# hp 17bII+ Financial Calculator

Owner's Manual

Welcome to the hp 17bII+

The hp 17bII+ is part of Hewlett-Packard's new generation of calculators:

■ The *two-line display* has space for messages, prompts, and labels.

■ Menus and messages show you options and guide you through problems.

■ *Built-in applications* solve these business and financial tasks:

■ **Time Value of Money.** For loans, savings, leasing, and amortization.

■ **Interest Conversions.** Between nominal and effective rates.

■ **Cash Flows.** Discounted cash flows for calculating net present value and internal rate of return.

■ **Bonds.** Price or yield on any date. Annual or semi-annual coupons; 30/360 or actual/actual calendar.

■ **Depreciation.** Using methods of straight line, declining balance, sum-of-the-years' digits, and accelerated cost recovery system.

■ **Business Percentages.** Percent change, percent total, markup.

■ **Currency Exchange.** Exchange calculations between two currencies.

■ **Statistics.** Mean, correlation coefficient, linear estimates, and other statistical calculations.

■ **Clock.** Time, date, and appointments.

■ Use the *Solver* for problems that aren't built in: type an equation and then solve for any unknown value. It's easier than programming!

■ There are 28K bytes of memory to store data, lists, and equations.

■ You can print information using the hp 82240 Infrared Printer.

■ You can choose either ALG (Algebraic) or RPN (Reverse Polish Notation) entry logic for your calculations.

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List of Examples

The following list groups the examples by category.

Important Information

■ *Take the time to read chapter 1.* It gives you an overview of how the calculator works, and introduces terms and concepts that are used throughout the manual. After reading chapter 1, you'll be ready to start using all of the calculator's features.

■ You can choose either ALG (Algebraic) or RPN (Reverse Polish Notation) mode for your calculations. Throughout the manual, the "✔ "in the margin indicates that the examples or keystrokes must be performed differently in RPN. Appendixes D, E, and F explain how to use your calculator in RPN mode.

■ Match the problem you need to solve with the calculator's capabilities and read the related topic. You can locate information about the calculator's features using the table of contents, the subject index, the list of examples, and the menu maps in appendix C (the gold-edged pages).

■ Before doing any time-value-of-money or cash-flow problems, refer to pages 64 and 92 to learn how the calculator uses positive and negative numbers in financial calculations.

■ For a deeper treatment of specific types of calculations, refer to chapter 14, "Additional Examples." If you especially like learning by example, this is a good reference spot for you.

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Getting Started

Watch for this symbol in the margin. It identifies examples or keystrokes that are shown in ALG mode and must be performed differently in RPN mode. Appendixes D, E, and F explain how to use your calculator in RPN mode.

The mode affects only arithmetic calculations — all other operations, including the Solver, work the same in RPN and ALG modes.

Power On and Off; Continuous Memory

To turn on the calculator, press `CLR` (*clear*) (note ON printed below the key). To turn it off, press ▬ and then `CLR`. This *shifted* function is called `OFF` (note OFF printed above the key). Since the calculator has *Continuous Memory*, turning it off does not affect the information you've stored there.

To conserve energy, the calculator turns itself off after 10 minutes of no use.

If you see the low battery symbol (▬▭) at the top of the display, you should replace the batteries as soon as possible. Follow the instructions on page 224.

Adjusting the Display Contrast

The display's brightness depends on lighting, your viewing angle, and the display contrast setting. To change the display contrast, hold down the `CLR` key and press `+` or `−`.

Setting the Language

The calculator can display information in six different languages. The language initially used by the calculator was preset at the factory. To change the language:

1. Press the 🔴 [MODES].

2. Press [INTL] to display the INTL menu, which stands for "international".

3. Press the appropriate menu key to change the language.

Table 1-1. Keys for language

Key	Description
DEUT	German
ENGL	English
ESPÑ	Spanish
FRAN	French
ITAL !	Italian
PORT	Portuguese

What You See in the Display

Menu Labels. The bottom line of the display shows the menu labels for each of the six major menus (work areas) in the calculator. More about these later in this chapter.

The Calculator Line. The calculator line is where you see numbers (or letters) that you enter, and the results of calculations.

Annunciators. The symbols shown here are called *annunciators*. Each one has a special significance.

Shift (▬) is active. (page 19)

Sending information to the printer. (page 184)

Alarm going off (or past due). (page 147)

Batteries low. (page 224)

Annunciators

Calculator line

125.00+█ ◄ Cursor

FIN | BUS | SUM | TIME | SOLVE | CURRX

Menu labels for the MAIN menu. To display the MAIN menu, press ▬ MAIN (that is, first ▬ , then EXIT).
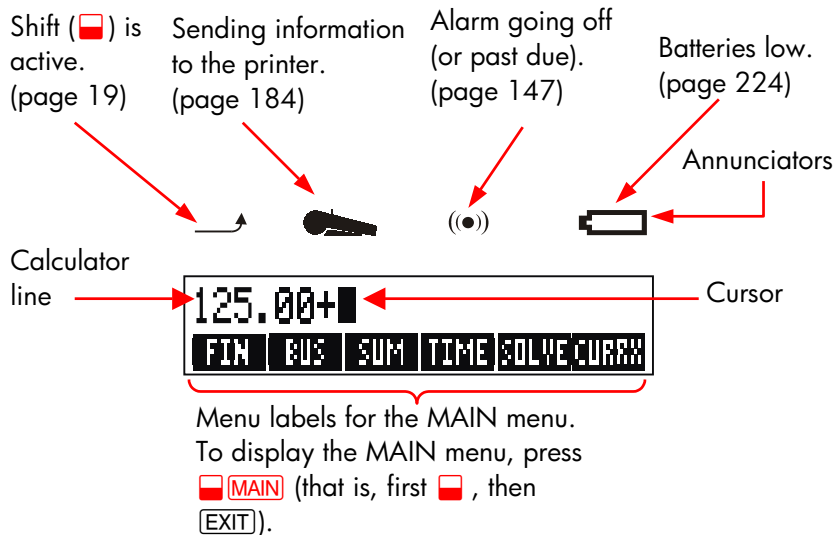
The Shift Key (▬)

Some keys have a second, *shifted* function printed in color above the key. The colored shift key accesses these operations. For example, pressing and releasing ▬ , then pressing CLR turns the calculator off. This is written ▬ OFF .

Pressing ▬ turns on the shift annunciator (──↗). This symbol stays on until you press the next key. If you ever press ▬ by mistake, just press ▬ again to turn off the ──↗.

Backspacing and Clearing

The following keys erase typing mistakes, entire numbers, or even lists or sets of data.

Table 1-2. Keys for Clearing

Key	Description
◀	Backspace; erases the character before the cursor.
CLR	Clear; clears the calculator line. (When the calculator is off, this key turns the calculator on, but *without* clearing anything.)
▬ CLR DATA	This clears all information in the current work area (*menu*). For example, it will erase all the numbers in a list if you are currently viewing a list (SUM or CFLO). In other menus (like TVM), ▬ CLR DATA clears all of the values that have been stored. In SOLVE, it can delete all equations.

The cursor (▮) is visible while you are keying in a number or doing a calculation. When the cursor is visible, pressing ◀ deletes the last character you keyed in. When the cursor is not visible, pressing ◀ erases the last number.

Keys:	Display:	Description:
12345 ◀ ◀ .66	123.66▮	Backspacing removes the 4 and 5.
▬ 1/x	0.01	Calculates 1/123.66.
◀	0.00	Clears the calculator line.

In addition, there are more drastic clearing operations that erase more information at once. Refer to "Resetting the Calculator" on page 228 in appendix A.

Doing Arithmetic

The " ✔ " in the margin is a reminder that the example keystrokes are for ALG mode.

This is a brief introduction to doing arithmetic. More information on arithmetic is in chapter 2. Remember that you can erase errors by pressing ◀ or ⌷CLR⌷.

To calculate 21.1 + 23.8:

Keys:	Display:	Description:
21.1 ⊞	21.10+	
23.8	21.10+23.8	
⊟	44.90	⊟ completes calculation.

Once a calculation has been completed, pressing another digit key *starts* a new calculation. On the other hand, pressing an operator key *continues* the calculation:

77.35 ⊟	77.35-	Calculates 77.35 – 90.89
90.89 ⊟	-13.54	
65 ⬛⌷√x⌷ ⌷×⌷ 12		New calculation:
⊟	96.75	$\sqrt{65}$ x 12.
⌷÷⌷ 3.5 ⊟	27.64	Calculates 96.75 ÷ 3.5.

You can also do long calculations *without* pressing ⊟ after each intermediate calculation—just press it at the end. The operators perform from left to right, in the order you enter them. Compare:

$$\frac{65 + 12}{3.5} \qquad \text{and} \qquad 65 + \frac{12}{3.5}$$

65 ⊞ 12 ⌷÷⌷		Operations occur in the
3.5 ⊟	22.00	order you see them.

| 65 ⊞ ⟮ 12 ⊡ | | Use parentheses to impose |
| 3.5 ⟯ ⊟ | 68.43 | an order of calculation. |

Keying in Negative Numbers (⊞⁄₋)

The ⊞⁄₋ key *changes the sign* of a number.

- To key in a negative number, type that number, then press ⊞⁄₋.
- To change the sign of an already displayed number (it must be the rightmost number), press ⊞⁄₋.

Keys:	**Display:**	**Description:**
75 ⊞⁄₋	−75	Changes the sign of 75.
✓ ⊠ 7.1 ⊟	−532.50	Multiplies −75 by 7.1.

Using the Menu Keys

The calculator usually displays a set of labels across the bottom of the display. The set is called a *menu* because it presents you with choices. The MAIN menu is the starting point for all other menus.

Menu Labels
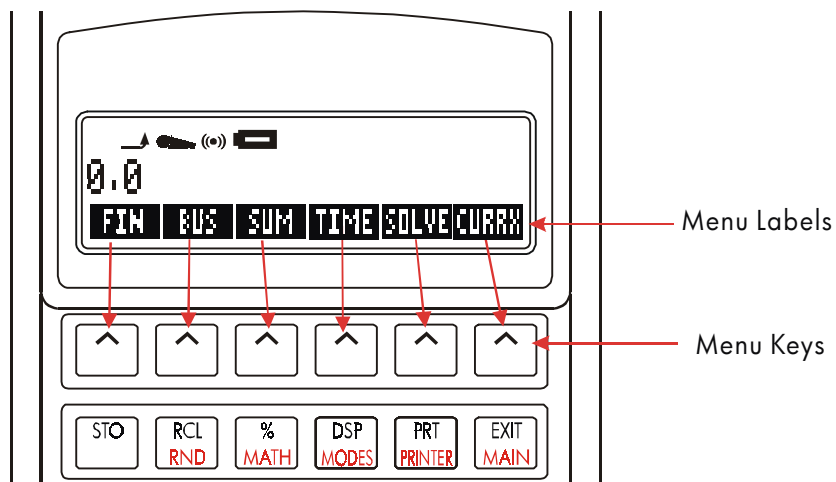
Menu Keys

The top row of keys is related to the labels along the bottom of the display. The labels tell you what the keys do. The six keys are called *menu keys*; the labels are called *menu labels*.

The MAIN Menu

The MAIN menu is a set of primary choices leading to other menu options. No matter which menu you currently see, pressing ▭ MAIN redisplays the MAIN menu. The menu structure is *hierarchical*.

