceding example. If there are no values in the target range, there is no effect on the display. When you enter a value into any location in the target range, however, it is displayed with two decimal places.

Making One Copy of a Column

To make one copy of a column, the source range is specified as the top and bottom locations (for example, A1...A32). The target range is specified as the coordinate of the top location of the new column.

The cursor need not be located at the beginning of the source range. You can erase the starting coordinate from the edit line with [BACKSPACE] and type both the source and target ranges.

Example

	Type:	Result:	
1.	**/CY**	The worksheet clears and the cursor moves to A1.	
2.	**1 ↓ 2 ↓ 3 ↓ 4 [ENTER]**	A column of numbers in column A.	
3.	**/R**	Prompt line:	Replicate: Source range or ENTER
		Edit line:	A4
4.	**[BACKSPACE]**	Erases the first source coordinate.	

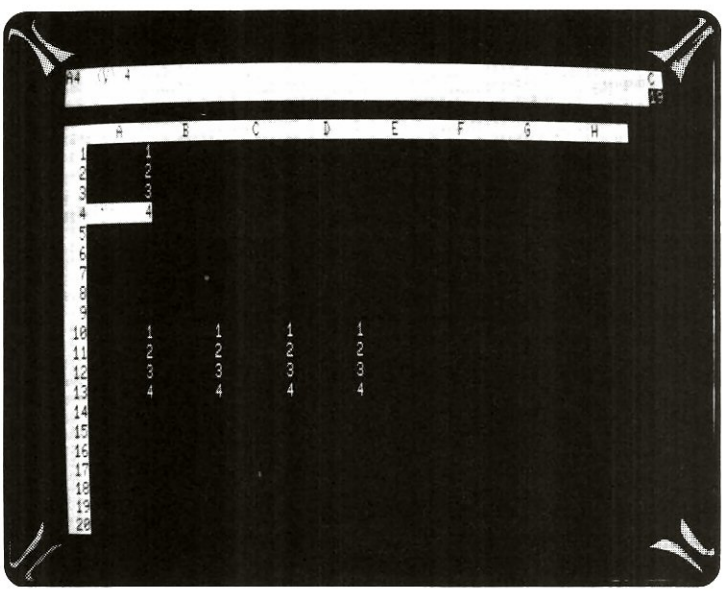
5. **A1**	Edit line:	A1
6. .	Edit line:	A1...
7. **A4 [ENTER]**	Prompt line:	Replicate: Target range
	Edit line:	A1...A4:
8. **C4**	Edit line:	A1...A4: C4
9. **[ENTER]**	Column A (A1-A4) is copied to column C (C4-C7).	

Making Several Copies of a Column

To make several copies of a column, the source range is specified as the top and bottom coordinates of the source range and the target range is specified as a range of locations across a row. The column is copied starting at each location in the target range.

Example

Type:	**Result:**
1. Steps 1-7 from the preceding example.	
2. **A10.D10 [ENTER]**	Column A (A1-A4) is copied to columns A through D (A10-A13 through D10-D13). The screen should look like the following photograph:

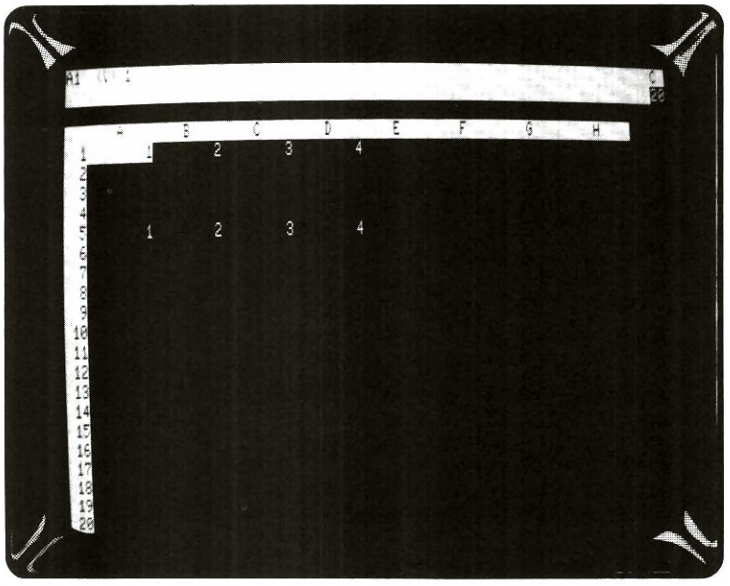


Making One Copy of a Row

To make one copy of a row, the source range is specified as the beginning and ending coordinates of the row to be copied (for example, A1...C1). The target range is specified as the beginning coordinate in the row to receive the copy.

Example

	Type:	Result:
1.	/CY	The worksheet clears and the cursor moves to A1.
2.	1 ➡ 2 ➡ 3 ➡ 4 [ENTER] >A1 [ENTER]	A row of numbers in row 1.
3.	/R.D1 [ENTER]	Prompt line: Replicate: Target range Edit line: A1...D1:
4.	A5 [ENTER]	Row 1 (A1-D1) is copied to row 5 (A5-D5). The screen should look like the following photograph:

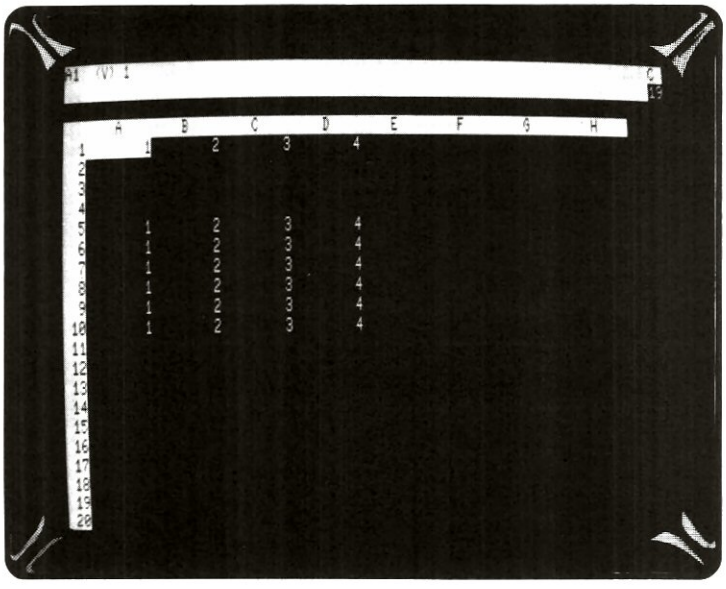


Making Several Copies of a Row

To make several copies of a row, the source range is specified as the left and right coordinates of the source range and the target range is specified as a range of locations down a column. The row is copied starting at each location in the target range.

Example

	Type:	Result:
1.	Steps 1-3 of the preceding example.	
2.	**A5.A10 [ENTER]**	Row 1 (A1-D1) is copied to rows 5-10 (A5-A10 through D5-D10). The screen should look like the following photograph:



Replicating Formulas

When the Replicate command copies a formula that contains one or more references to another location (for example, .6*B5-A21), it either copies the references with No change or Relative to the new location. It prompts for an N or R for each reference in the formula being replicated.

Example

	Type:	Result:
1.	**/CY**	The worksheet clears and the cursor moves to A1.

2. **2 ⬇ +A1+2 [ENTER]**
   /R [ENTER]

   Entry line: A2 (V) +A1+2
   Prompt line: Replicate: Target range
   Edit line: A2...A2:

   The [ENTER] after /R tells the VisiCalc program that the source range consists of the single location A2.

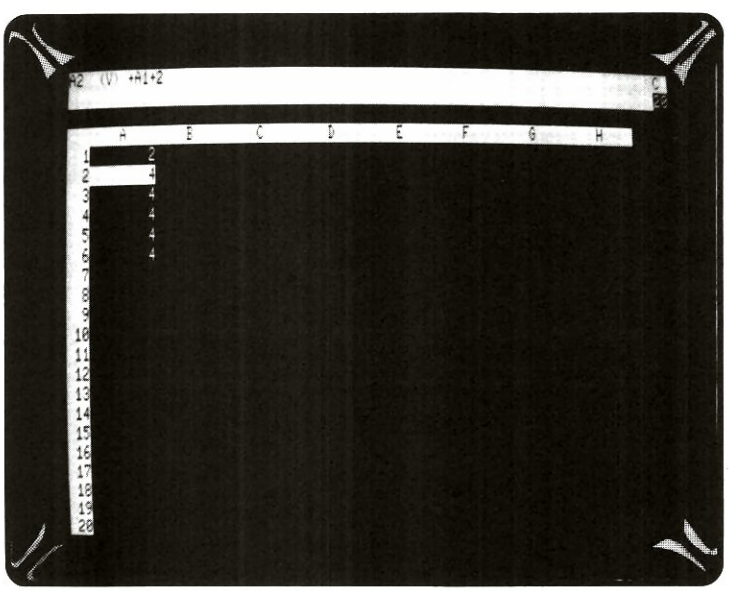
3. **A3.A6 [ENTER]**

   Prompt line: Replicate: N = No change, R = Relative
   Edit line: A2: A3...A6: +A1

   The edit cue over +A1 indicates that the VisiCalc program is asking whether to copy the reference to location +A1 unchanged (the same in each position in the target range) or whether it is to be copied *relative* to each new position.

4. **N**

   The reference to location A1 is copied with no change. The screen should look like the following photograph:

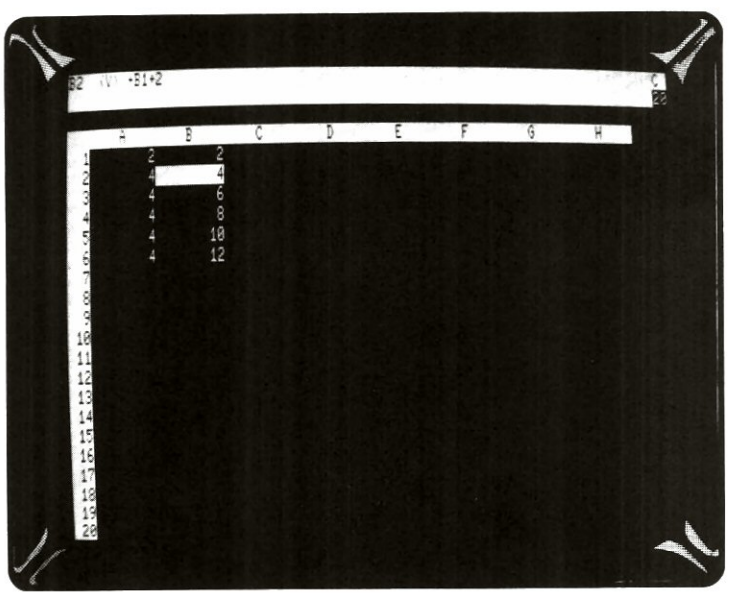


Move the cursor down the column. Each copy of the formula contains the reference to A2, just as the source location does. This is the result of choosing No Change instead of Relative.

The next example sets up the same structure for comparison in column B.

Example

	Type:	Result:
1.	**>B1 [ENTER]**	The cursor moves to B1.
2.	**2 ↓ +B1+2 [ENTER]** **/R [ENTER]** +B1+2	Entry line: B2 (V) Edit line: B2...B2 Prompt line: Replicate: Target range The [ENTER] after /R tells the VisiCalc program that the source range consists of the single location A2.
3.	**B3.B6 [ENTER]**	Prompt line: Replicate: N = No change, R = Relative Edit line: B2: B3...B6: +B1 The edit cue highlights +B1 just as it did +A1 in the previous example. Again, it wants to know whether to copy the reference to location B1 unchanged (N) or relative (R) to the target locations.
4.	**R**	The reference to location B1 is copied relative to each target location; that is, it becomes B2 in the formula at B3, B3 in the formula at B4, etc. The screen should look like the following photograph:

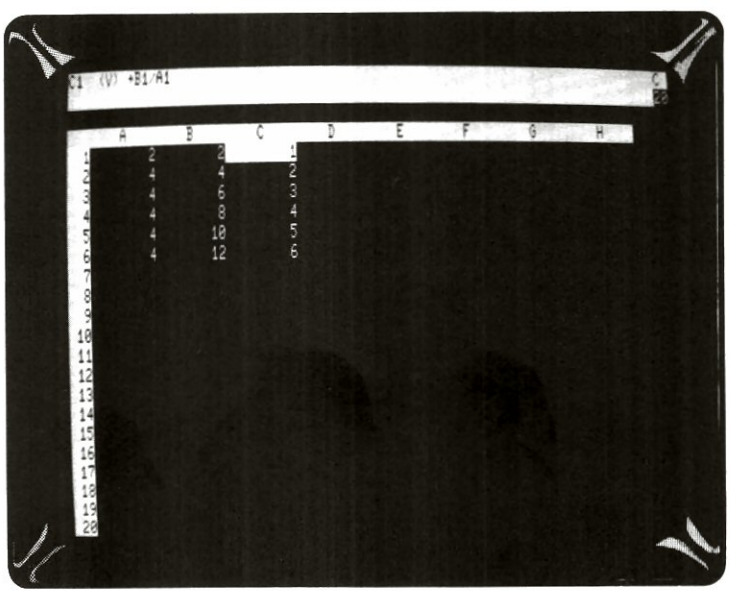


The formulas behind columns A and B are quite different. Move the cursor down column B to see how the formula changes on each line. Now move down column A; each formula copied from A2 is the same.