Table 1-3. The MAIN Menu

Menu Label	Operations Done in This Category	Covered in:
`FIN` (Finance)	TVM: Time value of money: loans, savings, leasing, amortization.	Chapter 5
	ICNV: Interest conversions.	Chapter 6
	CFLO: Lists of cash flows for internal rate of return and net present value.	Chapter 7
	BOND: Yields and prices for bonds.	Chapter 8
	DEPRC: Depreciation using SL, DB, and SOYD methods, or ACRS.	Chapter 9
`BUS` (Business Percentages)	Percent of total, percent change, markup on cost, markup on price.	Chapter 3
`SUM` ! (Statistics)	Lists of numbers, running total, mean, weighted statistics, forecasting, summation statistics, and more.	Chapter 10
`TIME` (Time Manager)	Clock, calendar, appointments, date arithmetic.	Chapter 11
`SOLVE` ! (Equation Solver)	Creates customized menus from your own equations for calculations you do often.	Chapter 12
`CURRX` ! (Currency Exchange)	Converting any currency to its equivalent in another currency	Chapter 4

Choosing Menus and Reading Menu Maps

Below is a *menu map* illustrating one possible path through three levels of menus: from the MAIN menu to the BUS menu to the MU%C (*markup as a percent of cost*) menu. There are no menus that branch from the MU%C menu because the MU%C menu is a final destination—you use it to do calculations, rather than to choose another menu.
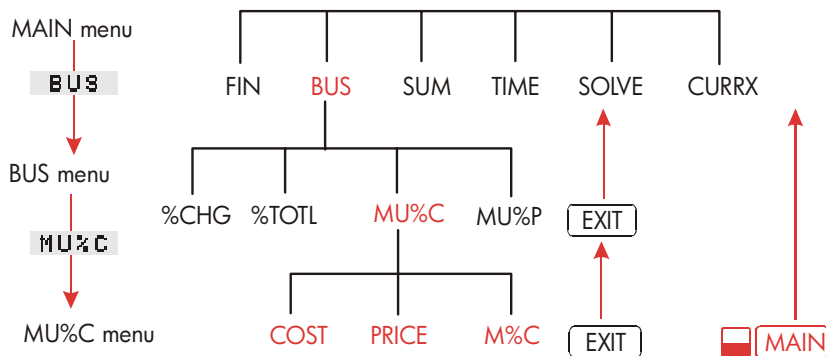
- Press `BUS` to choose the BUS menu. Then press `MU%C` to choose the MU%C menu.
- Press `EXIT` to return to the previous menu. Pressing `EXIT` enough times returns you to the MAIN menu.
- Press ▬`MAIN` to return to the MAIN menu directly.

When a menu has more than six labels, the label `MORE` appears at the far right. Use it to switch between sets of menu labels on the same "level".

Example: Using Menus. Refer to the menu map for MU%C (above) along with this example. The example calculates the percent markup on cost of a crate of oranges that a grocer buys for $4.10 and sells for $4.60.

Step 1. Decide which menu you want to use. The MU%C (markup as a percent of cost) menu is our destination. If it's not obvious to you which menu you need, look up the topic in the subject

index and examine the menu maps in appendix C.

Displaying the MU%C menu:

Step 2. To display the MAIN menu, press ▬ MAIN . This step lets you start from a known location on the menu map.

Step 3. Press   BUS   to display the BUS menu.

Step 4. Press   MU%C   to display the MU%C menu.

Using the MU%C menu:

Step 5. Key in the cost and press   COST   to store 4.10 as the *COST*.

```
COST=4.10
COST PRICE M%C
```

Step 6. Key in the price and press   PRICE   to store 4.60 as the *PRICE*.

Step 7. Press   M%C   to calculate the markup as a percent of cost. The answer: MARKUP%C=12.20.

```
MARKUP%C=12.20
COST PRICE M%C
```

Step 8. To leave the MU%C menu, press EXIT twice (once to get back to the BUS menu, and again to get to the MAIN menu) or ▬ MAIN (to go directly to the MAIN menu).

Calculations Using Menus

Using menus to do calculations is easy. You don't have to remember in what order to enter numbers and in what order results come back. Instead, the menus guide you, as in the previous example. All the keys you need are together in the top row. The menu keys both store numbers for the calculations and start the calculations.

The MU%C menu can calculate *M%C*, the percent markup on cost, given *COST* and *PRICE*.

Keys: 4.60 `PRICE`   Store 4.60
Display: `PRICE=4.60`

Keys: 4.10 `COST`   Store 4.10
Display: `COST=4.10`

COST   PRICE   M%C

Keys: `M%C`   Calculate 12.20   Calculator Memory
Display: `MARKUP%C=12.20`
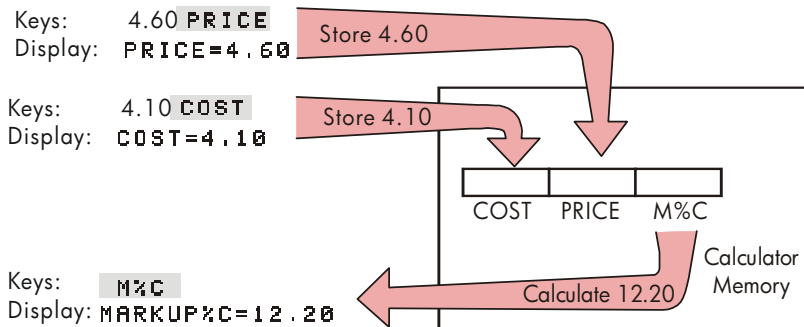
Then the same menu can calculate *PRICE* given *COST* and *M%C*.

Keys: 20   `M%C`
Display: `MARKUP%C=20.00`   Store 20.00

Keys: 4.10 `COST`   Store 4.10
Display: `COST=4.10`

COST   PRICE   M%C

Keys: `PRICE`   Calculator Memory
Display: `PRICE=4.92`   Calculate 4.92
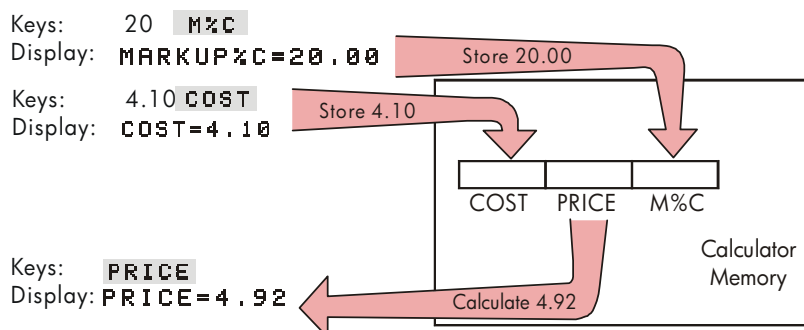
Notice that the two calculations use the same three variables; each variable can be used both to store and calculate values. These are called *built-in variables*, because they are permanently built into the calculator.

Many menus in this calculator work like the example above. The rules for using variables are:

- **To store a value**, key in the number and press the menu key.*† Arithmetic calculations, as well as single values, can be stored.
- **To calculate a value**, press the menu key without first keying in a number. The calculator displays CALCULATING… when a value is being calculated.
- **To verify a stored value**, press [RCL] (*recall*) followed by the menu key. For example, [RCL] COST displays the value stored in *COST*.
- **To transfer a value to another menu**, do nothing if it is displayed (that is, it is in the calculator line). A number in the calculator line remains there when you switch menus. To transfer more than one value from a menu, use storage registers. See page 45, "Storing and Recalling Numbers."

Exiting Menus ([EXIT])

The [EXIT] key is used to leave the current menu and go back to the previously displayed menu (as shown in the previous example). This is true for menus you might pick by accident, too: [EXIT] gets you out.

Clearing Values in Menus

The [CLR DATA] key is a powerful feature to clear all the data in the currently displayed menu, giving you a clean slate for new calculations.

- If the current menu has variables (that is, if the display shows menu labels for variables, such as *COST*, *PRICE*, and *M%C* in the MU%C menu), pressing [CLR DATA] clears the values of those variables to zero.

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* If you have just switched menus and want to store the result already in the calculator line, then you should press [STO] before the menu key

† To store the same number into two different variables, use [STO] for the second variable, e.g. 25 PRICE [STO] COST

■ If the current menu has a list (SUM, CFLO, or Solver), pressing ▬CLR DATA clears the values in the list.
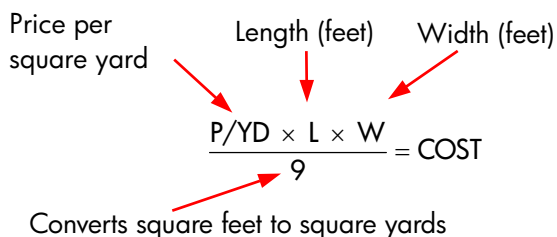
To see what value is currently stored in a variable, press RCL *menu label*.

Solving Your Own Equations (SOLVE)

This chapter has introduced some of the built-in menus the calculator offers. But if the solution to a problem is not built into hp 17bII+ , you can turn to the most versatile feature of all: *the Equation Solver*. Here you define your own solution in terms of an equation. The Solver then creates a menu to go with your equation, which you can use over and over again, just like the other menus in the calculator.

The Solver is covered in chapter 12, but here is an introductory example. Because equations usually use letters of the alphabet, this section also explains how to type and edit letters and other characters that aren't on the keyboard.

Example:Using the Solver. Suppose you frequently buy carpet and must calculate how much it will cost. The price is quoted to you per square yard. Regardless of how you do the calculation (even if you do it longhand), you are using an equation.

Price per square yard   Length (feet)   Width (feet)

$$\frac{P/YD \times L \times W}{9} = COST$$

Converts square feet to square yards

To type this equation into the Solver, use the ALPHA menu.

Typing Words and Characters: the ALPHAbetic Menu

The ALPHAbetic menu is automatically displayed when you need it to type letters and characters. The ALPHA menu also includes characters not found on the keyboard:

■ Uppercase letters.
■ Space.
■ Punctuation and special characters.
■ Non-English letters.
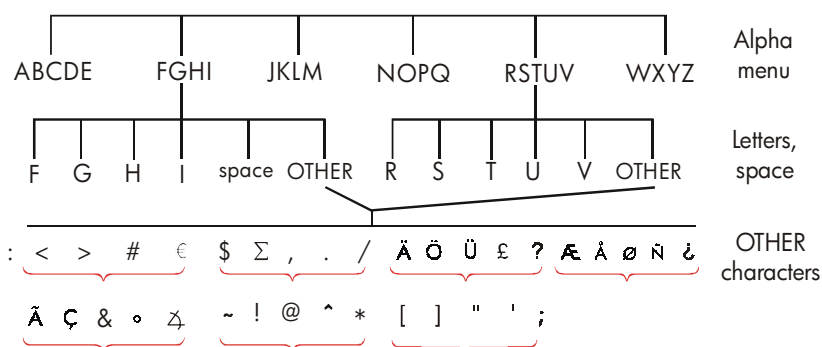
To type a letter you need to press two keys; for example, A is produced by the keystrokes `ABCDE` `A` .

Each letter menu has an `OTHER` key for accessing punctuation and non-English characters. The letter menus with just four letters (for example, FGHI) include a space character (`!`).

To familiarize yourself with the ALPHA menu, type in the equation for the cost of carpeting. The necessary keystrokes are shown below. (Note the access to the special character, "/".) Use ◀, if necessary, to make corrections. If you need to do further editing, refer to the next section, "Editing ALPHAbetic Text." When you're satisfied that the equation is correct, press INPUT to enter the equation into memory.

Keys				Characters

Keys   **Characters**

🔴 [MAIN]

SOLVE	NEW		

| NOPQ | P | | | P |

| WXYZ | OTHER | MORE | ╱ | P╱ |

| WXYZ | Y | ABCDE | D | P╱YD |

| ⊠ | JKLM | L | ⊠ | P╱YD×L× |

| WXYZ | W | [÷][9][=] | | P╱YD×L×W÷9= |

| ABCDE | C | NOPQ | O | P╱YD×L×W÷9=CO |

| RSTUV | S | RSTUV | T | P╱YD×L×W÷9=COST |

[INPUT]   P╱YD×L×W÷9=COST

Note that the ╱ is just a character, part of the variable's name. It is *not* an operator, which ÷ is.

Editing ALPHAbetic Text

The companion to the ALPHA menu is the ALPHA-Edit menu. To display the ALPHA-Edit menu, press EDIT in the SOLVE menu (or press [EXIT] in the ALPHA menu).

EDIT

DEL   ◄◄─   ◄─   ─►   ─►►   ALPHA   [EXIT]

ABCDE   FGHI   JKLM   NOPQ   RSTUV   WXYZ   [EXIT]
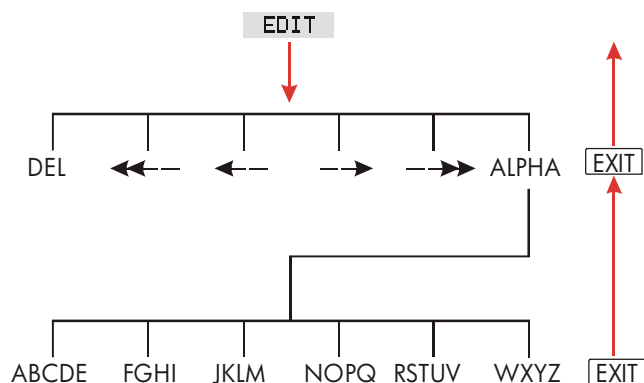
Table 1-4. Alphabetic Editing

Operation	Label or Key to Press
ALPHA-Edit Menu	
Inserts character before the cursor.	Any character.
Deletes character at the cursor.	`DEL` !
Moves the cursor far left, one display-width.	`<<--`
Moves the cursor left.	`<--`
Moves the cursor right.	`-->`
Moves the cursor far right, one display-width.	`-->>`
Displays the ALPHA menu again.	`ALPHA`
Keyboard	
Backspaces and erases the character before the cursor.	⬅
Clears the calculator line.	CLR

Calculating the Answer (CALC)

After an equation is input, pressing `CALC` verifies it and creates a new, customized menu to go with the equation.

```
0.00
P/YD   L    W   COST
```

Menu labels for your variables

Each of the variables you typed into the equation now appears as a menu label. You can store and calculate values in this menu the same way you do in other menus.

Calculate the cost of carpet needed to cover a 9′ by 12′ room. The carpet costs $22.50 per square yard.

Starting from the MAIN menu (press ▊ MAIN):

Keys:	Display:	Description:
SOLVE	P/YD×L×W÷9=COST	Displays the SOLVE menu and the current equation.*
CALC		Displays the customized menu for carpeting.
22.5 P/YD	P/YD=22.50	Stores the price per square yard in *P/YD*.
12 L	L=12.00	Stores the length in *L*.
9 W	W=9.00	Stores the width in *W*.
COST	COST=270.00	Calculates the cost to cover a 9′ x 12′ room.

Now determine the most expensive carpet you can buy if the maximum amount you can pay is $300. *Notice that all you need to do is enter the one value you are changing*—there is no need to re-enter the other values.

300 COST	COST=300.00	Stores $300 in *COST*.
P/YD	P/YD=25.00	Calculates the maximum price per square yard you can pay.
EXIT EXIT		Exits Solver.

* If you entered this equation but don't see it now, press ▲ or ▼ until you do.

Controlling the Display Format

The DSP menu (press $\boxed{\text{DSP}}$) gives you options for formatting numbers. You can pick the number of decimal places to be displayed, and whether to use a comma or a period to "punctuate" your numbers.

```
SELECT DISPLAY FORMAT
 FIX  ALL  .   ,
```
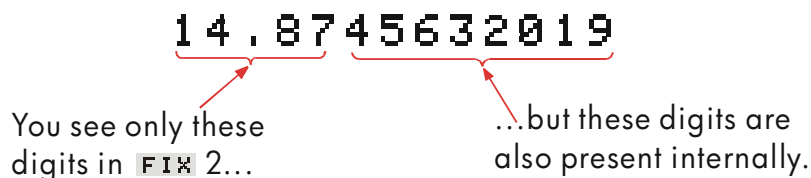
Decimal Places

To change the number of displayed decimal places, first press the $\boxed{\text{DSP}}$ key. Then either:

- Press `FIX`, type the number of decimal places you want (from 0 to 11), and press $\boxed{\text{INPUT}}$; or

- Press `ALL` to see a number as precisely as possible at any time (12 digits maximum).

Internal Precision

Changing the number of displayed decimal places affects what you see, but does not affect the internal representation of numbers. The number inside the calculator always has 12 digits.

$$14.8745632019$$

You see only these digits in `FIX` 2...

...but these digits are also present internally.

Temporarily SHOWing ALL

To *temporarily* see a number with full precision, press ▬$\boxed{\text{SHOW}}$.This shows you the ALL format for as long as you hold down $\boxed{\text{SHOW}}$.

Rounding a Number

The ⬜ RND function rounds the number in the calculator line to the number of displayed decimal places. Subsequent calculations use the rounded value.

Starting with two displayed decimal places:

Keys:	Display:	Description:
5.787	5.787▮	
DSP FIX		Four decimal places are
4 INPUT	5.7870	displayed.
DSP ALL	5.787	All significant digits; trailing zeros dropped.
DSP FIX		Two decimal places are
2 INPUT	5.79	displayed.
⬜ SHOW	FULL PRECISION IS:	Temporarily shows full
(hold)	5.787	precision.
⬜ RND		Rounds the number to two
⬜ SHOW (hold)	5.79	decimal places.

Exchanging Periods and Commas in Numbers

To exchange the periods and commas used for the decimal point and digit separators in a number:

1. Press DSP to access the DSP (*display*) menu.

2. Specify the decimal point by pressing ⬜ . or ⬜ , . Pressing ⬜ . sets a period as the decimal point and comma as the digit separator (U.S. mode). (For example, 1,000,000.00.) Pressing ⬜ , sets a comma as the decimal point and period as the digit separator (non-U.S. mode). (For example, 1.000.000,00.)

Error Messages

Sometimes the calculator cannot do what you "ask", such as when you press the wrong key or forget a number for a calculation. To help you correct the situation, the calculator beeps and displays a message.

■ Press ⌈CLR⌉ or ⌈◀⌉ to clear the error message.

■ Press any other key to clear the message *and* perform that key's function.

For more explanations, refer to the list of error messages just before the subject index.

Modes

Beeper. Beeping occurs when a wrong key is pressed, when an error occurs, and during alarms for appointments. You can suppress and reactivate the beeper in the MODES menu as follows:

1. Press ▬ MODES .

2. Pressing BEEP will simultaneously change and display the current setting for the beeper:

■   BEEPER ON beeps for errors and appointments.

■   BEEPER ON: APPTS ONLY beeps only for appointments.

■   BEEPER OFF silences the beeper completely.

3. Press ⌈EXIT⌉ when done.

Print. Press ▬ MODES PRNT to specify whether or not the printer ac adapter is in use. Then press ⌈EXIT⌉.

Double Space. Press ▬ MODES DBL to turn double-spaced printing on or off. Then press ⌈EXIT⌉.

Algebraic. Press ▬ MODES ALG to select algebraic entry logic.

RPN. Press ▬ MODES RPN to select Reverse Polish Notation entry logic.

Language. Press ▭MODES INTL to change the language.

Calculator Memory (▭MEM)

The calculator stores many different types of information in its memory. Each piece of information requires a certain amount of storage space.* You can monitor the amount of *available memory* by pressing ▭MEM.

```
AVAILABLE MEMORY:
30,740 BYTES      100%
```

Number of bytes of
memory still free

Percentage of total
memory still free

The amount of memory available for storing information and working problems is about 30,740 bytes. (Units of memory space are called *bytes*.) The calculator gives you complete flexibility in how you use that available memory (such as for lists of numbers or equations). Use as much of the memory as you want for any task you want.

If you use nearly all of the calculator's memory, you'll encounter the message INSUFFICIENT MEMORY. To remedy this situation, you must erase some previously stored information. Refer to "Managing Calculator Memory" on page 227 in appendix A.

The calculator also allows you to erase at once *all* the information stored inside it. This procedure is covered in "Erasing Continuous Memory" on page 230.

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* Storing numbers in menus like TVM (non-Solver menus) does *not* use any of your memory space.

2

Arithmetic

If you prefer RPN to algebraic logic, please read appendix D before you read this chapter. The "✓" in the margin is a reminder that the example keystrokes are for ALG mode.

The Calculator Line

The calculator line is the part of the display where numbers appear and calculations take place. Sometimes this line includes labels for results, such as `TOTAL=124.60`. Even in this case you can use the number ✓ for a calculation. For example, pressing ⊞ 2 ⊟ would calculate 124.60 plus 2, and the calculator would display the answer, 126.60.

There is always a number in the calculator line, even though sometimes the calculator line is hidden by a message (such as `SELECT COMPOUNDING`). To see the number in the calculator line, press ◀, which removes the message.

✓ Doing Calculations

Simple calculating was introduced in chapter 1, page 21. Often longer calculations involve more than one operation. These are called *chain calculations* because several operations are "chained" together. To do a chain calculation, you don't need to press ⊟ after each operation, but only at the very end.

For instance, to calculate $\dfrac{750 \times 12}{360}$ you can type either:

750 ⊠ 12 ⊟⊡ 360 ⊟
or
750 ⊠ 12 ⊡ 360 ⊟

In the second case, the ⟨÷⟩ key acts like the ⟨=⟩ key by displaying the result of 750 x 12.

Here's a longer chain calculation.

$$\frac{456 - 75}{18.5} \times \frac{68}{1.9}$$

This calculation can be written as: 456 − 75 ÷ 18.5 x 68 ÷ 1.9.
Watch what happens in the display as you key it in:

Keys:	Display:
456 ⟨−⟩ 75 ⟨÷⟩	381.00÷
18.5 ⟨×⟩	20.59x
68 ⟨÷⟩	1,400.43÷
1.9 ⟨=⟩	737.07

✓Using Parentheses in Calculations

Use parentheses when you want to postpone calculating an intermediate result until you've entered more numbers. For example, suppose you want to calculate:

$$\frac{30}{85 - 12} \times 9$$

If you were to key in 30 ⟨÷⟩ 85 ⟨−⟩, the calculator would calculate the intermediate result, 0.35. However, that's not what you want. To delay the division until you've subtracted 12 from 85, use parentheses:

Keys:	Display:	Description:
30 ⟨÷⟩⟨(⟩ 85⟨−⟩	30.00÷(85.00−	No calculation is done.
12 ⟨)⟩	30.00÷73.00	Calculates 85 − 12.
⟨×⟩ 9	0.41x9	Calculates 30 / 73.
⟨=⟩	3.70	Calculates 0.41x 9.

Note that you must include a ⊠ for multiplication; parentheses do *not* imply multiplication.

✓The Percent Key

The ⅙ key has two functions:

Finding a Percentage. In most cases, ⅙ divides a number by 100. The one exception is when a plus or minus sign precedes the number. (See "Adding or Subtracting a Percentage," below.)

For instance, 25 ⅙ results in 0.25.

To find 25% of 200, press: 200 ⊠ 25 ⅙ ⊟. (Result is 50.00.)

Adding or Subtracting a Percentage. You can do this all in one calculation:

For instance, to decrease 200 by 25%, just enter 200 ⊟ 25 ⅙ ⊟. (Result is 150.00.)

Example: Calculating Simple Interest. You borrow $1,250 from a relative, and agree to repay the loan in a year with 7% simple interest. How much money will you owe?

Keys:	Display:	Description:
1250 ⊞ 7 ⅙	1,250.00+87.50	Interest on the loan is $87.50.
⊟	1,337.50	You must repay this amount at the end of one year.

The Mathematical Functions

Some of the math functions appear on the keyboard; others are in the MATH menu. Math functions act on the last number in the display.

Table 2-1. Shifted Math Functions

Key	Description
■ $1/x$	reciprocal
■ $\sqrt{x}$	square root
■ x^2	square

Keys:	Display:	Description:
4 ■ $1/x$	0.25	Reciprocal of 4.
20 ■ $\sqrt{x}$	4.47	Calculates $\sqrt{20}$.
✓ + 47.2 ×	51.67x	Calculates 4.47 + 47.20.
✓ 1.1 ■ x^2	51.67x1.21	Calculates 1.1^2.
✓ =	62.52	Completes calculation of $(4.47 + 47.2)\ x1.1^2$.

✓The Power Function (Exponentiation)

The power function, y^x, raises the preceding number to the power of the following number.

Keys:	Display:	Description:
125 ■ y^x 3 =	1,953,125.00	Calculates 125^3.
125 ■ y^x 3		Calculates the cube root of
■ $1/x$ =	5.00	125, which is the same as $(125)^{1/3}$.

The MATH Menu

To display the MATH menu, press ▭ [MATH] (the shifted [%] key). Like the other mathematics functions, these functions operate on only the last number in the display.

Table 2-2. The MATH Menu Labels

Menu Label	Description
LOG !	Common (base 10) logarithm of a positive number.
10^X	Common (base 10) antilogarithm; calculates 10^x.
LN	Natural (base *e*) logarithm of a positive number.
EXP !	Natural antilogarithm; *calculates* e^x.
N!	Factorial.
PI	Inserts the value for π into the display.