If a formula contains more than one reference to another location, the VisiCalc program asks how to copy each reference.

Example

	Type:	Result:	
1.	**>C1 [ENTER]**	The cursor moves to C1.	
2.	**+B1/A1 [ENTER]**	Entry line:	C1 (V) +B1/A1
		The formula references two locations (B1 and A1).	
3.	**/R [ENTER]**	Edit line: Prompt line:	C1...C1: Replicate: Target range
4.	**C2.C6 [ENTER]**	Edit line:	C1: C2...C6 +B1
		Prompt line:	Replicate: N = No change, R = Relative
		The edit cue highlights the reference to B1, asking how to copy that reference.	
5.	**R**	Edit line:	C1: C2...C6: +B1/A1
		Prompt line:	Replicate: N = No change, R = Relative
		The edit cue highlights the reference to A1, asking how to copy that reference.	
6.	**N**	The screen should look like the following photograph:	

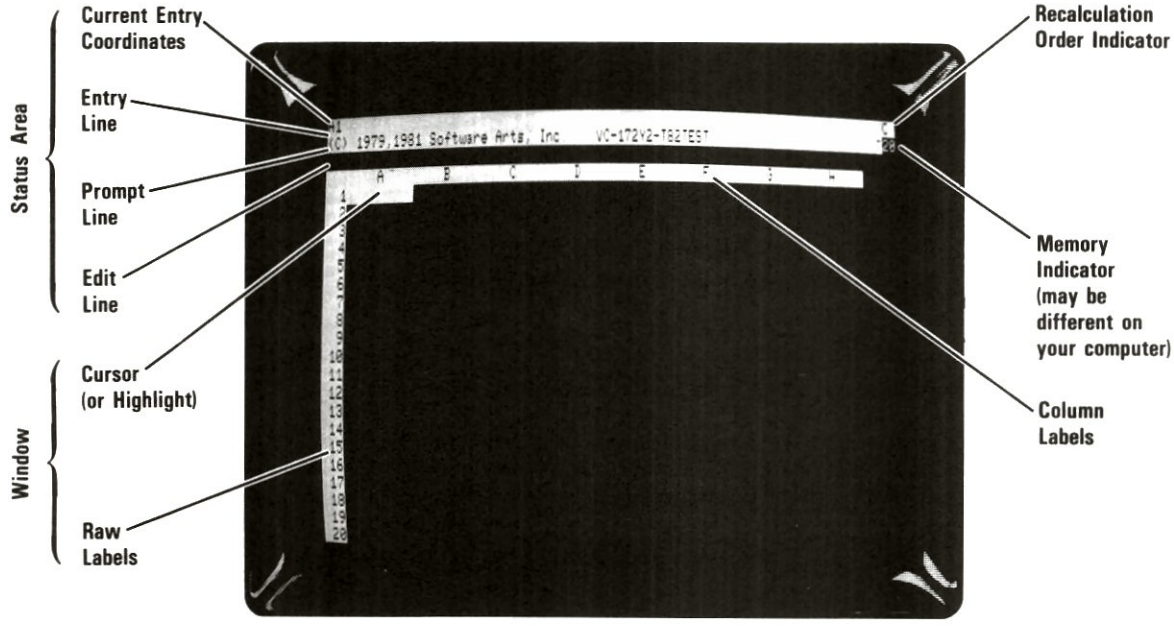


Move the cursor down column C to see how the dividend changes at each location but the divisor remains the same. To experiment further, replicate this formula with both dividend and divisor relative and with both unchanged. See "Replicating a Formula" and the headings that follow in Lesson Two for more examples of the Replicate command.

It is possible to replicate a formula into a position so that valid relative value references cannot be assigned. If you inserted a new column at A and replicated the formula at C1 to A1, the relative position of the value references A1 and B1 would be located off the worksheet to the left. The VisiCalc program assigns the value ERROR to locations that contain such a reference.

Also be careful not to create forward or circular references or incorrect calculation order when you replicate formulas. See "Order of Recalculation" and "Forward and Circular References" in Lesson Four and "Values" in this chapter for a description of these conditions and ways to circumvent them.

The Screen



The screen includes the *status area* (the top three lines), the column and row borders, and the entry positions that make up the window through which you view the electronic worksheet.

Status Area

The three lines of the status area are (from the top down) the *entry line*, the *prompt line*, and the *edit line*. The entry line and the prompt line share the wide white bar at the top; the edit line is the dark line just above the column border.

Entry Line

The *entry line* is the top line of the status area. It can display as many as five items of information:

1. The coordinate of the cursor location. This is always displayed.
2. The local format, if one is assigned to the location.
3. The type of entry ("L" for Label, "V" for Value, or "/−" for Repeating Label), if the location contains an entry.
4. The entry just as it was written, if the location contains an entry.
5. A character that indicates the order of recalculation ("C" for column-order, "R" for row-order). An exclamation point is displayed next to it when the worksheet is being recalculated.

Prompt Line

The *prompt line* is the middle line of the status area. It displays a prompt at the left side that describes the options at any point in a command sequence, and a number at the right side that tells how much memory is available (in units of 1024 characters or "K").

Edit Line

The *edit line* is the bottom line of the status area. It displays each character as it is typed, or the coordinate as the cursor is moved to write coordinates in a formula. The edit cue (a small white block) appears after the last character entered.

The characters on the edit line can be edited by erasing them with the [BACKSPACE] key and retyping to correct any errors. The VisiCalc program also, on occasion, uses this line to display information it wants you to confirm or clarify before it carries out a command.

The Window and Worksheet

The VisiCalc *window* is that portion of the screen beneath the column border and to the right of the row border. The window can be scrolled with the arrow keys to show any portion of the worksheet.

The column border extends across the top of the worksheet and labels 63 columns, A through BK. The row border extends down the left side and labels rows 1 through 254.

Entry Positions

The intersection of each column and row defines an *entry position*. Each is identified by a column letter followed by a row number (A5, for example). This identifier is the coordinate of the entry position.

The Cursor

Each time the VisiCalc program is loaded or cleared with the Clear command, a column-wide rectangle covers entry position A1. This rectangle is the *cursor.*

The cursor marks the position on the worksheet where entries can be written or commands are to be carried out. The coordinate of the cursor location is displayed at the left side of the entry line. During the course of some commands, the cursor can be moved with the arrow keys.

Moving the Cursor

The arrow keys (← → ↑ ↓) move the cursor in the indicated direction to any position on the worksheet. Typing an arrow key moves the cursor one entry position at a time.

When the cursor is at the edge of the screen, further cursor movement in the same direction causes the window to move over the worksheet, or *scroll,* until it reaches the edge of the worksheet. The Go To command moves the cursor directly to a location without scrolling.

Repeating Key

To cause any key to repeat, press that key and the [REPEAT] key at the same time. Use of the repeating capability with the arrow keys moves the cursor more quickly without extra keystrokes. The window scrolls with the cursor.

Pointing With the Cursor

If a command requires the coordinate of an entry position, the coordinate can be typed or entered in the formula by pointing to it with the cursor. As the cursor moves, the coordinate on the edit line changes. If a command does not require the coordinate of an entry position, typing one of the arrow keys may end the command and move the cursor to the next entry position.

Typeahead

If you type faster than the VisiCalc program can accept the characters, it stores the characters and catches up as soon as it can. If you type long enough and fast enough, it cannot save any more characters and the entry coordinate on the entry line flashes each time you try to type another character until it has room to save more.

Correcting Mistakes

[BREAK] cancels a command or entry. The Blank command erases an entry from the worksheet.

While an entry is being typed, characters on the edit line can be erased by typing [BACKSPACE]. Each time [BACKSPACE] is typed, the edit cue moves left and erases the last character typed.

An existing entry can be replaced by moving the cursor to the entry position and typing a new entry. The new entry replaces the old one when it is ended with [ENTER] or one of the arrow keys. If the entry is canceled with [BREAK], the old entry is unchanged. The edit line shows the new entry as it is typed; the entry line shows the old entry until the new one is written.

The Edit command changes the contents of the edit line; it can be used to correct an entry while it is being typed or change an entry already written on the worksheet. The edit cue can be moved back and forth over the entry: ➡ and ⬅ move it one character right or left; ⬆ moves it to the beginning of the edit line and ⬇ moves it to the end. To erase the character to the leftZof the edit cue, type [BACKSPACE]; to insert a character to the left of the edit cue, simply type the letter. To end the Edit command and write the entry on the worksheet, type [ENTER].

To use the Edit command to change an entry being typed (before it is written on the worksheet), type [CTRL]-E; the edit cue remains at the end of the edit line. To change an entry already written on the worksheet, move the cursor to the location and type /E. The entry is copied to the edit line and the edit cue is positioned at the beginning.

Storage Command

(S)

Storage: L S D Q E #

(L)

Storage: File to Load

Type file name or scroll directory.
(ENTER)
Loads specified file (in the "sheet format") or displays error message on edit line.

(S)

Storage: File for Saving

Type file name or scroll directory.
(ENTER)
Writes file on to diskette (in "sheet format") under specified file name or displays an error message.

(D)

Storage: File to Delete

Type file name or scroll directory.
(ENTER)

Delete File: Type Y to Confirm

(Y)
Removes file from diskettes:
Any other key aborts command.

(Q)

Quit: Type Y to Confirm

Leaves VisiCalc program and returns to operating system:
any other key aborts command.

(E)

Storage: Execute TRSDOS Command

Type DIR, SETCOM, or FORMS.
(ENTER)
The command is executed.
Any key returns to VisiCalc screen.

(#)

Data: Save, Load

(S)

Data Save: File for Saving

Type printer name, serial communications port name, or scroll directory.
(ENTER)

Data Save: Lower Right

Type coordinate of lower right corner of area to be saved.
(ENTER)

Data Save: R, C or ENTER

(R)
Writes file by rows beginning at position held by cursor when storage command initiated; uses DIF format with specified file name.

(C)
Writes file by columns beginning at position held by cursor when storage command initiated; uses DIF format with specified file name.

(L)

Data Load: File to Load

Enter name of DIF file by typing or scrolling directory.
(ENTER)

Data Load: R, C or ENTER

(R)
Loads file by rows beginning at cursor.

(C)
Loads file by columns beginning at cursor.

The Storage command includes several options:

L Loads a previously saved worksheet.

S Saves the VisiCalc worksheet on diskette or hard disk.

D Deletes a file from the storage disk.

Q Quits the VisiCalc program.

E Executes a TRSDOS command.

Loads or saves a file in DIF format.

When saving the worksheet, the Storage command produces a record of the formulas, formats, and other instructions that produce the worksheet (not the image of the worksheet as it appears on the screen, which is saved by the Print command). This record can be sent to one of several locations:

- A printer.
- A serial port.
- A diskette file.
- A hard disk file

Load Option—/SL

The Load option loads a worksheet that was saved with the Save option. When the file is loaded, the worksheet is displayed exactly as it was when it was saved unless it contains forward or circular references; those locations display ERROR. (If ERROR appears while the file is loading, wait a moment. The VisiCalc program will recalculate the sheet after all data is loaded; at that point ERROR will disappear unless it is the result of a forward or circular reference.)

If one worksheet is on the screen when another is loaded, the first is not cleared; the second worksheet is loaded over the first. If a location is filled on both worksheets, the entry on the second worksheet replaces the entry on the first. If a location on the second worksheet is blank, it does not erase the entry of the corresponding location on the first. This makes it possible for one worksheet to be combined with another. If the worksheets are not to be combined, the screen should be cleared (with the Clear command) before the second worksheet is loaded.

The following example shows how to load a worksheet named 'budget" from drive 0:

Example

	Type:	Result:	
1.	**/S**	Prompt line:	Storage: L S D Q E #
2.	**L**	Prompt line:	Storage: File to load
3.	**budget [ENTER]**		

During the loading process, the prompt line reads Storage: Loading followed by a flashing asterisk. When the worksheet is loaded, it appears on the screen just as it did when it was saved (including any split windows, fixed titles, and global format).

Instead of typing in the file name, you can display the name of each file on the diskette and then select the one you want. Type ➡ instead of "budget" at step 3 in the preceding example. The name of the first file on the diskette is displayed on the edit line. Each time you type ➡, the next file name is displayed until the name of each file on the diskette has been displayed. (If you type ➡ again, the Storage command is canceled.) If you have more than one disk drive used for storing worksheets, you can specify another drive by typing the drive designation first and then the ➡. For instance, to search the diskette in disk drive 2, type **:0** ➡.

When the file name you want is on the edit line, type [ENTER] and the VisiCalc program loads the worksheet just as if you had typed the file name. The VisiCalc program adds a /VC to your filename when you use the **/S** storage command. When you load the worksheet with that name again it is not necessary to add the /VC.