Keys:	Display:	Description:
2.5 ▭ [MATH]		Calculates $10^{2.5}$.
10^X	316.23	
4 N!	24.00	Calculates the factorial of 4.
[EXIT]		Exits MATH menu.

You can access the MATH menu when another menu is displayed. For instance, while using SUM you might want to use a MATH function. Just press ▭ [MATH], then perform the calculation. Pressing [EXIT] returns you to SUM. The MATH result remains in the calculator line. Remember, however, that you must exit MATH before you resume using SUM.

Saving and Reusing Numbers

Sometimes you might want to include the result of a previous calculation in a new calculation. There are several ways to reuse numbers.

The History Stack of Numbers

When you start a new operation, the previous result moves out of the display *but is still accessible.* Up to four lines of numbers are saved: one in the display and three hidden. These lines make up the *history stack.*

"Invisible" numbers remaining from previous results.

```
1.00
2.00
3.00
4.00
FIN   BUS   SUM  TIME SOLVE CURRX
```

[▲]

```
2.00
3.00
4.00
1.00
FIN   BUS   SUM  TIME SOLVE CURRX
```

[▼]

```
4.00
1.00
2.00
3.00
FIN   BUS   SUM  TIME SOLVE CURRX
```
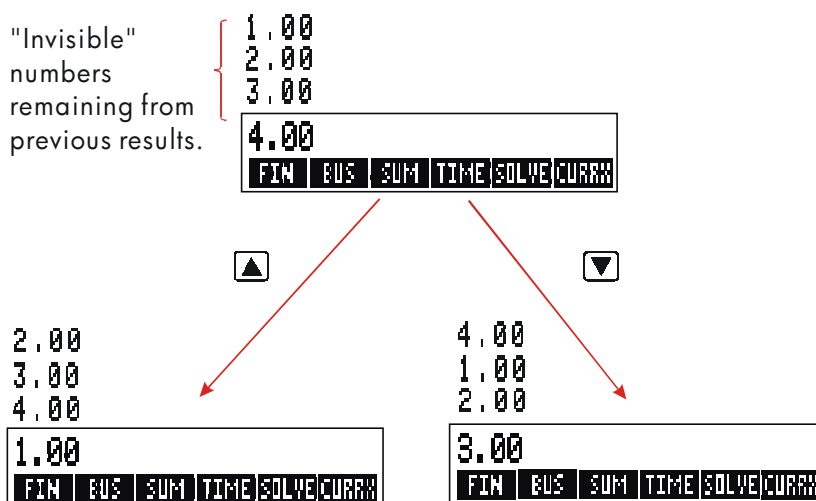
The ▼, ▲, and [■][R↓] keys "roll" the history stack down or up one line, bringing the hidden results back into the display. If you hold down ▲ or ▼, the history stack wraps around on itself. However, you cannot roll the history stack when an incomplete calculation is in the display. Also, you cannot gain access to the stack while using lists (SUM, CFLO) in ALG mode, or SOLVE in either ALG or RPN mode. All numbers in the history stack are retained when you switch menus.

Pressing [■][x≷y] exchanges the contents of the bottom two lines of the display.

Pressing ■ CLR DATA clears the history stack. Be careful if a menu is active, because then CLR DATA also erases the data associated with that menu.

✓Keys:	Display:	Description:
75.55 ⊟ 32.63		
⊟	42.92	
150 ÷ 7 =	21.43	42.92 moves out of display.

Now, suppose you want to multiply 42.92 x 11. Using the history stack saves you time.

▼	42.92	Moves 42.92 back to calculator line.
× 11 =	472.12	

✓Reusing the Last Result (■ LAST)

The ■ LAST key copies the last result—that is, the number just above the calculator line in the history stack—into a current calculation.
This lets you reuse a number without retyping it and also lets you break up a complicated calculation.

$$\frac{39 \: + \: 8}{\sqrt{123 \: + \: 17}}$$

Keys:	Display:	Description:
123 ⊞ 17 =	140.00	Calculates 123 + 17.
■ $\sqrt{x}$	11.83	Calculates $\sqrt{140}$.
39 ⊞ 8 =÷		Copies 11.83 to the
■ LAST	47.00÷11.83	calculator line.
=	3.97	Completes the calculation.

An equivalent keystroke sequence for this problem would be:
39 ⊞ 8 ÷ ⟮123 ⊞ 17 ⟯ ▮√x̄ ⊟

Storing and Recalling Numbers

The ⟦STO⟧ key copies a number from the calculator line into a designated storage area, called a *storage register*. There are ten storage registers in calculator memory, numbered 0 through 9. The ⟦RCL⟧ key recalls stored numbers back to the calculator line.

✓ If there is more than one number on the calculator line, ⟦STO⟧ stores only the last number in the display.

To store or recall a number:

1. Press ⟦STO⟧ or ⟦RCL⟧. (To cancel this step, press ◀.)
2. Key in the register number.

The following example uses two storage registers to do two calculations that use some of the same numbers.

$$\frac{475.6}{39.15} \qquad \frac{560.1 + 475.6}{39.15}$$

✓ Keys:	Display:	Description:
475.6 ⟦STO⟧ 1	475.60	Stores 475.6 into register 1.
÷ 39.15 ⟦STO⟧ 2	475.60÷39.15	Stores 39.15 (rightmost number) into register 2.
⊟	12.15	Completes calculation.
560.1 ⊞ ⟦RCL⟧ 1	560.10+475.60	Recalls contents of register 1.
÷ ⟦RCL⟧ 2	1,035.70÷39.15	Recalls register 2.
⊟	26.45	Completes calculation.

The [STO] and [RCL] keys can also be used with variables. For example, [STO] M%C (in the MU%C menu) stores the rightmost number from the display into the variable *M%C*. [RCL] M%C copies the contents of *M%C* into the calculator line. If there is an expression in the display (such as `2+4▪`), then the recalled number replaces only the last number.

You do not need to clear storage registers before using them. By storing a number into a register, you overwrite whatever existed there before.

Doing Arithmetic Inside Registers and Variables

You can also do arithmetic inside storage registers.

Keys:	Display:	Description:
45.7 [STO] 3	`45.70`	Stores 45.7 in reg. 3.
2.5 [STO][×] 3	`2.50`	Multiplies contents of register 3 by 2.5 and stores result (114.25) back in register 3.
[RCL] 3	`114.25`	Displays register 3.

Table 2-3. Arithmetic in Registers

Keys	New Register Contents
[STO][+]	old register contents + displayed number
[STO][−]	old register contents − displayed number
[STO][×]	old register contents x displayed number
[STO][÷]	old register contents ÷ displayed number
[STO] ■ [y^x]	old register contents ^ displayed number

You can also do arithmetic with the values stored in variables. For example, 2 [STO] [×] M%C (in the MU%C menu) multiplies the current contents of *M%C* by 2 and stores the product in *M%C*.

Scientific Notation

Scientific notation is useful when working with very large or very small numbers. Scientific notation shows a small number (less than 10) times 10 raised to a power. For example, the 1984 Gross National Product of the United States was $3,662,800,000,000. In scientific notation, this is 3.6628×10^{12}. For very small numbers the decimal point is moved to the right and 10 is raised to a negative power. For example, 0.00000752 can be written as 7.52×10^{-6}.

When a calculation produces a result with more than 12 digits, the number is automatically displayed in scientific notation, using a capital E in place of "x10^".

Remember that [+/−] changes the sign of the entire number, and not of the exponent. Use [−] to make a negative exponent.

Type in the numbers 4.78×10^{13} and -2.36×10^{-15}.

Keys:	Display:	Description:
4.78 ■[E] 13	4.78E13	Pressing ■[E] starts the exponent.
■[CLR DATA]	0.00	Clears number.
2.36 ■[E][−] 15	2.36E-15	Pressing [−] before an exponent makes it negative.
[+/−]	-2.36E-15	Pressing [+/−] makes the entire number negative.
■[CLR DATA]		Clears number.

Range of Numbers

The largest positive and negative numbers available on the calculator are $\pm 9.99999999999 \times 10^{499}$; the smallest positive and negative numbers available are $\pm 1 \times 10^{-499}$.

3

Percentage Calculations in Business

The business percentages (BUS) menu is used to solve four types of problems. Each type of problem has its own menu.

```
              FIN     BUS     SUM    TIME    SOLVE    CURRX

              %CHG   %TOTL    MU%C    MU%P
```
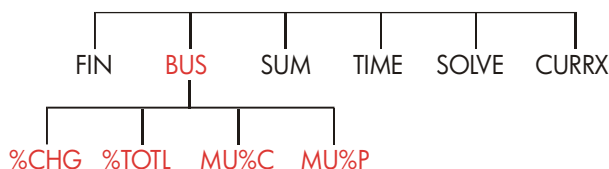
Table 3-1. The Business Percentages (BUS) Menus

Menu	Description
Percent change (%CHG)	The difference between two numbers (*OLD* and *NEW*), expressed as a percentage (*%CH*) of *OLD*.
Percent of total (%TOTL)	The portion that one number (*PART*) is of another (*TOTAL*), expressed as a percentage (*%T*).
Markup on cost (MU%C)	The difference between price (*PRICE*) and cost (*COST*), expressed as a percentage of the cost (*M%C*).
Markup on price (MU%P)	The difference between price (*PRICE*) and cost (*COST*), expressed as a percentage of the price (*M%P*).

The calculator retains the values of the BUS variables until you clear them by pressing ■ CLR DATA. For example, pressing ■ CLR DATA while in the %CHG menu clears *OLD*, *NEW*, and *%CH*.

To see what value is currently stored in a variable, press RCL *menu label*. This shows you the value without recalculating it.

Using the BUS Menus

Each of the four BUS menus has three variables. You can calculate any one of the three variables if you know the other two.

1. To display the %CHG, %TOTL, MU%C, or MU%P menu from the MAIN menu, press BUS , then the appropriate menu label. Pressing %CHG , for example, displays:

```
0.00
OLD  NEW  %CH
```

2. Store each value you know by keying in the number and pressing the appropriate menu key.
3. Press the menu key for the value you want to calculate.

Examples Using the BUS Menus

Percent Change (%CHG)

Example. Total sales last year were $90,000. This year, sales were $95,000. What is the percent change between last year's sales and this year's?

Keys:	Display:	Description:
BUS %CHG		Displays %CHG menu.

90000	OLD	OLD=90,000.00	Stores 90,000 in *OLD*.
95000	NEW	NEW=95,000.00	Stores 95,000 in *NEW*.
%CH	!	%CHANGE=5.56	Calculates percent change.

What would this year's sales have to be to show a 12% increase from last year? *OLD* remains 90,000, so you don't have to key it in again. Just enter *%CH* and ask for *NEW*.

12	%CH	%CHANGE=12.00	Stores 12 in *%CH*.
	NEW	NEW=100,800.00	Calculates the value 12% greater than 90,000.

Percent of Total (%TOTL)

Example. Total assets for your company are $67,584, The firm has inventories of $23,457. What percentage of total assets is inventory?

You will be supplying values for *TOTAL* and *PART* and calculating *%T*. This takes care of all three variables, so there is no need to use [CLR DATA] to remove old data.

Keys:		Display:	Description:
BUS	%TOTL		Displays %TOTL menu.
67584	TOTAL	TOTAL=67,584.00	Stores $67,584 in *TOTAL*.
23457	PART	PART=23,457.00	Stores $23,457 in *PART*.
	%T	%TOTAL=34.71	Calculates percent of total.

Markup as a Percent of Cost (MU%C)

Example. The standard markup on costume jewelry at Balkis's Boutique is 60%. The boutique just received a shipment of chokers costing $19.00 each. What is the retail price per choker?

Keys:	Display:	Description:
BUS MU%C		Displays MU%C menu.
19 COST	COST=19.00	Stores cost in *COST*.
60 M%C	MARKUP%C=60.00	Stores 60% in *M%C*.
PRICE	PRICE=30.40	Calculates price.

Markup as a Percent of Price (MU%P)

Example. Kilowatt Electronics purchases televisions for $225, with a discount of 4%. The televisions are sold for $300. What is the markup of the net cost as a percent of the selling price?

What is the markup as percent of price without the 4% discount?