These file names can be edited, just as if you had typed them. To edit the file name on the edit line, type [CTRL]-E and edit the line as described in "Edit Command" in this chapter. When the name is correct, type [ENTER]. This feature is useful when, for example, you have forgotten a file name. As you display the file names, one might remind you of the name you forgot. The name "projfeb", for example, might remind you that the file you want is called "projaug". To change the file name from "projfeb" to "projaug", type [BACKSPACE] to back up the edit cue until you've deleted "feb", then type aug [ENTER]. The worksheet saved in the file named "projaug" is loaded.

If the VisiCalc program cannot find the file you tell it to load, the prompt line reads Error: File not found. This could mean you misspelled the name, the wrong diskette is in the drive, or the wrong drive is being searched. Either correct the name, put in the proper diskette, or add the proper drive number (preceded by a colon) to the end of the file name.

Save Option—/SS

The Save option of the Storage command (/SS) saves the record of the worksheet. The record can be sent to a file or a printer.

See "Print Command" in this chapter for a description of how to specify a printer. See "File Names" for a description of how to specify a file name.

Note: A diskette must be formatted before anything can be written on it. See Appendix A for instructions on how to format a diskette.

If you specify the name of a file that is already on the diskette, the VisiCalc program prompts you to make sure you want to replace the existing file: Storage: File exists. Y to replace. If you type Y, the saved file replaces the file with the same name; if you type anything else, the Storage command is canceled.

The ability to display the names of the files on a diskette makes it easy to name files as new versions of existing files. For example, you could modify a file called "sales5" and, instead of replacing it with the new version, display the file name, type [BACKSPACE] to erase the 5, then type 6. The result: a new version named "sales6"; "sales5" is still on the diskette.

Although a diskette has enough room to hold many worksheets, it still has a finite amount of space. If the disk fills while a worksheet is being saved, Error: Disk full appears on the edit line; the VisiCalc program saved only part of the worksheet. If this happens, delete the incomplete file from the disk (see "Delete Option" later in this topic) and save the worksheet on a diskette with enough room.

The following example saves the worksheet in a file named "budget":

Example

	Type:	**Result:**	
1.	**/S**	Prompt line:	Storage: L S D Q E #
2.	**S**	Prompt line:	Storage: File for saving
3.	**budget [ENTER]**	The status area clears and the drive activates, saving the worksheet with the file name typed.	

Delete Option—/SD

The Delete option of the Storage command (/SD) *irretrievably erases* a file from the diskette.

The following example deletes a file named "budget" from the diskette in drive 0:

Example

	Type:	Result:	
1.	**/SD**	Prompt line:	Storage: File to Delete
2.	**budget/VC**	Edit line:	budget/VC
		The **/VC** must be added to the filename when the Delete option is being used.	
	or **:0➡**	Edit line: The name of the first file on the diskette in drive 0.	
		Each subsequent ➡ causes the next file name to be displayed. Continue until the name of the file you want is displayed (if you type ➡ after the last file name is displayed, the Storage command is canceled).	
3.	**[ENTER]**	Prompt line:	Delete file: Type Y to confirm.
4.	**Y**	The file is deleted from the diskette. If you type anything other than Y, the Storage command is canceled.	

Quit Option—/SQ

The Quit option of the Storage command (/SQ) returns control to the Disk Operating System. It first prompts Quit: Type Y to confirm. In response, type **Y**. If you don't want to start another program, simply remove the diskettes and turn the computer off.

Execute TRSDOS Command Option—/SE

This command allows you to leave the VisiCalc program, execute a TRSDOS command, and return to the VisiCalc screen that was displayed when the command was issued.

Example

	Type:	Result:	
1.	**/SE**	Prompt line: Execute TRSDOS Command	Storage:
		The edit cue prompts for one of four TRSDOS command: DIR, SETCOM, FORMS, or I (in TRSDOSII).	
2.	**DIR [ENTER]**	The directory of the diskette in drive 0 appears on the screen followed by the flashing cursor.	
		Any key typed will cause the VisiCalc screen to reappear as it was before /SE was typed.	

DIF™ Options

The two remaining options—S#S and S#L—are used to save and load worksheets stored in the DIF format, which makes it possible for the VisiCalc program to share files with other programs. For a complete description of the DIF format and these options, see Appendix C.

Save DIF™ Option—/S#S

The Save DIF option of the Storage command (/S#S) saves the worksheet in the DIF format. The VisiCalc program adds /DIF to the file name so it can be recognized later as a worksheet saved as a DIF file.

Values are saved to their full precision. This precision may cause the saved worksheet to differ from the displayed version. To save the worksheet with all values calculated to the same precision as the version on the screen, you must change the value that is stored in memory with a rounding formula (see "Making the VisiCalc Program Less Precise" in "Functions" in Chapter Three).

The VisiCalc program saves and loads a worksheet in one of two ways—by row or by column. The VisiCalc program prompts you to specify the orientation by typing **R** or **[ENTER]** or C. Specify **R** or press **[ENTER]** when saving a worksheet to be loaded later by the VisiCalc program. This saves the data by rows.

The following example saves the area of the worksheet whose upper-left boundary is A1 and lower right boundary is J14 in a file named BUDGET/DIF on the disk in drive 1:

Example

	Type:	**Result:**	
1.	**>A1 [ENTER]**	The cursor moves to A1.	
2.	**/S#**	Prompt line:	Data: Save Load
3.	**S**	Prompt line:	Data save: File for Saving
4.	**budget:1 [ENTER]**	Prompt line:	Data save: Lower right
5.	**J14 [ENTER]**	Prompt line:	Data save: R C or ENTER
		Or you can move the cursor to J14.	
6.	**R**	The prompt line clears and the drive activates, saving the sheet as a DIF file.	

Load DIF™ Option—/S#L

The Load DIF option of the Storage command (/S#L) loads a worksheet stored on a diskette in the DIF format. The file can be one saved with the Save DIF option of the Storage command, or created by another program.

Unlike a worksheet saved in the normal fashion—which is loaded into the same position it occupied when it was saved—the upper left corner of a worksheet loaded in the DIF format is the position of the cursor when the Storage command is typed.

The following example loads the worksheet stored in a file named BUDGET/DIF on the diskette in drive 0 starting at location C10:

Example

	Type:	**Result:**	
1.	**/CY**	The worksheet clears and the cursor moves to A1.	
2.	**>C10 [ENTER]**	The cursor moves to C10.	
3.	**/S#L**	Prompt line:	Data load: File to Load
4.	**budget [ENTER]**	Prompt line:	Data load: R C or ENTER
5.	**R**	The worksheet appears, starting at C10.	

As with the other options of the Storage command, you can display the names of the files on the diskette by typing ➡ in response to the File to load: prompt.

To transpose from loading across rows to loading down columns, type **C** instead of **R** at step 4. A worksheet saved in columnar format can be transposed to row format by typing **R** at this point.

Titles Command

(T)

Titles: H V B N

(H)
Fixes all rows (horizontal)
in window from cursor up.

(V)
Fixes all columns (vertical)
in window from cursor left.

(B)
Fixes all columns both in window.

(N)
Negates all title fixing.

The Titles command fixes rows and columns in place so that they remain in view as the window scrolls over the worksheet. The position of the cursor at the time the Titles command is entered determines which column(s) and/or row(s) are fixed.

In response to /T (the Titles command), the prompt line displays Titles: H V B N The characters following Titles: are options:

H Horizontal titles.

V Vertical titles.

B Both horizontal and vertical titles.

N No titles (cancels any titles that are fixed).

The Titles command causes no apparent change in the worksheet. The effect of title fixing becomes apparent, however, when the window scrolls; the locations that are not fixed move across the screen, but the titles remain unmoving.

The arrow keys won't move the cursor to a location that is in a row or column fixed as a title. The coordinate on the entry line indicates an error when the cursor bumps into a fixed title just like it does when bumps into one of the borders of the worksheet. The Go To command (>), however, can be used to move to a location in a row or column fixed as a title.

If vertical titles are fixed and the column width is increased so that only one column can be displayed, the VisiCalc program cancels the vertical title settings. If the column width is later reduced, vertical titles must be fixed again.

Horizontal Option—/TH

The Horizontal option of the Titles command fixes all rows at and above the row that contains the cursor. To fix rows 1 and 2 as titles, place the cursor anywhere in line 2. To fix only row 1, place the cursor in row 1.

Vertical Option—/TV

The Vertical option of the Titles command fixes all columns at and to the left of the column that contains the cursor. To fix columns A and B, place the cursor anywhere in column B. To fix only Column A, place the cursor in column A.

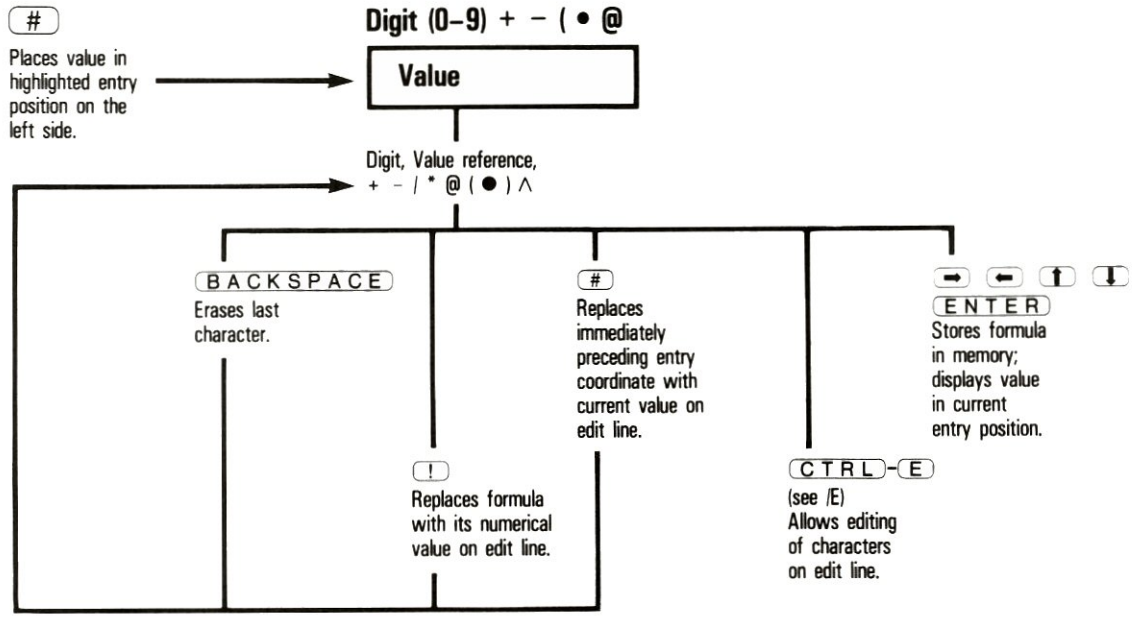
Both Option—/TB

The Both option of the Titles command fixes Both rows and columns at the same time. The rows are fixed at and above the row that contains the cursor and the columns are fixed at and to the left of the column that contains the cursor. To fix row 1 and column A, place the cursor at location A1. To fix rows 1 and 2 and columns A and B, place the cursor at B2.

None Option—/TN

The None option of the Titles command cancels any rows or columns fixed by the Titles command. The cursor can be anywhere when the command is entered.

Values



A value is an entry on the worksheet used in calculations. The VisiCalc program looks at the first character of what is typed to determine whether the entry is a value or a label; if the entry begins with any of the following characters, is it assumed to be a value:

0-9. The digits zero through nine and decimal point.

\+ Plus sign.

− Minus sign.

@ The beginning of a function name.

(Left parentheses (start an inner portion of a formula).

Value at cursor location.

A value is a *formula* that consists of one or more of the following:

- A number: 1, −11, 25.5, 3.4E4.
- A reference to the coordinates of another location: A5, J23.
- An arithmetic operator: +, −, =, *, /, >.
- A function: @SUM(M2...M12), @PI.

As soon as the entry is recognized as a value, the word Value appears on the prompt line and the typed character appears on the edit line. Each subsequent character appears on the edit line as it is typed until the value is written on the worksheet (by typing [ENTER] or an arrow key) or canceled (by typing [BREAK]).

If you make a typing error while typing a value, type [BACKSPACE] to erase the last character typed and continue typing. The Edit command can also be used to correct a value after it is written on the worksheet.

When the formula is written on the worksheet, its calculated value is displayed. The formula itself appears on the entry line of the status area.

References to Another Location

The value of another worksheet location can be used in a formula by including the coordinates of the other location. The value changes whenever the entry at the other location is changed.

When the first element of a formula is a reference to another location, the formula must begin with a character that starts a value such as + or 0+. If it begins with a letter, the VisiCalc program assumes the entry is a label (see "Labels" in this chapter).

If the last character typed is an arithmetic operator, typing an arrow key does not end the value and write it on the worksheet; it enters the coordinate on the edit line so that a reference to another location can be included in a formula by pointing the cursor to the location to be referenced. To write the formula on the worksheet, [ENTER] must be typed.

For example, if 1+ is on the edit line and the cursor is moved to A5, the formula on the edit line is 1+A5. Typing a cursor-moving key at this point does not write the formula on the worksheet, it changes A5 to the coordinate of the new cursor position. [ENTER] must be typed to end the formula.

If the formula is to be 1+A5−B5, typing− after moving the cursor to A5 returns the cursor to the formula entry position. Now the cursor can be moved to B5, which makes the formula on the edit line 1+A5−B5; again, [ENTER] ends the formula.

The VisiCalc program does not allow an illegal formula to be entered (such as one that ends with an arithmetic operator). It indicates an error and waits for the formula to be completed. To continue after an illegal entry of this type, the formula must be edited or canceled. A valid formula that causes an illegal calculation (such as dividing by zero) causes the special value ERROR to be displayed where the illegal calculation occurs and at all other locations that reference the calculation.

The complexity of a formula—the number of references to other locations, arithmetic operators, parentheses, and memory available—determine the maximum length of a formula. If a formula becomes too complex (the formula has been nested more than 9 times or contains too many characters), the VisiCalc program indicates an error and stops displaying additional characters on the edit line. Only the formula up to that point can be written on the worksheet.

Precision of VisiCalc Values

The VisiCalc program stores all values in base 10 with either 11 or 12 significant digits. The largest number the VisiCalc program can accurately calculate is .999999999999E62. The smallest is 9.999999999E−66. When a number is displayed in the General format (see "Format Command" in this chapter), the VisiCalc program shifts between conventional and scientific notation as required to display the value with the greatest precision.

In scientific notation, the number 123456789123 is displayed as 1.235E11 with a column width of 9. The E11 means "times 10 to the 11th power." Except in Dollars-and-cents format, which displays all numbers with two decimal places, non-significant zeros are dropped.

If the columns are too narrow to display a number even in scientific notation, the VisiCalc program fills its entry position with > signs. The display format (Integer, Dollars-and-cents, etc.) and column width do not change the number stored in memory, only the way it is displayed.

Order of Precedence of Calculation

The VisiCalc program performs calculations in the order it encounters each operator from left to right. No operator takes precedence over another. Portions of a formula in parentheses are calculated first. If there are parentheses within parentheses, the VisiCalc program calculates the innermost first. For example, 5+6/2*4 evaluates to 22, but 5+((6/2)*4) evaluates to 17.

Calculating Values on the Edit Line

Typing an exclamation point (!) at the end of a formula causes the calculated value to replace the formula on the edit line. Typing a crosshatch (#) immediately after a reference to another location causes the value of that location to replace the reference to it on the edit line.

The following example shows both these features:

Example

	Type:	**Result:**
1.	/CY	The worksheet clears and the cursor moves to A1.
2.	1➡ 2 ➡ 3 ⬅ ⬅	Three values in row 1.
3.	⬇ + ⬆ + ⬆ ➡ + ⬆ ➡ ➡	Entry line: A2 Edit line: +A1+ B1+C1
4.	#	Edit line: +A1+B1+3 The reference to C1 is replaced by the value of C1. If [ENTER] is typed now, the formula on the edit line is written at A2.

5. !	Edit line:	6
	The entire formula on the edit line is replaced by the calculated value of the formula. If [ENTER] is typed now, the value 6 is written at A2.	
6. [**BREAK**]	Entry line:	clear
	Edit line:	clear
	A2:	clear
	The entry is canceled.	

This feature makes it possible to use the VisiCalc program as a calculator. The edit line becomes the calculator display; any valid formula can be typed and evaluated using the !, then cleared with [BREAK].

The # can be used to copy the value at a location (not the formula, just the calculated value) to another location. With the cursor at the destination location, type +, move the cursor to the location whose value is to be copied (or type its coordinate) and type # [ENTER]. The value of the origin location is calculated and written at the destination. If the value of the origin location is later changed, the value at the destination location is unchanged because the reference to the origin location was not copied, just the value.

Recalculation Order

A formula can contain as many references to other locations as the complexity of the formula allows. Unless manual recalculation is specified, the worksheet is recalculated each time an entry is written on the worksheet. Recalculation always starts at location A1.

When first loaded, the VisiCalc program is set to calculate column-by-column. It calculates the value at A1, then A2, then A3 to the end of column A. Then it recalculates B1, B2, B3 to the end of column B; then C1, C2, C3 and so on. The C in the upper-right corner of the screen indicates that the order of recalculation is by column.

The Global command can be used to change the order of calculation from column-by-column to row-by-row. When recalculation by row is in effect, an R is displayed in the upper-right corner of the screen.

Forward and Circular References

The worksheet should be arranged so that all formulas that contain references to other locations are located *after* the referenced locations are calculated. When the VisiCalc program is set to recalculate by columns, all references to other locations should appear either in a column to the right of the location that is referenced, or below the referenced location in the same column. When it is set to recalculate by rows, all references should appear in a row below the referenced location or to the right of the referenced location in the same row.

If the worksheet is not arranged in this way, the formula containing a reference to another location is recalculated before the new value is calculated for the referenced location. After it is recalculated, the worksheet displays the value of the formula as calculated using the *old* value of the referenced location. The referenced location itself, however, displays its *new* value.

This problem, called a *forward reference*, is often difficult to diagnose and might cause you to suspect that the VisiCalc program has made an error. If you suspect the worksheet contains a forward reference, type !. This forces another recalculation.

Watch the location whose value is incorrect. If its value changes, look for forward references; the worksheet probably must be redesigned to eliminate them. (It is possible to leave the forward reference and type ! to force an extra recalculation, but this can be inconvenient, especially if there are forward references to other forward references, a situation that can require several forced recalculations to produce a correct result.)

Forward references sometimes occur in some areas of accounting when column totals are placed at the *top* of the page.

Note: If a worksheet that includes forward references is saved and later loaded from diskette, the locations that contain forward references display ERROR. A recalculation must be forced (by typing !) to eliminate the ERROR values and display correct results. The forward references should be eliminated by reorganizing the worksheet.

A *circular reference* is a formula that cites itself, such as 1+A1 in location A1. Each time the worksheet is recalculated, the value of this formula changes even if no other change is made to the worksheet. A circular reference prevents accurate results and can be particularly difficult to diagnose.

Version Command

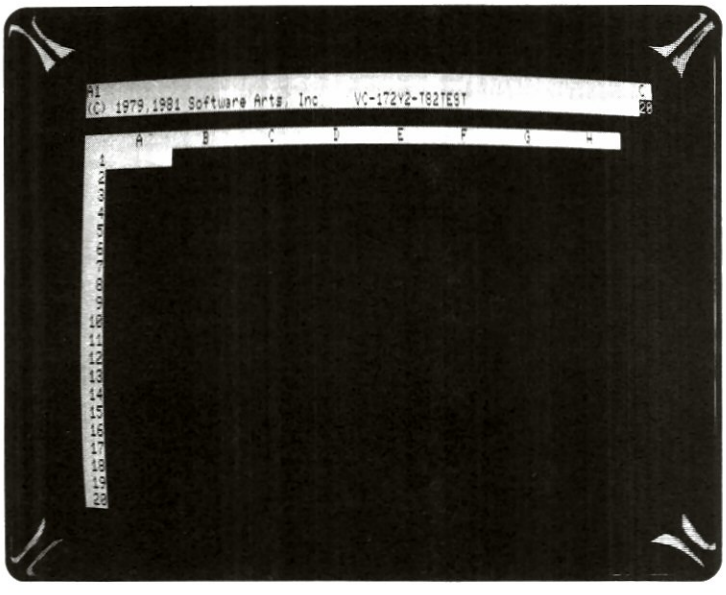
/V

© 1980, 1982 Software Arts, Inc. XXX

Displays copyright notice and version number on prompt line; clears automatically with next keystroke.

The Version command displays the copyright notice and version number of the VisiCalc program in the status area. It does not affect the worksheet. The Version command is entered by typing /**V**.

Should you need to call or write with questions about the VisiCalc program, be sure to include the version number displayed by the Version command. The following photograph shows how the notice appears on the screen:



Window Command

(W)

Window: H V 1 S U

(H)
Splits window horizontally at cursor.

(;) Jumps cursor between windows.

(V)
Splits window vertically at cursor.

(1)
Expands window containing cursor to full screen.

(S)
Initiates horizontal or vertical synchronized scrolling.

(U)
Stops synchronized scrolling.

The Window command (/W) splits the screen vertically or horizontally so that the worksheet can be viewed through two windows simultaneously. The windows can be positioned to show rows or columns too far apart to be viewed through the single window.

When the screen is split, the windows can be scrolled independently or together. Worksheet locations can be displayed in different formats in each window; each window can have a different column width.

Horizontal Option—/WH

The Horizontal option of the Window command (/WH) splits the window by placing a second column border (A, B, C, etc.) just above the row that contains the cursor. When the command is executed, the cursor moves up one row into the upper window. For example, typing /WH when the cursor is at A4 places the horizontal border between A4 and A3 and moves the cursor to A3.

Because the column bar is placed between two rows and because it moves the cursor up, /WH cannot work if the cursor is in row 1—there's no "between" and nowhere to put the cursor. The following example shows both the horizontal and vertical window options:

Example

	Type:	**Result:**
1.	/CY	The screen clears and the cursor moves to A1.
2.	→ 2 → 3 → 4 [ENTER]	A row of numbers in row 1.

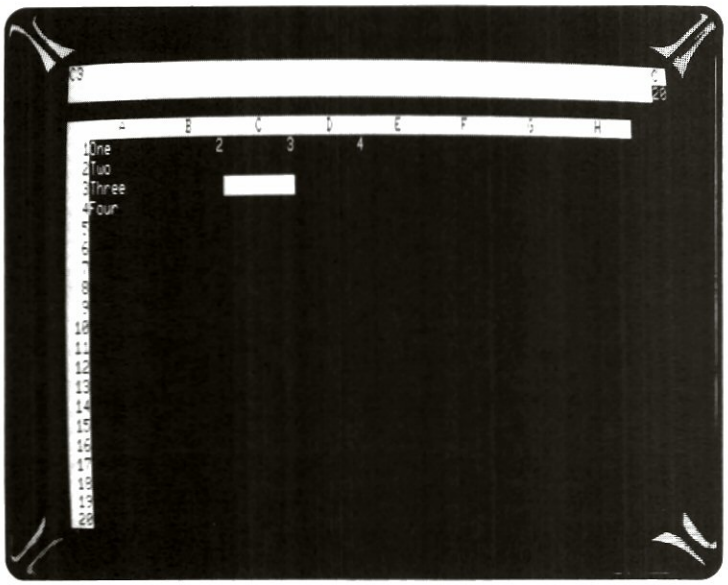
3. **>A1 [ENTER]**

4. **One ↓ Two ↓**
   Three ↓ Four ↓

   A column of words in column A.

5. **>C3 [ENTER]**

   The screen should look like the following photograph:

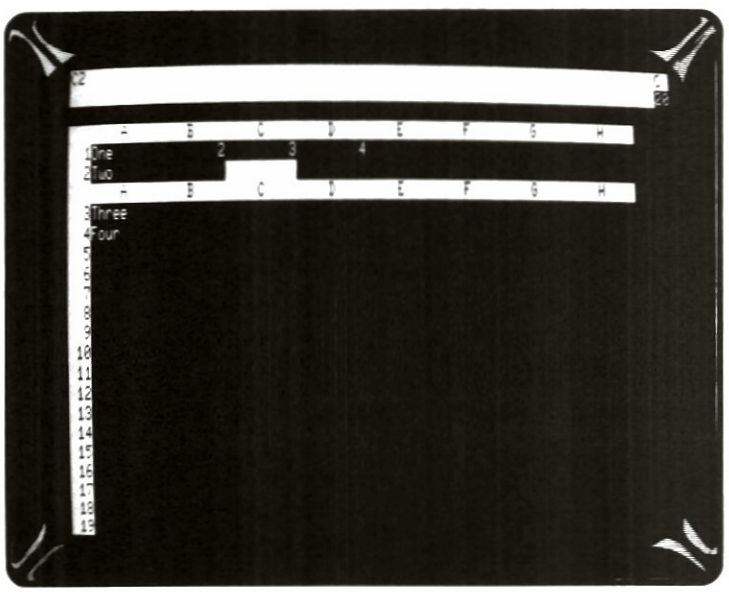


6. **/W**

   Prompt line: Window: H V 1 S U

7. **H**

   The screen should look like the following photo (note the position of the cursor and the horizontal bar):



Each window now shows the worksheet independently. The cursor can move around the worksheet in the top window. Move the cursor to A1 to highlight One in the top window. Type ; to move the cursor to entry position C3 in the bottom window.

Typing ; moves the cursor to its last position in the other window. In this case, that position was C3. Type ; again. The cursor returns to A1, the last entry position it rested on before it moved to the lower window.

Any VisiCalc command can be entered in either window; with two exceptions, the effect of a command on the worksheet is shown in both windows. The two exceptions are the Column and Format options of the Global command, which are set in one window at a time (see "Format Command" and "Global Command" in this chapter for a more detailed description of formats and how to set them).

Move to the bottom window by typing ; and remove the horizontal window by typing /W1. There is now one window; it has the format options of the window that contained the cursor when the Window command was entered.

The screen can be split into two windows only when one window is displayed (you can't change directly from horizontal windows to vertical windows or vice versa). The size of each window is determined by the position of the cursor at the time the Window command is entered.

If you intend to follow the vertical window example, type **>A1 [ENTER]** to bring the example back into view.