Keys:	Display:	Description:
BUS MU%P		Displays MU%P menu.
225 ⊟ 4 %		Calculates and stores net cost in *COST*.
COST	COST=216.00	
300 PRICE	PRICE=300.00	Stores 300 in *PRICE*.
M%P	MARKUP%P=28.00	Calculates markup as a percent of price.

Use $225 for *COST* and leave *PRICE* alone.

Keys:	Display:	Description:
225 COST	COST=225.00	Stores 225 in *COST*.
M%P	MARKUP%P=25.00	Calculates markup.

Sharing Variables Between Menus

If you compare the MU%C menu and the MU%P menus, you'll see that they have two menu labels in common — COST and PRICE .

```
       %CHG        %TOTL        MU%C           MU%P
                                  |              |
                        ┌─────────┼─────────┐    |
                      COST      PRICE      M%C    |
                        └────┬────┘         |     |
                             |        ┌─────┼─────┐
                             |      COST  PRICE  M%P
                             |        └──┬──┘
                             └─ Shared variables ┘
```
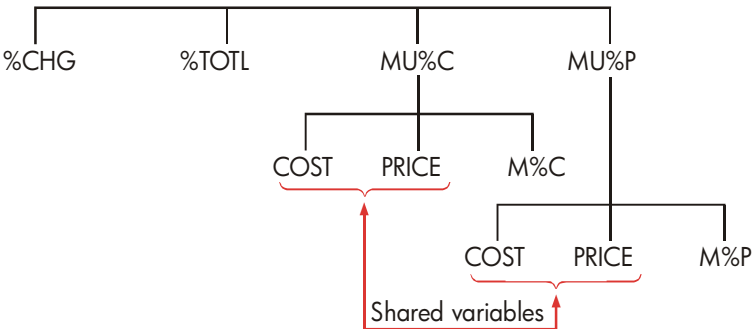
The calculator keeps track of the values you key in according to those labels. For example, if you key in *COST* and *PRICE* in the MU%C menu, exit to the BUS menu, and then display the MU%P menu, the calculator retains those values. In other words, the variables are *shared* between the two menus.

Example: Using Shared Variables. A food cooperative buys cases of canned soup with an invoice cost of $9.60 per case. If the co-op routinely uses a 15% markup on cost, for what price should it sell a case of soup?

Keys:	Display:	Description:
BUS MU%C		Displays MU%C menu.
9.6 COST	COST=9.60	Stores 9.60 in *COST*.
15 M%C	MARKUP%C=15.00	Stores 15% in *M%C*.
PRICE	PRICE=11.04	Calculates retail price.

What is the markup on price? Switch menus but keep the same *COST* and *PRICE*.

Keys:	Display:	Description:
EXIT MU%P		Exits MU%C menu and displays MU%P menu.
M%P	MARKUP%P=13.04	Calculates markup as a percent of price.

4

Currency Exchange

Calculations

The CURRX menu does currency exchange calculations between two currencies using an exchange rate that you calculate or store.

The CURRX Menu

```
    FIN    BUS    SUM    TIME   SOLVE   CURRX
                                          |
                    US$  EUR€  RATE   C.STO  C.RCL  SELCT
```
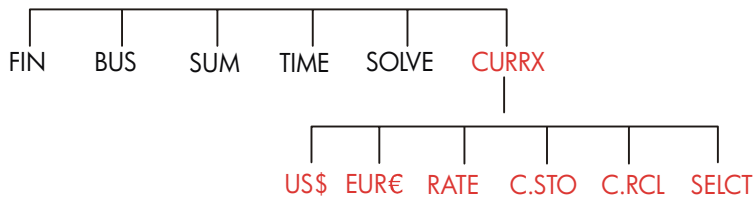
To display the currency exchange menu from the MAIN menu, press CURRX .

```
0.00
US$  EUR€  RATE  C.STO  C.RCL  SELCT
```

Currency #1 is US$ Currency #2 is EUR€
(U.S Dollar)   (EURO Dollar)
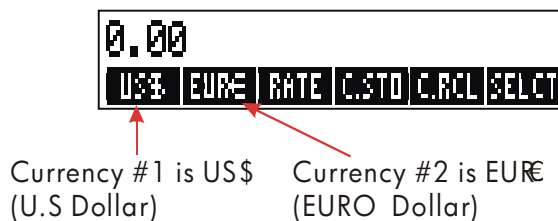
Table 4–1. The CURRX Menu

Menu Key	Description
Curr1	Current *currency#1*;stores or calculates the number of units of this currency
Curr2	Currency *currency#2*;stores or calculates the number of units of this currency
RATE	Stores or calculates the exchange rate between the two current currencies. The rate is expressed as the number of units of *currency #2* equivalent to 1 unit of *currency #1*.
C.STO	Stores the current *currency #1*, *currency #2*, and RATE.
C.RCL	Recalls a previously stored pair of currencies and RATE.
SELCT	Selects a new set of currencies.

Selecting a Set of Currencies

To select a pair of currencies:

1. Press SELCT to display the menu of currencies. Press more, if necessary, to see additional currencies (see table 4–2).

2. Press a menu key to select *currency #1*.

3. Press a menu key to select *currency #2*. RATE is automatically reset to 1.0000.

4. Enter an exchange rate. There are two ways enter the RATE :

■ *Calculate* the rate from a known equivalency (see the example "Calculating an Exchange Rate," page 57.). Calculating an exchange rate is usually the easier way to enter a correct rate, since the order in which you selected the two currencies doesn't mater.

■ *Store* the exchange rate by keying in the value and pressing RATE (see "Storing an Exchange Rate" on page 58).

Table 4–2. Currencies

`US$`	`EUR€`		`CAN$`	`UK£`
United States of America (Dollars)	Austria, Belgium, Germany, Spain, Finland, France,	Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Vatican City (EURO)	Canada (Dollars)	United Kingdom (Pounds)
`SF`	`NIS`	`D.KR`	`N.KR`	`S.KR`
Switzerland (Francs)	Israeli **(New Shekel)**	Denmark (Kroner)	Norway (Kroner)	Sweden (Kronor)
`R !`	`A`	`B`	`CZ$`	`INTI`
Russia (Rouble) South Africa (Band) Saudi Arabia (Riyals)	Argentina	Vanuatu (Bolivar)	Brazil	Peru
`PESO`	`HK$`	`NT$`	`RMB`	`WON`
Bolivia Chile, Colombia, Mexico, Philippines, Uruguay (Pesos)	Hong Kong (Dollars)	Taiwan (New Dollars)	China (Yuan Renminbi)	South Korea (Won)
`YEN`	`A$`	`M$`	`NZ$`	`RP`
Japan (Yen)	Australia (Dollars)	Malaysia (Ringgits)	New Zealand (Dollars)	Indonesia (Rupiahs)
`S$`	`BAHT`	`IN.RS`	`PK.RS`	`CURR1` `CURR2`
Singapore (Dollars)	Thailand (Baht)	India (Rupee)	Pakistani (Rupees)	Miscellaneous*
* Use for currencies not shown in table				

Entering a Rate

The following two examples illustrate the two ways to enter an exchange rate.

Example: Calculating an Exchange Rate. You have just flown from Canada to United States, and you need to exchange your Canadian Dollars for U.S Dollars. The conversion chart looks this :

United States Conversion Chart (in US$)	
Currency	**Rate**
Euro (EUR€)	1.0842
Canadian (CAN$)	.6584
Hong Kong (HK$)	.1282

The chart states these equivalencies: *

1 EUR€	is equivalent to	1.0842	US$
1 CAN$	is equivalent to	0.6584	US$
1 HK$	is equivalent to	0.1282	US$

Part 1: Select the currencies, and calculate an exchange rate form them.

Keys:	Display:	Description:
CURRX !	ENTER A RATE	Display the CURRX menu
SELCT CAN$	SELECT CURRENCY 2	Select *CAN$* as *currency #1*
US$	ENTER A RATE	Select *US$* as *currency #2*
1 CAN$	CAN$=1.00	Store number of *CAN$*

---

* The chart is in terms of United States dollars. Many charts have two columns—a "Buy" column and a "Sell" column. The "Buy" column is used for transactions in which the "Bank" buys the listed currency from you in exchange for United States dollars. Thus, if you arrive in United States with *CAN$*, the exchange rate in the "Buy" column applies for buying *US$* with your *CAN$*. The "Sell" column applies for selling *US$* in exchange for *CAN$*.

0.6584 US$	US$=0.66	Stores equivalent number of *US$*
RATE	RATE=0.66	Calculates the *RATE*.

Part 2: The following keystrokes show that you can reverse the order in which the two currencies are selected.

Keys:	Display:	Description:
SELCT US$	SELECT CURRENCY 2	Select *US$* as *currency #1*
CAN$	ENTER A RATE	Select *CAN$* as *currency #2*
1 CAN$	CAN$=1.00	Store number of *CAN$*
0.6584 US$	US$=0.66	Stores equivalent number of *US$*
RATE	RATE=1.52	Calculates the *RATE*. (1 ÷ 0.6584)

Example : Storing an Exchange Rate. If you choose to store the exchange rate directly, you must select the currencies in the correct order, since the *RATE* is defined as the number of units of *currency #2* equivalent to **one** unit of *currency#1*

Use the United States conversion chart on page 57 to store an exchange rate for converting between Hong Kong Dollars and U.S. Dollars.

Keys:	Display:	Description:
CURRX !	ENTER A RATE	Display the CURRX menu
SELCT MORE		Select *HK$* as *currency #1*
MORE MORE		
HK$	SELECT CURRENCY 2	
US$	ENTER A RATE	Select *US$* as *currency #2*
0.1282 RATE	RATE=0.13	Store the *RATE*

Converting Between Two Currencies

Once the currencies are selected and a *RATE* has been entered, you can convert any number of units of one currency to the other.

Example : Converting between Hong Kong and U.S Dollars.
Part 1: Use the exchange rate stored in the previous example to calculate how many U.S dollars you would receive for 3,000 Hong Kong Dollars.

Keys:	Display:	Description:
3000 `HK$`	HK$=3,000.00	Store number of *HK$*
`US$`	US$=384.60	Calculates equivalent *US$*

Part 2: A wool sweater in a shop window costs 75 US$. What is its cost in HK$ Dollars**?**

Keys:	Display:	Description:
75 `US$`	US$=75.00	Store number of *US$*
`HK$`	HK$=585.02	Calculates equivalent *HK$*

Storing and Recalling Sets of Currencies

Pressing `C.STO` or `C.RCL` displays the C.STO/C.RCL menu, which is used to store and recall sets of currencies and the rates. The menu can store up to six sets of currencies. Initially, the menu contains six blank labels.

Storing Sets of Currencies. To store the current set of currencies and the rate, press. Then, press `C.STO` any menu key to assign the set to that key. For example, storing the currencies in the previous example stores *currency #1 = HK$, currency #2 = US$,* and *RATE* = 0.1282. (The values *US$* = 75 and *HK$* = 585.02 are not stored.)

Recalling Sets of Currencies. To recall a stored set of currencies and their exchange rate, press `C.RCL`, followed by the appropriate menu key. The hp 17bII+ automatically returns to the CURRX menu. The equivalency message and menu labels show the recalled currencies and *RATE*.

Clearing the Currency Variables

Pressing ▬ `CLR DATA` while the CURRX menu is displayed sets the RATE to 1.0000. The values of the two current currencies are cleared to 0.

5

Time Value of Money

The phrase *time value of money* describes calculations based on money earning interest over a period of time. The TVM menu performs compound-interest calculations and calculates (and prints) amortization schedules.

- In *compound interest* calculations, interest is added to the principal at specified *compounding periods*, thereby also earning interest. Savings accounts, mortgages, and leases are compound-interest calculations.

- In *simple interest* calculations, the interest is a percent of the principal and is repaid in one lump sum. Simple interest calculations can be done using the ⌗ key (page 40). For an example that calculates simple interest using an annual interest rate, see page 190.

The TVM Menu

| | FIN | BUS | SUM | TIME | SOLVE | CURRX |

TVM — ICNV — CFLO — BOND — DEPRC

N — I%YR — PV — PMT — FV — OTHER

P/YR — BEG — END — AMRT
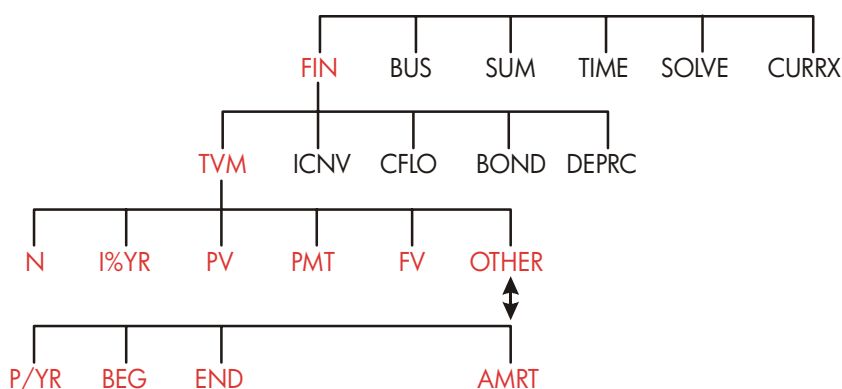
The time value of money (TVM) menu does many compound-interest calculations. Specifically, you can use the TVM menu for a series of *cash flows* (money received or money paid) when:

■ The dollar amount is the same for each payment.*
■ The payments occur at regular intervals.
■ The payment periods coincide with the compounding periods.

12 payments (or periods)   Payment mode: the
per year   end of each period

```
┌─────────────────────────────────┐
│ 12 P/YR            END MODE      │
│ ▐ N ▌ I%YR ▌ PV ▌ PMT ▌ FV ▌OTHER│
└─────────────────────────────────┘
```

To second level of TVM
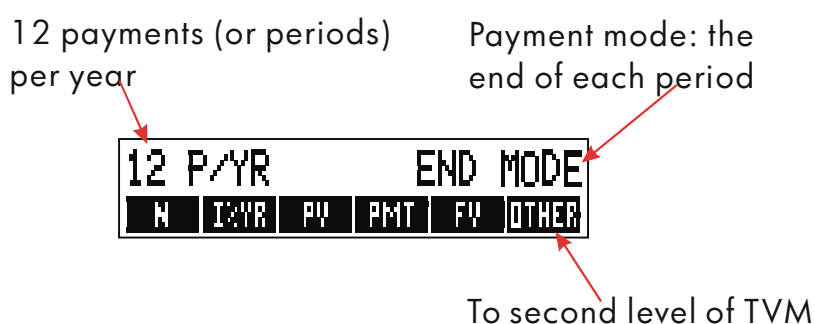
Figure 5-1. The First Level of TVM

The first level of the TVM menu has five menu labels for variables plus
OTHER . The OTHER key accesses a second-level menu used to specify
payment conditions (the *payment mode*) and to call up the AMRT
(*amortization*) menu.

```
┌─────────────────────────────────┐
│ 12 P/YR            END MODE      │
│ ▐P/YR▌ BEG ▌ END ▌         ▌AMRT ▌│
└─────────────────────────────────┘
```

Figure 5-2. The Second Level of TVM

---

* For situations where the amount of the payment varies, use the CFLO (*cash flows*) menu.

Table 5-1. TVM Menu Labels

Menu Label	Description
	First Level
`N` !	Stores (or calculates) the *total* number of payments or compounding periods.*† (For a 30-year loan with monthly payments, *N*=12 x 30=360.)
�P `N`	Shortcut for N: Multiplies the number in the display by *P/YR*, and stores the result in *N*. (If *P/YR* were 12, then 30 ▢ `N` would set *N*=360.)
`I%YR`	Stores (or calculates) the nominal *annual* interest rate as a percentage.
`PV`	Stores (or calculates) the present value—an initial cash flow or a discounted value of a series of future cash flows (*PMTs* + *FV*). To a lender or borrower, *PV* is the amount of the loan; to an investor, *PV* is the initial investment. If *PV* paid *out*, it is negative. *PV* always occurs at the beginning of the first period.
`PMT`	Stores (or calculates) the dollar amount of each periodic payment. All payments are equal, and no payments are skipped. (If the payments are unequal, use CFLO, not TVM.) Payments can occur at the beginning or end of each period. If PMT represents money paid out, it is negative.
`FV`	Stores (or calculates) the future value—a final cash flow or a compounded value of a series of previous cash flows (*PV* + *PMTs*). *FV* always occurs at the end of the last period. If *FV* is paid *out*, it is *negative*.
	↓ `OTHER` [EXIT] ↑
	Second Level
`P/YR`	Specifies the number of payments or compounding periods per year.† (it must be an integer, 1 through 999.)

* When a non-integer *N* (an "odd period") is calculated, the answer must be interpreted carefully. See the savings account example on page 71. Calculations using a stored, non-integer *N* produce a mathematically correct result, but this result has no simple interpretation. The example on page 172 uses the Solver to do a partial-period (non-integer) calculation in which interest begins to accrue prior to the beginning of the first regular payment period.

† The number of payment periods must equal the number of compounding periods. If this is not true, see page 87. For Canadian mortgages, see page 197.

Table 5-1. TVM Menu Labels (Continued)

Menu Label	Description
	Second Level (Continued)
BEG !	Sets *Begin mode*: payments occur at the beginning of each period. Typical for savings plans and leasing. (The Begin and End modes do not matter if *PMT*=0.)
END	Sets *End mode*: payments occur at the end of each period. Typical for loans and investments.
AMRT	Accesses the *amortization* menu. See page 78.

The calculator retains the values of the TVM variables until you clear them by pressing ▬ CLR DATA . When you see the first-level TVM menu, pressing ▬ CLR DATA clears *N*, *I%YR*, *PV*, *PMT*, and *FV*.

When the second-level menu (OTHER) is displayed, pressing ▬ CLR DATA resets the payment conditions to 12 P/YR END MODE.

To see what value is currently stored in a variable, press RCL *menu label*. This shows you the value without recalculating it.

Cash Flow Diagrams and Signs of Numbers

It is helpful to illustrate TVM calculations with *cash-flow diagrams*. Cash-flow diagrams are time lines divided into equal segments called *compounding* (or *payment*) *periods*. Arrows show the occurrence of cash flows (payments in or out). Money received is a positive number (arrow up) and money paid out is a negative number (arrow down).

Note The correct *sign* (positive or negative) for TVM numbers is essential. The calculations will make sense only if you consistently show *payments out* as *negative* and *payments in*

(receipts) as *positive*. Perform a calculation from the point of view of *either* the lender (investor) or the borrower, but not both!
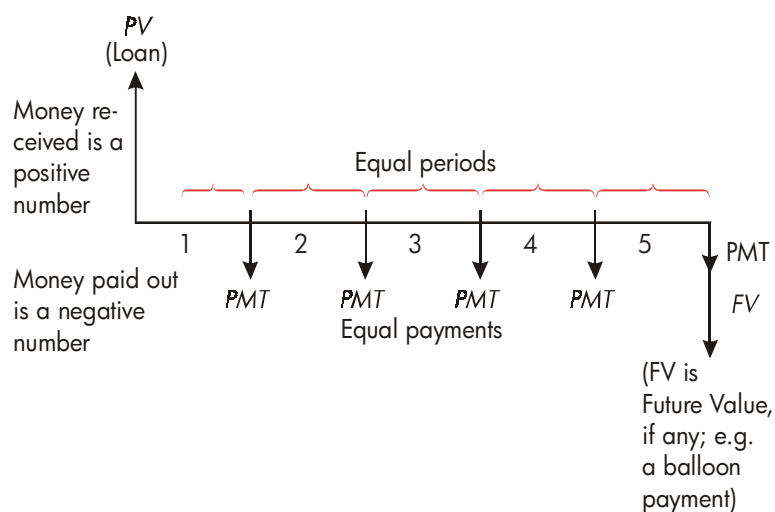
Figure 5-3. A Cash Flow Diagram for a Loan from Borrower's Point of View (End Mode)
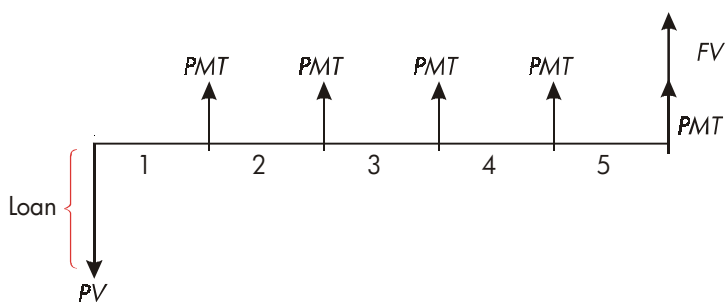
Figure 5-4. A Cash Flow Diagram for a Loan from Lender's Point of View (End Mode)

Payments occur at either the *beginning* of each period or the *end* of each period. End mode is shown in the last two figures; Begin mode is shown in the next figure.
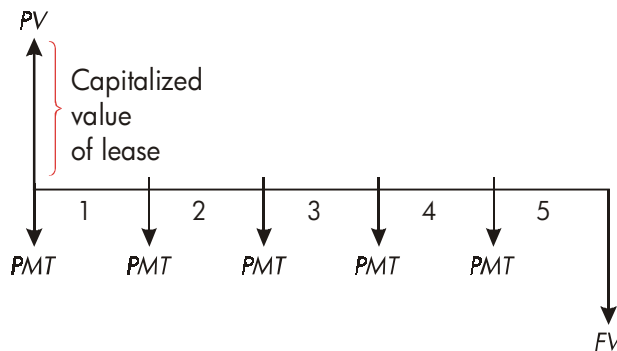
Figure 5-5. Lease Payments Made at the Beginning of Each Period (Begin Mode)

Using the TVM Menu

First draw a cash-flow diagram to match your problem. Then:

1. From the MAIN menu, press FIN   TVM .

2. To clear previous TVM values, press ▄CLR DATA , (Note: You don't need to clear data if you enter new values for *all five* variables, or if you *want* to retain previous values.)

3. Read the message that describes the number of payments per year and the payment mode (Begin, End). If you need to change either of these settings, press OTHER .

- ■ To change the number of payments per year, key in the new value and press P/YR . (If the number of payments is different from the number of compounding periods, see "Compounding Periods Different from Payment Periods," page 87.)

- ■ To change the Begin/End mode, press BEG or END .

- ■ Press EXIT to return to the primary TVM menu.

4. Store the values you know. (Enter each number and press its menu key.)

5. To calculate a value, press the appropriate menu key.

You must give every variable—except the one you will calculate—a value, even if that value is zero. For example, *FV* must be set to zero when you are calculating the periodic payment (*PMT*) required to fully pay back a loan. There are two ways to set values to zero:

■ Before storing any TVM values, press ▉[CLR DATA] to clear the previous TVM values.

■ Store zero; for example, pressing 0 ▉FV▉ sets *FV* to zero.

Loan Calculations

Three examples illustrate common loan calculations. (For amortization of loan payments, see page 77.) Loan calculations typically use End mode for payments.

Example:A Car Loan. You are financing the purchase of a new car with a 3-year loan at 10.5% annual interest, compounded monthly. The purchase price of the car is $7,250. Your down payment is $1,500. What are your monthly payments? (Assume payments start one month after purchase — in other words, at the end of the first period.) What interest rate would reduce your monthly payment by $10?
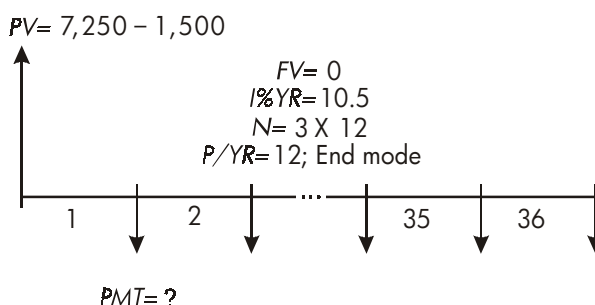
$PV= 7,250 - 1,500$

$FV= 0$
$I\%YR= 10.5$
$N= 3 \times 12$
$P/YR= 12$; End mode

1   2   ...   35   36

$PMT= ?$

Keys:	Display:	Description:
FIN TVM		Displays TVM menu.
▬ CLR DATA	12 P/YR END MODE	Clears history stack and TVM variables.
OTHER		If needed: sets 12
▬ CLR DATA		payment periods per year;
EXIT	12 P/YR END MODE	End mode.
✓3 ✕ 12		Figures and stores number
N	N=36.00	of payments.
10.5 I%YR	I%YR=10.50	Stores annual interest rate.
✓7250 ⊟ 1500		Stores amount of the loan.
PV	PV=5,750.00	
PMT	PMT=-186.89	Calculates payment. Negative value means money to be *paid out*.