Vertical Option—/WV

The Vertical option of the Window command (/WV) splits the window by adding a second row border (1, 2, 3, etc.) just to the left of the column that contains the cursor. For example, typing /WV when the cursor is at B3 places the vertical border between A3 and B3 and moves the cursor left to A3.

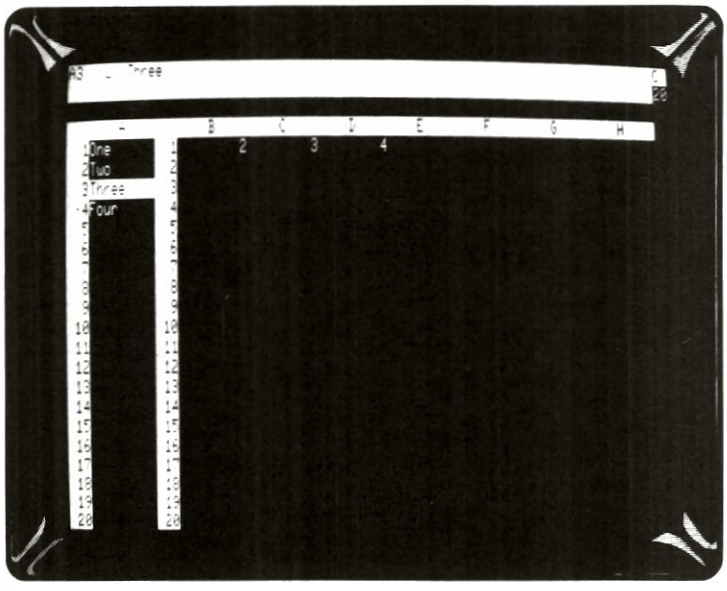
When the screen is split vertically, the columns in the right window may be slightly narrower than those in the left window, to make room for the additional row border. As a rule, the VisiCalc program narrows the right window by one space if the narrowing preserves a column on the screen.

The behavior of vertical windows—cursor movement, effect of commands, etc.—is like horizontal windows.

If the previous example is not on the screen, type steps 1 through 4 from the horizontal window example before continuing.

Example

Type:	Result:
1. >B3 [ENTER]	The cursor moves to B3.
2. /W	Prompt line: Window: H V 1 S U
3. V	The screen should look like the following photograph (note the position of the border and cursor):



One Window Option—/W1

The One Window option of the Window command (/W1) displays a single window. If the command is entered while the screen is split, the global format and column width settings of the window that contains the cursor are applied to the single window.

Synchronized Scrolling Option—/WS

The Synchronized Scrolling option of the Window command (/WS) synchronizes horizontal scrolling in horizontal windows or vertical scrolling in vertical windows. If the window that contains the cursor is scrolled, the other window also scrolls.

Unsynchronized Scrolling Option—/WU

The Unsynchronized Scrolling option of the Window command (/WU) turns off synchronized scrolling.

Note: The last three options of the Window command (/W1, /WS, and /WU) can only be used when the screen is split.

APPENDICES

Appendix A: Floppy Disk Drives

Appendix B: Hard Disk Systems

Appendix C: Exchanging Files

Appendix A. Floppy Disk Drives

Getting Started With TRSDOS

You will need three blank single-sided diskettes. (You may use previously-used diskettes which you no longer want.) There are several things you must do before you use the VisiCalc program for the first time. These steps are listed below in the order they must be done, and then explained fully in the next pages.

1. Load TRSDOS. TRSDOS stands for the TRS-80 Disk Operating System and contains the programs which run your computer and disk drive.

2. Prepare some storage diskettes.

3. Load the VisiCalc program.

Once these steps are completed, you can begin using the VisiCalc program.

Loading TRSDOS

Your package contains a VisiCalc/TRSDOS diskette. You should use the TRSDOS BACKUP program to copy this diskette and store the copy in a safe place as your backup diskette.

The diskette contains TRSDOS 2.0a and the VisiCalc program. TRSDOS is a short way of saying TRS-80 Disk Operating System. These programs get your computer started and let it work with the disk drives.

If you have a computer that may use TRSDOS II, you may use TRSDOS II with the VisiCalc program. You will first have to copy the VisiCalc program from the VisiCalc/TRSDOS diskette to a TRSDOS II diskette, following the instructions in this appendix. All instructions in this book are applicable to either TRSDOS 2.0a or TRSDOS II. We will use the name TRSDOS to refer to both disk operating systems. The label side of the VisiCalc/TRSDOS diskette will be inserted in your drive facing left if you are using Thinline drives and right if you are using standard drives.

Note: If you have Thinline drives you cannot use the VisiCalc/TRSDOS 2.0a diskette (as described below). If you have only one Thinline drive you must convert the VisiCalc/TRSDOS diskette with the THINLINE program from your TRSDOS 2.0b system master. See your owner's manual for details of these operations. If you have two or more Thinline drives, you may use a TRSDOS II diskette or a TRSDOS 2.0b diskette.

To Start Up a Diskette System:

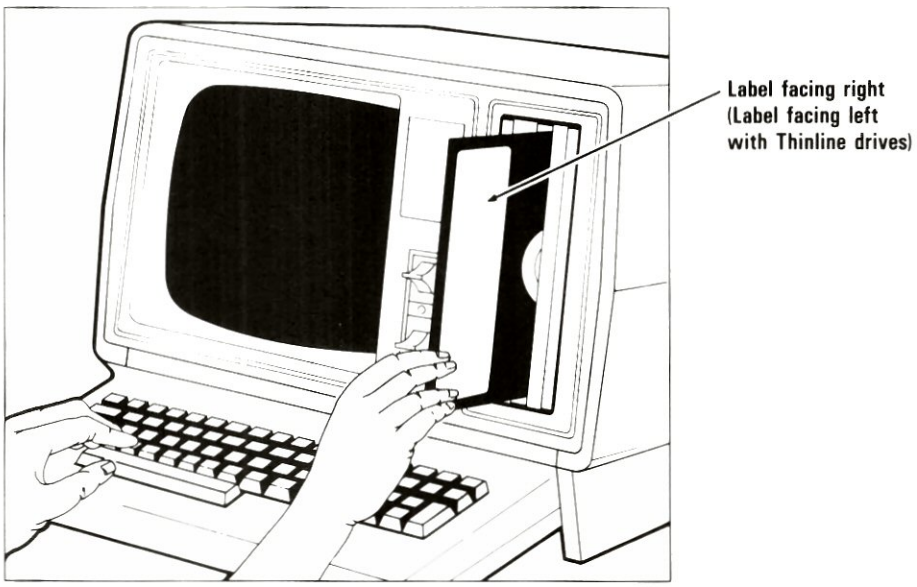
1. Be sure all drives are empty and all components are turned off. If no Disk Expansion System (additional drives) is present, be sure to connect the Disk Terminator plug to the computer (see the *TRS-80 Model II Owner's Manual*).

2. Turn on the power to your computer as recommended by your owners manual. The busy light will come on for drive 0. The message:

   INSERT DISKETTE

   will appear on the screen. If the message does not appear, turn off the computer and check all connections. Wait at least 15 seconds and start again at step 1.

3. Carefully insert the VisiCalc/TRSDOS diskette into drive 0 with the TRSDOS label edge entering last as in the illustration. If you are using TRSDOS II you will insert a TRSDOS II diskette in drive 0 *instead* of the VisiCalc/TRSDOS diskette. Make sure the diskette label is facing the right way for your type of drive (left for Thinline, right for standard). Gently push the diskette all the way in. Then close the drive door.



   The drive will run for about half a minute and some messages will appear on the screen. If you see the message:

   NOT A SYSTEM DISKETTE

   you do not have the right diskette in drive 0 or you have the wrong side of the diskette. Remove the diskette in drive 0 and begin again at step 1.

4. A prompt for the date will appear.

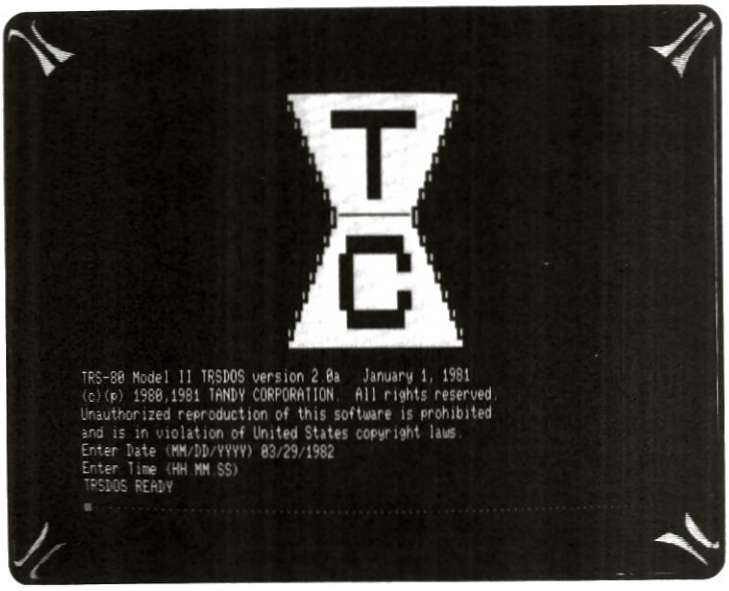
   Enter Date (MM/DD/YYYY)

   You must enter a date in the format indicated, for example, 12/26/1982. Then press the **[ENTER]** key.

5. A prompt for the time will appear.

   Enter Time (HH.MM.SS)

   You may enter a time and press **[ENTER]**, or you may just press **[ENTER]**. Your screen should resemble the following photograph.



You've completed the first step and have TRSDOS loaded into the computer's memory.

Copying the VisiCalc Program to a TRSDOS II Diskette:
The VisiCalc program must be copied to a TRSDOS II diskette for use with TRSDOS II. You will use the FCOPY program from a copy of your TRSDOS II Systems diskette. Leave the TRSDOS II Systems diskette in drive 0 and put the VisiCalc/TRSDOS diskette in drive 1.

Check to make sure the screen prompt reads:

TRSDOS-II Ready

and, in capital letters, type:

FCOPY [ENTER]

The FCOPY program will prompt you through the file copy procedure. Type **VC [ENTER]** when the program asks you for the SOURCE filespec or wildcard mask. Type **1 [ENTER]** when you are asked for the SOURCE drive and **0 [ENTER]** when you are asked for the DESTINATION drive. When the FCOPY program asks if the SOURCE disk is ready, make sure that you have the VisiCalc/TRSDOS diskette mounted in drive 1 and type **Y [ENTER]**.

The drives will turn and in a moment the program will respond with * * FCOPY Complete * * . When the disk drives have stopped whirring, and the busy lights are off, open the drive 1 door and remove the VisiCalc/TRSDOS diskette. Put it back in its sleeve with the label showing.

The diskette in drive 0 is now a VisiCalc/TRSDOS II diskette. You will use it to get you system working and load the VisiCalc program. Use this diskette whenever the instructions call for the use of the VisiCalc/TRSDOS diskette.

Preparing Storage Diskettes

A blank diskette must be formatted (prepared for use) before it can store a VisiCalc worksheet. If you have a single-drive system, or want to use your storage diskettes in drive 0, you must make the formatted diskettes into TRSDOS diskettes. TRSDOS II requires that a TRSDOS diskette be left in drive 0 during use. You may use the VisiCalc/TRSDOS diskette now, but you should create a TRSDOS diskette for this later. (See your *TRS-80 Computer Owner's Manual* for information on the TRSDOS **FORMAT** program and various configurations of storage diskettes.)

The lessons in this manual require at least one formatted or TRSDOS diskette. Prepare several storage diskettes before you begin using the VisiCalc program. *Always keep at least one blank storage diskette on hand.* To prepare storage diskettes for use with TRSDOS, follow the instructions below.

Making VisiCalc Storage Diskettes for Use With TRSDOS

Multiple Drive Systems

1. Put a TRSDOS diskette (the VisiCalc/TRSDOS diskette may be used) into drive 0 and a blank diskette into drive 1.

2. With the TRSDOS READY prompt on the screen and a TRSDOS diskette in drive 0 type:

   FORMAT 1 [ENTER]

3. This will make a formatted data diskette that can be used in drive 1, 2, or 3, but cannot be used in drive 0. To make a TRSDOS diskette that can be used in drive 0, leave the diskettes in the drives after step two and type:

   BACKUP 0 TO 1 [ENTER]

4. This diskette can be used for storage. However, a minimum configuration diskette would give you much more space to store your worksheets. Consult your TRS-80 Computer Owner's Manual for instructions on creating minimum configuration diskettes.

Single Drive Systems

Single drive users must use TRSDOS 2.0.

1. If you have a Thinline drive, place a TRSDOS 2.0b diskette into the drive with the label facing left. If you have a standard drive place a TRSDOS 2.0a diskette (the VisiCalc/TRSDOS 2.0a diskette may be used) into the drive with the label facing right.

2. Type:

   FORMAT 0 [ENTER]

   When the busy light goes out you will be prompted to place a blank diskette into the drive. Position the label as in step 1.