To calculate the interest rate that reduces the payment by $10, *add* 10 to reduce the negative *PMT* value.

Keys:	Display:	Description:
✓⊞ 10 PMT	PMT=-176.89	Stores the reduced payment amount.
I%YR	I%YR=6.75	Calculates the annual interest rate.

Example: A Home Mortgage. After careful consideration of your personal finances, you've decided that the maximum monthly mortgage payment you can afford is $630. You can make a $12,000 down payment, and annual interest rates are currently 11.5%. If you take out a 30-year mortgage, what is the maximum purchase price you can afford?

$PV = ?$

$FV = 0$
$I\%YR = 11.5$
$N = 30 \times 12$
$P/YR = 12$; End mode

| 1 | 2 | ... | 359 | 360 |
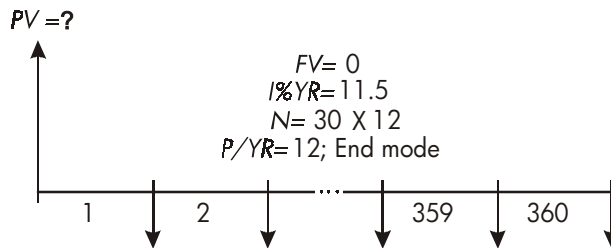
$PMT = -630$

Keys:	Display:	Description:
FIN TVM !		Display TVM menu.
■ CLR DATA	12 P/YR END MODE	Clears history stack and TVM variables.
OTHER ■ CLR DATA [EXIT]	12 P/YR END MODE	If needed: sets 12 payment periods per year; End mode.
30 ■ N	N=360.00	Pressing ■ first multiplies 30 by 12, then stores this number of payments in *N*.
11.5 I%YR	I%YR=11.50	Stores annual interest rate.
630 [+/−]		Stores a *negative* monthly payment.
PMT	PMT=−630.00	
PV	PV=63,617.64	Calculates loan amount.
✓ [+] 12000 [=]	75,617.64	Calculates total price of the house (loan plus down payment).

Example: A Mortgage with a Balloon Payment. You've taken out a 25-year, $75,250 mortgage at 13.8% annual interest. You anticipate that you will own the house for four years and then sell it, repaying the loan in a "balloon payment." What will be the size of your balloon payment?

PV= 75,250

$I\%YR$= 13.8
N= 4 X 12
P/YR=12; End mode

...

| 1 | 2 | ... | 47 | 48 |

PMT= ?
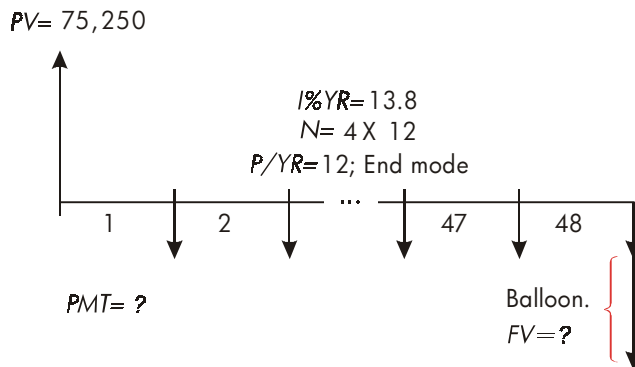
Balloon.
FV=?

The problem is done in two steps:

1. Calculate the monthly payment without the balloon (*FV*=0).
2. Calculate the balloon payment after 4 years.

Keys:	Display:	Description:
FIN TVM		Display TVM menu.
▭ CLR DATA	12 P/YR END MODE	Clears history stack and TVM variables.
OTHER ▭ CLR DATA		If needed: sets 12 payment
EXIT	12 P/YR END MODE	periods per year; End mode.

Step 1. Calculate *PMT* for the mortgage.

25 ▭ N	N=300.00	Figures and stores the number of monthly payments in 25 years.
13.8 I%YR	I%YR=13.80	Stores annual interest rate.
75250 PV	PV=75,250.00	Stores amount of the loan.
PMT	PMT=-894.33	Calculates monthly payment.

Step 2. Calculate the balloon payment after 4 years.

894.33 [+/−]		Stores *rounded PMT* value
PMT	PMT=-894.33	for exact payment amount
		(no fractional cents).*
4 ■ N	N=48.00	Figures and stores number
		of payments in 4 years.
FV	PV=-73,408.81	Calculates balloon payment
		after four years. This
		amount plus last monthly
		payment repays the loan.

Savings Calculations

Example: A Savings Account. You deposit $2,000 into a savings account that pays 7.2% annual interest, compounded annually. If you make no other deposits into the account, how long will it take for the account to grow to $3,000? Since this account has no regular payments (*PMT*=0), the payment mode (End or Begin) is irrelevant.

FV= 3,000

PMT= 0

I%YR=7.2
P/YR=1
N=?

PV= −2,000

---
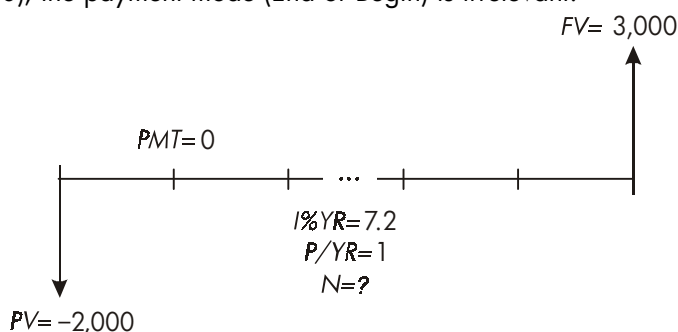
* The *PMT* stored in the previous step is the 12-digit number −894.330557971. The calculation of the balloon payment must use the actual monthly payment amount: the rounded number $894.33, an exact dollars-and-cents amount.

Keys:	Display:	Description:
FIN TVM		Displays TVM menu.
☐ CLR DATA	12 P/YR END MODE	Clears history stack and TVM variables.
OTHER		Sets one compounding
1 P/YR		per./yr. (one interest
EXIT	1 P/YR END MODE	pmt./yr.). Payment mode does not matter.
7.2 I%YR	I%YR=7.20	Stores annual interest rate.
2000 +/- PV	PV=-2,000.00	Stores amount of deposit.
3000 FV	FV=3,000.00	Stores future account balance in *FV*.
N	N=5.83	Calculates number of compounding periods (years) for the account to reach $3,000.

There is no conventional way to interpret results based on a non-integer value (5.83) of *N*. Since the calculated value of *N* is between 5 and 6, it will take 6 years of annual compounding to achieve a balance of at least $3,000. The actual balance at the end of 6 years can be calculated as follows:

6 N	N=6.00	Stores a whole number of years in *N*.
FV	FV=3,035.28	Calculates account balance after six years.

Example: An Individual Retirement Account (IRA). You opened an IRA on April 15, 2003, with a deposit of $2,000. Thereafter, you deposit $80.00 into the account at the end of each half-month. The account pays 8.3% annual interest, compounded semimonthly. How much money will the account contain on April 15, 2018?
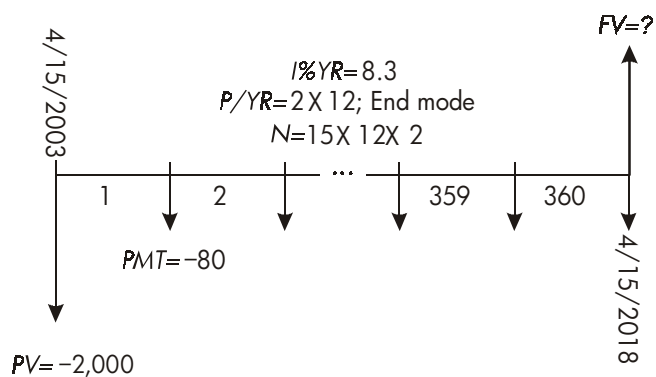
Keys:	Display:	Description:
FIN TVM		Displays TVM menu. It is not necessary to clear data because you do not need to set any of the values to zero.
OTHER		Sets 24 payment periods per year. End mode.
24 P/YR		
END [EXIT]	24 P/YR END MODE	
15 ▣ N	N=360.00	Figures and stores number of deposits in *N*.
8.3 I%YR	I%YR=8.30	Stores annual interest rate.
2000 [+/-] PV	PV=-2,000.00	Stores initial deposit.
80 [+/-] PMT	PMT=-80.00	Stores semimonthly payment.
FV	FV=63,963.84	Calculates balance in IRA after 15 years.

Leasing Calculations

Two common leasing calculations are 1) finding the lease payment necessary to achieve a specified yield, and 2) finding the present value (capitalized value) of a lease. Leasing calculations typically use "advance payments". For the calculator, this means Begin mode because all payments will be made at the beginning of the period. If there are two payments in advance, then one payment must be combined with the present value. For examples with two or more advance payments, see pages 75 and 199.

Example: Calculating a Lease Payment. A new car valued at $13,500 is to be leased for 3 years. The lessee has the option to purchase the car for $7,500 at the end of the leasing period. What monthly payments, with one payment in advance, are necessary to yield the lessor 14% annually? Calculate the payments from the lessor's point of view. Use Begin payment mode because the first payment is due at the inception of the lease.

Keys:	Display:	Description:
FIN TVM		Displays TVM menu.
OTHER		Sets 12 payment periods
12 P/YR		per year, Begin mode.
BEG [EXIT]	12 P/YR BEGIN MODE	
36 N	N=36.00	Stores number of payments.

14 I%YR	I%YR=14.00	Stores annual interest rate.
13500 +/-		Stores car's value in *PV*.
PV	PV=-13,500.00	(Money paid out by lessor.)
7500 FV	FV=7,500.00	Stores purchase option value in *FV*. (Money received by lessor.)
PMT	PMT=289.19	Calculates monthly payment received.

Example: Present Value of a Lease with Advance Payments and Option to Buy. Your company is leasing a machine for 4 years. Monthly payments are $2,400 with two payments in advance. You have an option to buy the machine for $15,000 at the end of the leasing period. What is the capitalized value of the lease? The interest rate you pay to borrow funds is 18%, compounded monthly.
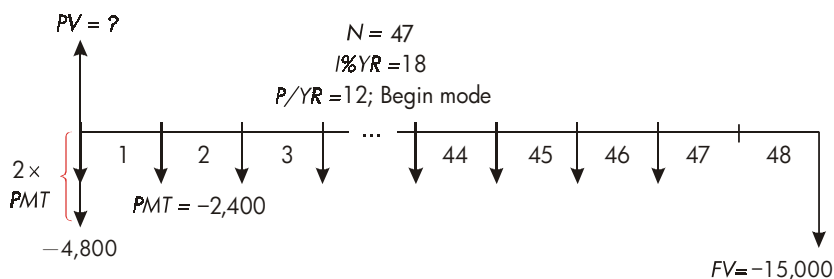
The problem is done in four steps:

1. Calculate the present value of 47 monthly payments in Begin mode. (Begin mode makes the first payment an advance payment.)

2. Add one additional payment to the calculated present value. This adds a second advance payment to the beginning of the leasing period, replacing what would have been the final (48th) payment.

3. Find the present value of the buy option.

4. Add the present values calculated in steps 2 and 3.

Keys:	Display:	Description:
FIN TVM		Displays TVM menu.
▬ CLR DATA	12 P/YR END MODE	Clears history stack and TVM variables.
OTHER		Sets 12 payment periods per year; Begin mode.
12 P/YR		
BEG [EXIT]	12 P/YR BEGIN MODE	

Step 1: Find the present value of the monthly payments.

47 N	N=47.00	Stores number of payments.
18 I%YR	I%YR=18.00	Stores annual interest rate.
2400 [+/-] PMT	PMT=-2,400.00	Stores monthly payment.
PV	PV=81,735.58	Calculates present (capitalized) value of the 47 monthly payments.

Step 2: Add the additional advance payment to *PV*. Store the answer.

✓ [+] 2400 [=]	84,135.58	Calculates present value of all payments.
[STO] 0	84,135.58	Stores result in register 0.

Step 3: Find the present value of the buy option.