3. Type:

   Y [ENTER]

   When the diskette is formatted, you will be asked to replace the TRSDOS diskette. Wait for the busy light to go out before you switch the diskettes. When the TRSDOS diskette is in position and the drive door is closed, press the space bar.

4. Type:

   XFERSYS 0 MIN [ENTER]

   and swap the diskettes as requested by the program. (For more information about the XFERSYS program see your TRS-80 Computer Owner's Manual.)

Loading the VisiCalc Program

Insert the VisiCalc/TRSDOS diskette in drive 0 with the TRSDOS label you previously marked facing in the left for Thinline drives and right for standard drives.

With the prompt:

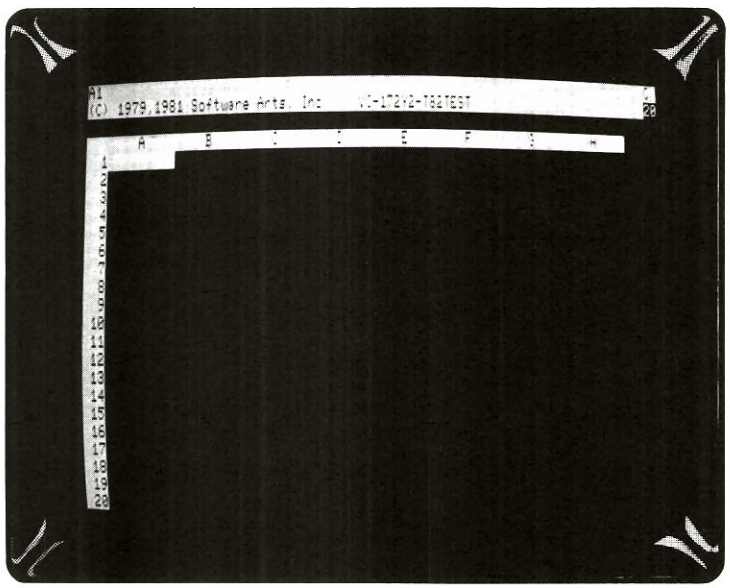
```
TRSDOS Ready
```

on your screen, type (in capital letters):

VC

and press **[ENTER]**.

As the program loads, the VisiCalc screen appears. The second line contains the copyright notice and the version number. The screen should look like the following photograph:



If the screen doesn't look like the preceding photograph, remove the VisiCalc/TRSDOS diskette from the drive. Turn off the computer and go through the "Loading TRSDOS" and "Loading the VisiCalc program" procedures again. If, after several tries, the VisiCalc program will not load, see your dealer for help.

When the VisiCalc program has loaded, the disk drive has stopped whirring, and the busy light is off, open the drive door and remove the VisiCalc program diskette. Put it back in its sleeve with the label showing; you won't need it again until the next time you load the program. Place your TRSDOS diskette in drive 0.

Note: Be careful with diskettes. Although they are replaceable, misuse can lose hours of work. Remove the diskette before turning off the system. Never open the drive door, try to remove a diskette, or turn the power off when the busy light is on.

Once the program is loaded, you're ready to go on to Lesson One and begin learning to use the VisiCalc program.

Appendix B. Hard Disk Systems

Getting Started With TRSDOS II

Although the tutorial chapters of this manual will constantly be referring to floppy diskette for storage of VisiCalc files, Hard Disk users will be able to use the same commands most of the time. There are two things you should keep in mind.

1. When loading a VisiCalc worksheet from the Hard Disk System you will use a :4 extender instead of the :0 listed in the manual. Instead of typing:

   TUTORIAL:0

   type:

   TUTORIAL:4

   This tells the computer to retrieve the information from the Hard Disk (:4) instead of the floppy drive 0. You do not need the extender during a save; your computer will automatically use the hard disk.

2. Backing up to another filename on your hard disk is a good practice. You should also follow the complete backup procedures outlined in the *Hard Disk Owner's Manual* on a regular basis.

You will need a TRS-80 Hard Disk System with TRSDOS II already installed. Instructions on Installation, Operations and initializing the Hard Disk with TRSDOS II can be found in the *TRS-80 Hard Disk Owner's Manual.*

There are several things you must do before you use the VisiCalc program for the first time. These steps are listed below, and then explained fully in the following pages.

Starting a Hard Drive System

Your package contains the VisiCalc/TRSDOS diskette. This disk is not copy protected and you should copy it and store the copy in a safe place as your backup diskette. Instructions for copying diskettes can be found in your *TRS-80 Operator's Manual.* The VisiCalc/TRSDOS diskette contains the TRSDOS 2.0a and VisiCalc programs. TRSDOS is another way of saying TRS-80 Disk Operating System. The Disk Operating System is a series of programs that get your computer started and let it work with the disk drives. Hard Disk users will use TRSDOS II, which resides on, and is loaded from, the hard disk. The VisiCalc program will always be copied from the VisiCalc/TRSDOS diskette to the hard disk and then loaded from the hard disk.

To Start Up the Hard Disk System:

1. Be sure all drives are empty and all components are turned off. If no Disk Expansion System (additional drives) is present, be sure to connect the Disk Terminator plug to the computer (see the *TRS-80 Model II Owner's Manual*).

2. Turn on the Hard Disk System. The fan will start and in a few seconds the green **ACTIVE** light will come on. This light will blink on and off during normal operations but right now it is steady. Now turn on all secondary hard disk drives.

3. Turn on the power to your computer. The **ACTIVE** light will blink and in a few seconds a prompt for the date will appear.

   Enter Date (MM/DD/YYYY)

   You must enter a date in the format indicated, for example, 12/09/1983. Then press the [**ENTER**] key.

4. A prompt for the time will appear.

   Enter Time (HH.MM.SS)

   You may enter a time and press

   [**ENTER**]

   or you may just press [**ENTER**]. Your screen will clear and the message

   TRSDOS II READY

   will appear. If the message does not appear, turn off the computer and check all connections. Wait at least 15 seconds and start again at step 1.

5. Turn on all peripherals (printer, Disk Expansion System, etc.).

You've completed the first step and have TRSDOS II loaded into the computer's memory.

Copying the VisiCalc Program to the Hard Disk System

Insert the VisiCalc/TRSDOS diskette in drive 0. If you have more than one floppy disk drive, note that drive 0 is the one closest to the screen.

Insert the diskette, label edge entering last with the TRSDOS II label facing:

Right if you are using standard disk drives.

Left if you are using a Thinline disk drives.

Check to make sure the screen prompt reads:

TRSDOS-II Ready

and, in capital letters, type:

FCOPY [ENTER]

The FCOPY program will prompt you through the file copy procedure. Type **VC [ENTER]** when the program asks you for the SOURCE filespec or wildcard mask. Type **0 [ENTER]** when you are asked for the SOURCE drive and **4 [ENTER]** when you are asked for the DESTINATION drive. When the FCOPY program asks if the SOURCE disk is ready, make sure that you have the VisiCalc/TRSDOS diskette mounted in drive 0 and type **Y [ENTER]**.

The drive will turn and in a moment the program will respond with * * FCOPY Complete * * . When the disk drive has stopped whirring, and the busy light is off, open the drive door and remove the VisiCalc/TRSDOS diskette. Put it back in its sleeve with the label showing.

Note: Never leave the VisiCalc program diskette in the drive. It could be harmed by power failures or mechanical failures in the drive. Be careful, too, with data storage diskettes. Although they are replaceable, misuse can lose hours of work. Remove the diskette before turning off the system. Never open the drive door, try to remove a diskette, or turn the power off when the busy light is on.

The VisiCalc program is now copied to your hard disk.

Loading the VisiCalc Program

Check to make sure the screen prompt reads:

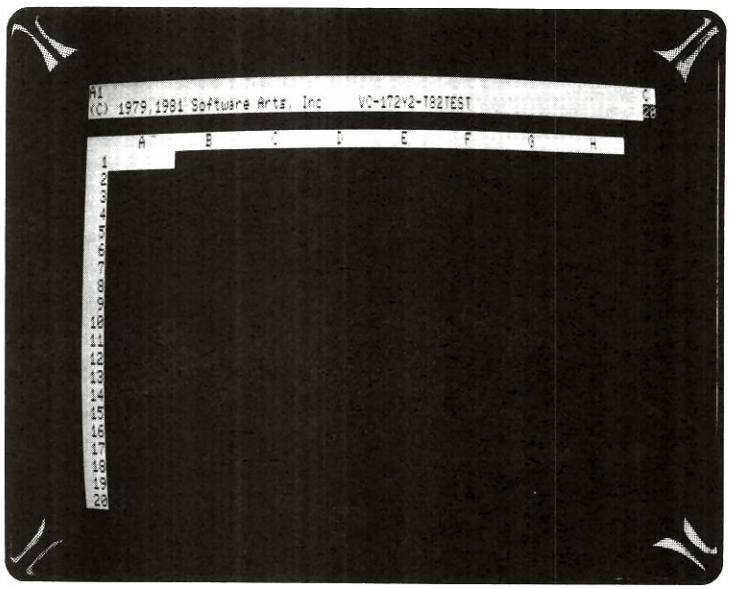
TRSDOS-II Ready

and, in capital letters, type:

VC

and press **[ENTER]**.

As the program loads, the VisiCalc screen appears. The second line contains the copyright notice and the version number. The screen should look like the following photograph:



If the screen doesn't look like the preceding photograph, remove the VisiCalc program diskette from the drive. Turn off the computer and go through the "Starting a Hard Disk System" and "Loading the VisiCalc Program" procedures again. If, after several tries, the VisiCalc program will not load, see your dealer for help.

When you are through working with the VisiCalc program turn the equipment off in the same order you turned it on. Turn off Hard Disks first, then the peripherals, and finally your computer.

Once the program is loaded, you're ready to go on to Lesson One and begin learning to use the VisiCalc program.

Appendix C. Exchanging Files

The DIF™ format is a standard file format that allows unrelated programs to share data.

- Within the VisiCalc program, you may use it to manipulate sections of the worksheet and to transfer sections of one worksheet to another. This allows data consolidation for purposes such as corporate or annual calculations. You can use the DIF format this way, regardless of previous computer experience.

- Outside of the VisiCalc program, it saves data in text files that can be read by other DIF-supporting programs. Thus, a file created by the VisiCalc program can be saved and read by other programs that support DIF. Files created with these other programs can be loaded by the VisiCalc program. These programs can be written (in BASIC, for example) so that data generated by the VisiCalc program can be integrated into a broader set of personal computing tools. Use of the DIF format in this way is recommended for experienced programmers only.

This appendix describes the VisiCalc commands that save and load DIF files and how the files can be used within the VisiCalc program. It then describes the format itself and lists three sample programs in BASIC that read and write DIF files.

Additional information about DIF is available through the DIF Clearinghouse. The DIF Clearinghouse is set up to:

- Coordinate and distribute information about DIF format.

- Maintain and distribute DIF Technical Specification.

Information about the DIF Clearinghouse can be obtained by writing to:

DIF Clearinghouse
P.O. Box 638
Newton Lower Falls, MA 02162

DIF™ is a trademark of Software Arts, Inc.

The Save DIF Option—/S#S

The Save DIF option of the Storage command (/S#S) saves the worksheet in the DIF format. The VisiCalc program adds /DIF to the file name so it can be recognized later as a worksheet saved as a DIF file.

The VisiCalc DIF option saves and loads a worksheet in one of two ways—by row or by column. The VisiCalc program prompts you to specify the orientation by typing **R** or **[ENTER]** or **C**. **R** or **[ENTER]** save worksheets by rows; **C** saves by columns. Specify **R** or press **[ENTER]** when saving a worksheet to be loaded later by the VisiCalc program.

When a worksheet is saved in the DIF format, all formulas are converted to their resultant values. Repeating labels are converted to the initial label without repetitions.

Load DIF Option—/S#L

The Load DIF option of the Storage command (/S#L) loads a worksheet stored on a diskette in the DIF format. The file can be one saved with the Save DIF option of the Storage command, or created by another program.

Unlike a worksheet saved in the normal fashion—which is loaded into the same position it occupied when it was saved—the upper-left corner of a worksheet loaded in the DIF format is the position of the cursor when the Storage command is typed.

As with the other options of the Storage command, you can display the names of the files on the diskette by typing ➡ in response to the File to load: prompt.

If you know the name of the file you can type it in at the File to load: prompt, but you must add the /DIF extender.

The VisiCalc DIF option loads a worksheet in one of two ways—by row or by column. The VisiCalc program prompts you to specify the orientation by typing **R** or [**ENTER**] or **C**.

Using the DIF Format Within the VisiCalc Program

The DIF format can be used to save rectangular portions of the worksheet and load them back in another place on the same or a different worksheet. The cursor position indicates the upper-left coordinate of the portion to be saved. You are prompted to enter the lower-right coordinate. When you reload the file, the upper-left corner of the saved portion is placed at the current cursor position.

Saving files in the DIF format converts all formulas to values. If you have a section of a worksheet containing formulas and wish to convert the formulas to values, save that section in the DIF format with a new file name and reload it again in the same place on the worksheet. All repeating labels will be converted to the initial labels without repetitions.

The DIF format allows transposing of rows and columns. A worksheet or section of a worksheet might be saved in the DIF format with R or [ENTER] to specify row orientation. When the worksheet is loaded, column orientation can be specified. The rows will then be displayed as columns and the columns as rows. Likewise, data may be saved by columns and loaded in rows.

For example, this file,

A1 B1 C1 D1

A2 B2 C2 D2

A3 B3 C3 D3

is saved by rows in the DIF format with A1 as the upper-left coordinate and C3 given as the lower-right coordinate. When the file is loaded with the cursor at A1, column orientation is specified. The result is:

A1 A2 A3

B1 B2 B3

C1 C2 C3

D1 D2 D3

The DIF Format

The following information is provided for experienced programmers.

The DIF format stores the worksheet in a form accessible to programs other than the VisiCalc program. To accommodate a wide range of languages in which such a program might be written, several simplifying techniques have been used:

- Information about the size of the file is provided at the beginning.
- Records are kept as short as possible.
- The data type (string or number) of each value is explicitly defined.
- Strings are stored one per line.
- Strings that contain special characters are enclosed in quotation marks.
- The file ends with an explicit End-Of-Data record.

The following figure shows a sample worksheet used to describe the format and the programs that work with the DIF format.

Year	1980	1981	1982
Sales	100	110	121
Cost	80	88	97
Profit	20	22	24

Sample Worksheet
The format stores the worksheet in a series of slices; the worksheet can be sliced either horizontally (by rows) or vertically (by columns). Each of these slices is called a tuple; each slice along the other axis is called a vector. In Figure B-1, for example, if the worksheet is saved by rows, the first vector is Year 1980 1981 1982 and the first tuple contains Year, - (one hyphen), Sales, Cost, and Profit; the entire worksheet is stored in four tuples of five values each.

If the worksheet in Figure B-1 is stored by columns, the first vector is Year – Sales Cost Profit and the first tuple contains Year 1980 1981 1982; the entire worksheet is stored in five tuples of four values each.

A DIF file consists of a series of *header* records that describe the file, followed by one set of *data* records for each tuple, and ends with a pair of *End-Of-Data* records.

Header

The header consists of four sets of three records that give information about the entire file:

```
TABLE
0,1
""
VECTORS
0,V                    V is the number of vectors in the file.
""
TUPLES
0,T                    T is the number of tuples in the file.
""
DATA
0,0
""
```

Data Records

The data records consist of a pair of header records that identify the beginning of a tuple, and a pair of records for each value in the tuple:

-1,0 BOT	Beginning Of Tuple records.
T1,N1 string1	First value of tuple.
T2,N2 string2	Second value of tuple.
T3,N3 string3	Third value of tuple.
. . .	
Tn,Nn stringn	Last (nth) value of tuple.

End-Of-Data Records

The End-Of-Data records mark the end of the file:

```
-1,0
EOD .FI
```

Programs That Work With the DIF Format

The following three programs demonstrate how BASIC programs might be written and used with the DIF format. These are sample programs that must be typed in exactly or developed by programmers. These programs perform the following functions:

- Dump a DIF file just as it is stored, record by record.
- Print a worksheet from a DIF file.
- Create a DIF file by prompting for the worksheet entries.

Dumping a DIF File

This program prints the DIF file just as it is stored, record by record. It asks for the name of the file, and whether to print it. If not instructed to print the file, the program displays the file on the screen.

```
100 REM ********************
110 REM *  INITIALIZATION  *
120 REM ********************
130 NUL$=CHR$(34)+CHR$(34)
140 FALSE=0
150 TRUE=-1
160 SCRN=0
450 REM
460 REM ******************
470 REM *  MAIN ROUTINE  *
480 REM ******************
490 REM
500 GOSUB 1000
510 GOSUB 1200
520 GOSUB 1400
530 GOSUB 1600
540 END
950 REM
960 REM ************************
970 REM *  PROMPT FOR ORDERS  *
980 REM ************************
990 REM
1000 CLS
1010 INPUT "FILE NAME : ";FI$
1020 IF RIGHT$(FI$,4) <> "/DIF" THEN FI$=FI$+"/DIF"
1030 INPUT "PRINT THE FILE (Y OR N) : ";REPLY$
1040 IF REPLY$="Y" OR REPLY$="y" THEN HARDCOPY=TRUE
1050 IF NOT HARDCOPY THEN CLS: RETURN
1060 LPRINT FI$:LPRINT:LPRINT
1070 RETURN
1150 REM
1160 REM ******************
1170 REM *  PRINT HEADER  *
1180 REM ******************
1190 REM
1200 OPEN "I",1,FI$
1210 INPUT#1,TITLE$
1220 INPUT#1,TYPE,NUMBER
1230 INPUT#1,STRNG$
1240 IF HARDCOPY THEN LPRINT TITLE$: LPRINT TYPE;",";NUMBER : ELSE PRINT TITLE$: PRINT TYPE;",";NUMBER
1250 IF HARDCOPY AND STRNG$="" THEN LPRINT NUL$: ELSE IF STRNG$="" THEN PRINT NUL$: GOTO 1270
1260 IF HARDCOPY THEN LPRINT STRNG$: ELSE PRINT STRNG$
1270 IF TITLE$ <> "DATA" THEN 1210
1280 IF NOT HARDCOPY THEN GOSUB 2000
1290 RETURN
1350 REM
1360 REM ************************
1370 REM *  PRINT DATA RECORDS  *
1380 REM ************************
1390 REM
1400 INPUT#1,TYPE,NUMBER
1410 INPUT#1,STRNG$
1420 IF SCRN = 10 AND NOT HARDCOPY THEN GOSUB 2000
1430 IF HARDCOPY THEN LPRINT TYPE;",";NUMBER: ELSE PRINT TYPE;",";NUMBER
1440 IF HARDCOPY AND STRNG$="" THEN LPRINT NUL$: ELSE IF STRNG$="" THEN PRINT NUL$: GOTO 1460
1450 IF HARDCOPY THEN LPRINT STRNG$: ELSE PRINT STRNG$
1460 IF STRNG$ <> "EOD" THEN SCRN=SCRN+1: GOTO 1400
1470 RETURN
1540 REM
1550 REM ********************
1560 REM *  END-OF-PROGRAM  *
1570 REM *  CLEANUP         *
1580 REM ********************
1590 REM
1600 CLOSE
1610 RETURN
1950 REM
1960 REM ***********
1970 REM *  PAUSE  *
1980 REM ***********
1990 REM
2000 PRINT:PRINT"PRESS ANY KEY TO CONTINUE"
2010 A$=INKEY$
2020 IF A$="" THEN 2010
2030 SCRN=0: CLS
2040 RETURN
```

Printing a Worksheet From a DIF File

The following program prints the worksheet as it would appear on the screen. It asks for the name of the file in which the worksheet was saved in the DIF format, the width of columns to be printed, and whether the worksheet was saved by rows or by columns.

```
60 REM ********************
70 REM *  INITIALIZATION  *
80 REM ********************
90 REM
100 CLEAR 1000
110 DIM WO$(50,50): REM DIM WORKSHEET
120 FALSE=0: TRUE=-1
130 BYRWS=FALSE
450 REM
460 REM ******************
470 REM *  MAIN ROUTINE  *
480 REM ******************
490 REM
500 GOSUB 1000
510 GOSUB 1200
520 GOSUB 1400
530 GOSUB 1800
540 IF NOT FILEBAD THEN GOSUB 1600
550 END
950 REM
960 REM ************************
970 REM *  PROMPT FOR ORDERS  *
980 REM ************************
990 REM
1000 CLS
1010 INPUT "FILE NAME : ";FI$
1020 IF RIGHT$(FI$,4) <> "/DIF" THEN FI$=FI$+"/DIF"
1030 INPUT "COLUMN WIDTH : ";CW
1040 INPUT "SAVED BY ROW OR COLUMN (R OR C) : ";REPLY$
1050 IF REPLY$="R" OR REPLY$="r" THEN BYRWS=TRUE
1060 INPUT "PRINT THE WORKSHEET (Y OR N) : ";REPLY$
1070 IF REPLY$="Y" OR REPLY$="y" THEN HARDCOPY=TRUE
1080 RETURN
1150 REM
1160 REM *****************
1170 REM *  READ HEADER  *
1180 REM *****************
1190 REM
1200 OPEN "I",1,FI$
1210 INPUT#1,TITLE$
1220 INPUT#1,TYPE,NUMBER
1230 INPUT#1,STRNG$
1240 IF TITLE$="VECTORS" THEN VECTRS=NUMBER
1250 IF TITLE$="TUPLES" THEN TUPLES=NUMBER
1260 IF TITLE$="DATA" THEN RETURN
1270 GOTO 1210
1350 REM
1360 REM ************************
1370 REM *  READ DATA RECORDS  *
1380 REM ************************
1390 REM
1400 FOR RW = 1 TO TUPLES
1410 INPUT#1,TYPE,NUMBER
1420 INPUT#1,STRNG$
1430 IF TYPE <> -1 OR STRNG$ <> "BOT" THEN GOSUB 2000: RETURN
1440 FOR COL = 1 TO VECTRS
1450 INPUT#1,TYPE,NUMBER
1460 INPUT#1,STRNG$
1470 IF TYPE <> 0 AND TYPE <> 1 THEN GOSUB 2000: RETURN
1475 GOSUB 2200
1480 IF BYRWS AND TYPE=0 THEN WO$(COL,RW)=NUMBER$: GOTO 1500
1490 IF BYRWS THEN WO$(COL,RW)=STRNG$
1500 IF NOT BYRWS AND TYPE=0 THEN WO$(RW,COL)=NUMBER$: GOTO 1520
1510 IF NOT BYRWS THEN WO$(RW,COL)=STRNG$
1520 NEXT COL
1530 NEXT RW
1540 RETURN
1550 REM
1560 REM **********************
1570 REM *  PRINT WORKSHEET  *
1580 REM **********************
1590 REM
```

```
1600 IF BYRWS THEN WDTH=TUPLES: DEPTH=VECTRS: GOTO 1620
1610 WDTH=VECTRS: DEPTH=TUPLES
1620 FOR RW = 1 TO DEPTH
1630 FOR COL = 1 TO WDTH
1640 IF HARDCOPY THEN LPRINT WO$(RW,COL);: ELSE PRINT WO$(RW,COL);
1650 NEXT COL
1660 IF HARDCOPY THEN LPRINT: ELSE PRINT
1670 NEXT RW
1680 RETURN
1750 REM
1760 REM ****************
1770 REM *  CLOSE FILE  *
1780 REM ****************
1790 REM
1800 CLOSE
1810 RETURN
1950 REM
1960 REM ******************
1970 REM *  ERROR IN FILE  *
1980 REM ******************
1990 REM
2000 CLOSE
2010 PRINT
2020 PRINT "ERROR IN FILE... "
2030 PRINT TAB(5); "TYPE = ";TYPE
2040 PRINT TAB(5); "NUMBER = ";NUMBER
2050 PRINT TAB(5); "STRING = ";STRNG$
2060 FILEBAD=TRUE
2070 RETURN
2140 REM
2150 REM **********************
2160 REM *      OFFSET        *
2170 REM *  LABELS & NUMBERS  *
2180 REM **********************
2190 REM
2200 IF TYPE <> 0 THEN 2300
2210 NUMBER$=STR$(NUMBER)
2220 IF LEN(NUMBER$) > CW-1 THEN NUMBER$=" "+LEFT$(NUMBER$,CW-1): RETURN
2230 BLANK$="           "
2240 BN=CW-LEN(NUMBER$)
2250 NUMBER$=LEFT$(BLANK$,BN)+NUMBER$
2260 RETURN
2300 IF LEN(STRNG$) > CW THEN STRNG$=LEFT$(STRNG$,CW): RETURN
2310 BLANK$="           "
2320 BN=CW-LEN(STRNG$)
2330 STRNG$=STRNG$+LEFT$(BLANK$,BN)
2340 RETURN
```

Creating a DIF File

The following program prompts for worksheet entries (by row-column coordinate), then writes the entries on a diskette in a DIF file. Either a string or number (integer or real) can be entered. To enter a label that starts with a number, type a quotation mark (") as the first character of the label. To end a row, type **[ESC] [ENTER]**; to end the worksheet, type **[ESC] [ESC] [ENTER]**.

The program assumes the coordinate of the lower-right corner of the worksheet is the row-column coordinate of the location immediately to the left of the coordinate where **[ESC] [ESC]** is typed, so the last row should be at least as wide as all preceding rows. The worksheet is saved by rows.

```
60 REM ********************
70 REM *  INITIALIZATION  *
80 REM ********************
90 REM
100 CLEAR 1000
110 ESC$=CHR$(27)
120 LR$=ESC$: REM LAST IN ROW
130 LS$=ESC$+ESC$: REM LAST ON SHEET
140 QUOTE$=CHR$(34)
150 NUL$=QUOTE$+QUOTE$
160 RW=1
170 COL=1
180 FALSE=0: TRUE=-1
190 DIM WO$(50,50): REM DIM WORKSHEET
450 REM
460 REM ******************
470 REM *  MAIN ROUTINE  *
480 REM ******************
490 REM
```

```
500 GOSUB 1000
510 GOSUB 1200
520 GOSUB 1400
530 GOSUB 2000
540 END
940 REM
950 REM ****************
960 REM *    PROMPT    *
970 REM *  FOR ORDERS  *
980 REM ****************
990 REM
1000 CLS
1010 INPUT "WRITE THE FILE (Y OR N) : ";REPLY$
1020 IF REPLY$="Y" OR REPLY$="y" THEN DISKCOPY=TRUE
1030 IF DISKCOPY THEN INPUT "FILE NAME : ";FI$: IF RIGHT$(FI$,4) <> "/DIF" THEN FI$=FI$+"/DIF"
1040 RETURN
1140 REM
1150 REM ******************
1160 REM *    PROMPT      *
1170 REM *  FOR ENTRIES   *
1180 REM ******************
1190 REM
1200 CLS
1210 WO$(RW,COL)=""
1220 PRINT "ROW ";RW;" , COLUMN ";CHR$(64+COL);": ";
1230 REPLY$=INKEY$: IF REPLY$="" THEN 1230
1240 IF REPLY$=CHR$(8) AND LEN(WO$(RW,COL))-1=0 THEN PRINT " ": GOTO 1210
1250 IF REPLY$=CHR$(8) THEN WO$(RW,COL)=LEFT$(WO$(RW,COL),LEN(WO$(RW,COL))-1): PRINT " ";WO$(RW,COL);: GOTO 1230
1260 IF REPLY$ <> CHR$(13) THEN PRINT REPLY$;: WO$(RW,COL)=WO$(RW,COL)+REPLY$: GOTO 1230
1270 PRINT
1280 IF WO$(RW,COL)=LS$ THEN WDTH=COL-1: DEPTH=RW: RETURN
1290 IF WO$(RW,COL)=LR$ THEN RW=RW+1: COL=1: PRINT: GOTO 1210
1300 COL=COL+1
1310 GOTO1210
1320 REM
1330 REM ******************
1340 REM *  WRITE HEADER  *
1350 REM ******************
1360 REM
1370 REM ------------
1380 REM    HEADER
1390 REM ------------
1400 IF NOT DISKCOPY THEN RETURN
1410 OPEN "O",1,FI$
1420 PRINT#1,"TABLE"
1430 PRINT#1,0;",";1
1440 PRINT#1,NUL$
1450 PRINT#1,"VECTORS"
1460 PRINT#1,0;",";DEPTH
1470 PRINT#1,NUL$
1480 PRINT#1,"TUPLES"
1490 PRINT#1,0;",";WDTH
1500 PRINT#1,NUL$
1510 PRINT#1,"DATA"
1520 PRINT#1,0;",";0
1530 PRINT#1,NUL$
1560 REM
1570 REM --------------
1580 REM  DATA RECORDS
1590 REM --------------
1600 FOR COL= 1 TO WDTH
1610 PRINT#1,-1;",";0
1620 PRINT#1,"BOT"
1630 FOR RW= 1 TO DEPTH
1640 IF VAL(WO$(RW,COL))<> 0 OR WO$(RW,COL)= "0" THEN PRINT#1,0;",";VAL(WO$(RW,COL)): PRINT#1,"V": GOTO 1680
1650 IF LEFT$(WO$(RW,COL),1)=QUOTE$ THEN WO$(RW,COL)=MID$(WO$(RW,COL),2)
1660 PRINT#1,1;",";0
1670 PRINT#1,QUOTE$;WO$(RW,COL);QUOTE$
1680 NEXT RW
1690 NEXT COL
1700 REM -------------
1710 REM  END-OF-DATA
1720 REM -------------
1730 PRINT#1,-1;",";0
1740 PRINT#1,"EOD"
1750 RETURN
1940 REM
1950 REM ********************
1960 REM *  END OF PROGRAM  *
1970 REM *  CLEANUP         *
1980 REM ********************
1990 REM
2000 CLOSE
2010 RETURN
```

—A—

—B—

—C—

—D—

—E—

—F—

—G—

—H—

—I—

—K—

—L—

—M—

N

—O—

—P—

—Q—

—R—

—S—

—T—

—U—

—V—

—W—

—X—

—INDEX OF SPECIAL CHARACTERS—

Important Note to VisiCalc (26-4521) Users

Hard disk users may use the FCOPY command to copy the VisiCalc program from the distribution floppy diskette to the hard disk as follows:

FCOPY VC:0 TO 4 [ENTER]

VisiCalc then can be used in exactly the same manner as with a floppy diskette except that the hard disk can be used for data storage and program storage.

Because the TRSDOS file search rules are somewhat complicated and depend on your particular combination of disk drives, if you have more than one disk drive (multiple hard disks, a hard disk and a floppy drive containing a floppy, or multiple floppy drives containing diskettes), always use a disk number as a part of the file name. If you do not do this files may be moved to your system disk without explicit warning.

Example: if you have a hard disk and a floppy drive 0 and wish to save your spread sheet under the name MYFILE/VC on drive 0 use

/SSMYFILE:0

to save the spread sheet on drive 4 use

/SSMYFILE:4

Also please note that VisiCalc only scans one disk (the hard disk if you have one). To scan another disk, provide an explicit drive number.

Example: to scan drive 0 on a hard disk system use

/SL:0 ➡

The execute TRSDOS command facility supports only 4 TRSDOS commands ... DIR, SETCOM, FORMS and I. Use of another TRSDOS command may produce unexpected results including loss of the current spread sheet.

Note: as stated in the TRSDOS owners manual, whenever you swap a floppy diskette you must use the I command to initialize the new diskette. This can (and must) be done even if VisiCalc is running (for example if you wish to replace the VisiCalc diskette in drive 0 with a minimum configuration diskette). To initialize a diskette when VisiCalc is running use

/SEI d (where d is the drive number).

Thank-you!

Radio Shack®

A Division of Tandy Corporation

TERMS AND CONDITIONS OF SALE AND LICENSE OF RADIO SHACK COMPUTER EQUIPMENT AND SOFTWARE PURCHASED FROM A RADIO SHACK COMPANY-OWNED COMPUTER CENTER, RETAIL STORE OR FROM A RADIO SHACK FRANCHISEE OR DEALER AT ITS AUTHORIZED LOCATION

LIMITED WARRANTY

I. CUSTOMER OBLIGATIONS

A. CUSTOMER assumes full responsibility that this Radio Shack computer hardware purchased (the "Equipment"), and any copies of Radio Shack software included with the Equipment or licensed separately (the "Software") meets the specifications, capacity, capabilities, versatility, and other requirements of CUSTOMER.

B. CUSTOMER assumes full responsibility for the condition and effectiveness of the operating environment in which the Equipment and Software are to function, and for its installation.

II. RADIO SHACK LIMITED WARRANTIES AND CONDITIONS OF SALE

A. For a period of ninety (90) calendar days from the date of the Radio Shack sales document received upon purchase of the Equipment, RADIO SHACK warrants to the original CUSTOMER that the Equipment and the medium upon which the Software is stored is free from manufacturing defects. THIS WARRANTY IS ONLY APPLICABLE TO PURCHASES OF RADIO SHACK EQUIPMENT BY THE ORIGINAL CUSTOMER FROM RADIO SHACK COMPANY-OWNED COMPUTER CENTERS, RETAIL STORES AND FROM RADIO SHACK FRANCHISEES AND DEALERS AT ITS AUTHORIZED LOCATION. The warranty is void if the Equipment's case or cabinet has been opened, or if the Equipment or Software has been subjected to improper or abnormal use. If a manufacturing defect is discovered during the stated warranty period, the defective Equipment must be returned to a Radio Shack Computer Center, a Radio Shack retail store, participating Radio Shack franchisee or Radio Shack dealer for repair, along with a copy of the sales document or lease agreement. The original CUSTOMER'S sole and exclusive remedy in the event of a defect is limited to the correction of the defect by repair, replacement, or refund of the purchase price, at RADIO SHACK'S election and sole expense. RADIO SHACK has no obligation to replace or repair expendable items.

B. RADIO SHACK makes no warranty as to the design, capability, capacity, or suitability for use of the Software, except as provided in this paragraph. Software is licensed on an "AS IS" basis, without warranty. The original CUSTOMER'S exclusive remedy, in the event of a Software manufacturing defect, is its repair or replacement within thirty (30) calendar days of the date of the Radio Shack sales document received upon license of the Software. The defective Software shall be returned to a Radio Shack Computer Center, a Radio Shack retail store, participating Radio Shack franchisee or Radio Shack dealer along with the sales document.

C. Except as provided herein no employee, agent, franchisee, dealer or other person is authorized to give any warranties of any nature on behalf of RADIO SHACK.

D. Except as provided herein, **RADIO SHACK MAKES NO WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

E. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation(s) may not apply to CUSTOMER.

III. LIMITATION OF LIABILITY

A. EXCEPT AS PROVIDED HEREIN, RADIO SHACK SHALL HAVE NO LIABILITY OR RESPONSIBILITY TO CUSTOMER OR ANY OTHER PERSON OR ENTITY WITH RESPECT TO ANY LIABILITY, LOSS OR DAMAGE CAUSED OR ALLEGED TO BE CAUSED DIRECTLY OR INDIRECTLY BY "EQUIPMENT" OR "SOFTWARE" SOLD, LEASED, LICENSED OR FURNISHED BY RADIO SHACK, INCLUDING, BUT NOT LIMITED TO, ANY INTERRUPTION OF SERVICE, LOSS OF BUSINESS OR ANTICIPATORY PROFITS OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR OPERATION OF THE "EQUIPMENT" OR "SOFTWARE". IN NO EVENT SHALL RADIO SHACK BE LIABLE FOR LOSS OF PROFITS, OR ANY INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF ANY BREACH OF THIS WARRANTY OR IN ANY MANNER ARISING OUT OF OR CONNECTED WITH THE SALE, LEASE, LICENSE, USE OR ANTICIPATED USE OF THE "EQUIPMENT" OR "SOFTWARE".

NOTWITHSTANDING THE ABOVE LIMITATIONS AND WARRANTIES, RADIO SHACK'S LIABILITY HEREUNDER FOR DAMAGES INCURRED BY CUSTOMER OR OTHERS SHALL NOT EXCEED THE AMOUNT PAID BY CUSTOMER FOR THE PARTICULAR "EQUIPMENT" OR "SOFTWARE" INVOLVED.

B. RADIO SHACK shall not be liable for any damages caused by delay in delivering or furnishing Equipment and/or Software.

C. No action arising out of any claimed breach of this Warranty or transactions under this Warranty may be brought more than two (2) years after the cause of action has accrued or more than four (4) years after the date of the Radio Shack sales document for the Equipment or Software, whichever first occurs.

D. Some states do not allow the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply to CUSTOMER.

IV. RADIO SHACK SOFTWARE LICENSE

RADIO SHACK grants to CUSTOMER a non-exclusive, paid-up license to use the RADIO SHACK Software on **one** computer, subject to the following provisions:

A. Except as otherwise provided in this Software License, applicable copyright laws shall apply to the Software.

B. Title to the medium on which the Software is recorded (cassette and/or diskette) or stored (ROM) is transferred to CUSTOMER, but not title to the Software.

C. CUSTOMER may use Software on one host computer and access that Software through one or more terminals if the Software permits this function.

D. CUSTOMER shall not use, make, manufacture, or reproduce copies of Software except for use on **one** computer and as is specifically provided in this Software License. Customer is expressly prohibited from disassembling the Software.

E. CUSTOMER is permitted to make additional copies of the Software **only** for backup or archival purposes or if additional copies are required in the operation of **one** computer with the Software, but only to the extent the Software allows a backup copy to be made. However, for TRSDOS Software, CUSTOMER is permitted to make a limited number of additional copies for CUSTOMER'S own use.

F. CUSTOMER may resell or distribute unmodified copies of the Software provided CUSTOMER has purchased one copy of the Software for each one sold or distributed. The provisions of this Software License shall also be applicable to third parties receiving copies of the Software from CUSTOMER.

G. All copyright notices shall be retained on all copies of the Software.

V. APPLICABILITY OF WARRANTY

A. The terms and conditions of this Warranty are applicable as between RADIO SHACK and CUSTOMER to either a sale of the Equipment and/or Software License to CUSTOMER or to a transaction whereby RADIO SHACK sells or conveys such Equipment to a third party for lease to CUSTOMER.

B. The limitations of liability and Warranty provisions herein shall inure to the benefit of RADIO SHACK, the author, owner and/or licensor of the Software and any manufacturer of the Equipment sold by RADIO SHACK.

VI. STATE LAW RIGHTS

The warranties granted herein give the **original** CUSTOMER specific legal rights, and the **original** CUSTOMER may have other rights which vary from state to state.

RADIO SHACK A DIVISION OF TANDY CORPORATION

U.S.A.: FORT WORTH, TEXAS 76102

CANADA: BARRIE, ONTARIO L4M 4W5

TANDY CORPORATION

AUSTRALIA	BELGIUM	U.K.
280-316 VICTORIA ROAD	PARC INDUSTRIEL DE NANINNE	BILSTON ROAD WEDNESBURY
RYDALMERE, N.S.W. 2116	5140 NANINNE	WEST MIDLANDS WS10 7JN

PRINTED IN U.S.A.