48 N	N=48.00	Stores number of payment periods.
15000 [+/-]		Stores amount of the buy option (money paid out).
FV	FV=-15,000.00	
0 PMT	PMT=0.00	There are no payments.

`PV`	`PV=7,340.43`	Calculates present value of the buy option.

Step 4: Add the results of step 2 and 3.

✓ `+` `RCL` 0 `=`	`91,476.00`	Calculates present, capitalized value of lease.

Amortization (AMRT)

The AMRT menu (press `TVM` `OTHER` `AMRT`) displays or prints the following values:

- The loan balance after the payment(s) are made.
- The amount of the payment(s) applied toward interest.
- The amount of the payment(s) applied toward principal.

```
                              TVM
        ┌──────┬──────┬───────┬──────┬──────────┐
        N    I%YR    PV     PMT     FV        OTHER
                                        ┌─────┬─────┬──────────────┐
                                     P/YR   BEG   END           AMRT
                              ┌───────┬───────┬──────┬───────┬────────┐
                             #P     INT    PRIN    BAL    NEXT    TABLE
```
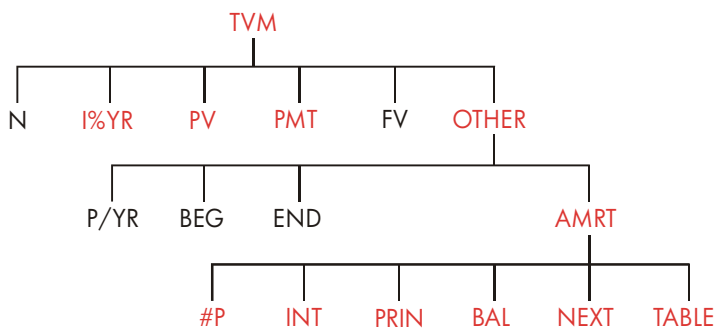
Table 5-2. AMRT Menu Labels

Menu Label	Description
#P	Stores the number of payments to be amortized, and calculates an amortization schedule for that many payments. Successive schedules start where the last schedule left off. #P can be an integer from 1 through 1,200.
INT !	Displays the amount of the payments applied toward interest.
PRIN !	Displays the amount of the payments applied toward principal.
BAL !	Displays the balance of the loan.
NEXT !	Calculates the next amortization schedule, which contains *#P* payments. The next set of payments starts whe re the previous set left off.
TABLE !	Displays a menu for printing an amortization table (schedule).

Displaying an Amortization Schedule

For amortization calculations, you need to know *PV*, *I%YR,* and *PMT*. If you have just finished doing these calculations with the TVM menu, then skip to step 3.

To calculate and display an amortization schedule:*

1. Press FIN   TVM to display the TVM menu.

---

* Amortization calculations use values of *PV*, *PMT,* and *INT* rounded to the number of decimal places specified by the current display setting. A setting of FIX 2 means that these calculations will be rounded to two decimal places.

2. Store the values for *I%YR* , *PV*, and *PMT*. (Press ⊞⊟ to make *PMT* a negative number.) If you need to calculate one of these values, follow the instructions under "Using the TVM Menu," on page 66. Then go on to step 3.

3. Press `OTHER` to display the rest of the TVM menu.

4. If necessary, change the number of payment periods per year stored in `P/YR` .

5. If necessary, change the payment mode by pressing `BEG` or `END`. (Most loan calculations use End mode.)

6. Press `AMRT` . (If you want to *print* the amortization schedule, go to page 82 to continue.)

7. Key in the number of payments to be amortized at one time and press `#P` . For example, to see a year of monthly payments at one time, set *#P* to 12. To amortize the entire life of a loan at one time, set *#P* equal to the total number of payments (*N*).
If *#P* = 12, the display would show:

Number of payments   Current set of
amortized at one time   payments to be amortized

```
#P=12 PMTS: 1-12
#P | INT |PRIN| BAL |NEXT|TABLE
```

Press to see results

8. To display the results, press, `INT` , `PRIN` and `BAL` (or press ▼ to view the results from the stack).

9. To continue calculating the schedule for *subsequent* payments, do **a** or **b**. To start the schedule over, do **c**.

    a. To calculate the next *successive* amortization schedule, with the same number of payments, press `NEXT` .

```
#P=12 PMTS: 13-24
#P  INT PRIN  BAL NEXT TABLE
```

b. To calculate a subsequent schedule with a *different* number of payments, key in that number and press ▢ #P .

c. To start over from payment #1 (using the same loan information), press ▭ CLR DATA and proceed from step 7.

Example: Displaying an Amortization Schedule. To purchase your new home, you have taken out a 30-year, $65,000 mortgage at 12.5% annual interest. Your monthly payment is $693.72. Calculate the amount of the first year's and second year's payments that are applied toward principal and interest.

Then calculate the loan balance after 42 payments (3½ years).

Keys:	Display:	Description:
FIN TVM		Displays TVM menu.
12.5 I%YR	I%YR=12.50	Stores annual interest rate.
65000 PV	PV=65,000.00	Stores loan amount.
693.72 +/−		Stores monthly payment.
PMT	PMT=-693.72	
OTHER		If needed: sets 12
▭ CLR DATA	12 P/YR END MODE	payment periods per year; End mode.
AMRT	KEY #PMTS; PRESS (#P)	Displays AMRT menu.
12 #P	#P=12 PMTS: 1-12	Calculates amortization schedule for first 12

		payments, but does not display it.
INT	INTEREST=-8,113.16	Displays interest paid in first year.
PRIN	PRINCIPAL=-211.48	Displays principal paid in first year.
BAL	BALANCE=64,788.52	Displays balance at end of first year.
NEXT	#P=12 PMTS: 13-24	Calculates amortization schedule for next 12 payments.
INT	INTEREST=-8,085.15	Displays results for second year.
PRIN	PRINCIPAL=-239.49	
BAL	BALANCE=64,549.03	

To calculate the balance after 42 payments (3½ years), amortize 18 additional payments ($42-24=18$):

18　#P	#P=18 PMTS: 25-42	Calculates amortization schedule for next 18 months.
INT	INTEREST= -12,066.98	Displays results.
PRIN	PRINCIPAL=-419.98	
BAL	BALANCE=64,129.05	

Printing an Amortization Table (TABLE)

To print an amortization schedule (or "table") do steps 1 through 5 for displaying an amortization schedule (see page 78).

6. Press AMRT Ignore the message KEY #PMTS; PRESS {#P}.

7. Press TABLE .

8. Key in the payment number of the first payment in the schedule and press FIRST . (For instance, for the very first payment, *FIRST*= 1.)

9. Key in the payment number of the last payment in the schedule and press LAST .

10. Key in the increment — the number of payments shown at one time— and press INCR . (For instance, for one year of monthly payments at a time, *INCR*=12.)

11. Press GO .

Values are retained until you exit the TABLE menu, so you can print successive amortization schedules by re-entering only those TABLE values that change.

Example: Printing an Amortization Schedule. For the loan described in the previous example (page 80), print an amortization table with entries for the fifth and sixth years. You can continue from the AMRT menu in the previous example (step 7, above) or repeat steps 1 through 6.

Starting from the AMRT menu:

Keys:	Display:	Description:
TABLE	PRINT AMORT TABLE	Displays menu for printing amortization table.
✓4 ⊠ 12 ⊞ 1 FIRST	FIRST=49.00	The 49th is the first payment in year 5.
✓6 ⊠ 12 LAST	LAST=72.00	The 72nd is the last payment in year 6.
12 INCR	INCR=12.00	Each table entry represents 12 payments

`GO`

(1 year).
Calculates and prints
amortization schedule
shown below.

```
I%YR=            12.50
PV=          65,000.00
PMT=           -693.72
FV=               0.00
P/YR=            12.00
END MODE

PMTS:49-60
INTEREST=  -7,976.87
PRINCIPAL=   -347.77
BALANCE=   63,622.94

PMTS:61-72
INTEREST=  -7,930.82
PRINCIPAL=   -393.82
BALANCE=   63,229.12
```

6

Interest Rate Conversions

The interest conversion (ICNV) menu converts between nominal and effective interest rates. To compare investments with different compounding periods, their *nominal interest rates* are converted to *effective interest rates*. This allows you, for example, to compare a savings account that pays interest quarterly with a bond that pays interest semiannually.

■ The nominal rate is the stated annual interest rate compounded *periodically*, such as 18% per year compounded monthly.

■ The effective rate is the rate that, *compounded only once* (that is, annually), would produce the same final value as the nominal rate. A nominal annual rate of 18% compounded monthly equals an effective annual rate of 19.56%.

When the compounding period for a given nominal rate is one year, then that nominal annual rate *is the same* as its effective annual rate.

The ICNV Menu

```
            FIN    BUS    SUM    TIME   SOLVE  CURRX
             |
       ┌─────┴──────┬──────┬──────┐
      TVM   ICNV   CFLO   BOND   DEPRC
             |
       ┌─────┴──────────────┐
      PER                  CONT
       |                    |
   ┌───┼────┐          ┌────┴───┐
 NOM%  EFF%  P       NOM%      EFF%
```
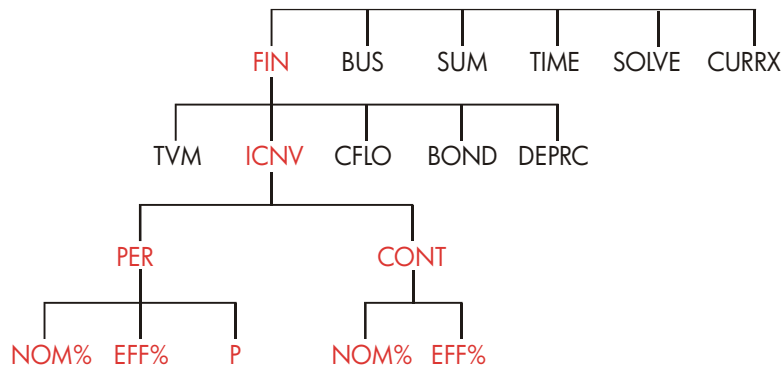
The ICNV menu converts between nominal and effective interest rates, using either:

- Periodic compounding; for example, quarterly, monthly, or daily compounding.
- Continuous compounding.

Converting Interest Rates

To convert between a nominal annual interest rate and an effective annual interest rate that is compounded *periodically*:

1. Press `FIN` `ICNV` to display the interest conversions menu.
2. Press `PER` for *periodic*.
3. Key in the number of compounding periods per year and press `P`.
4. To convert to the effective rate, first key in the nominal rate and press `NOM%`, then press `EFF%`.
5. To convert to the nominal rate, first key in the effective rate and press `EFF%`, then press `NOM%`.

To convert between a nominal annual interest rate and an effective annual interest rate that is compounded *continuously*:

1. Press [FIN] [ICNV] to get the interest conversions menu.

2. Press [CONT] for "continuous".

3. To convert to the effective rate, key in the nominal rate and press [NOM%], then press [EFF%].

4. To convert to the nominal rate, key in the effective rate and press [EFF%], then press [NOM%].

Values of *EFF%* and *NOM%* are shared between the PER and CONT menus. For example, an effective interest rate in CONT remains stored in *EFF%* when you exit the CONT menu and enter the PER menu. Pressing ▬[CLR DATA] in either menu clears *NOM%* and *EFF%* in both.
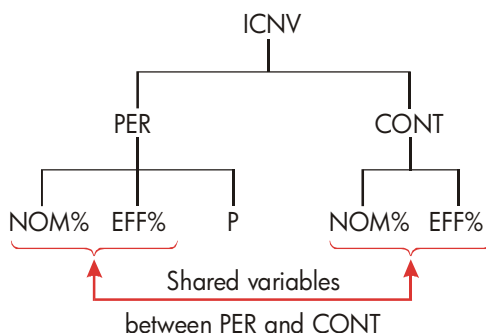
Example: Converting from a Nominal to an Effective Interest Rate.
You are considering opening a savings account in one of three banks. Which bank has the most favorable interest rate?

    Bank #1   6.7% annual interest, compounded quarterly.
    Bank #2   6.65% annual interest, compounded monthly.
    Bank #3   6.65% annual interest, compounded continuously.

Keys:	Display:	Description:
[FIN] [ICNV]		Displays ICNV menu.
[PER]	COMPOUNDING P TIMES/YR	Displays PER menu.

4 P	P=4.00	Stores number of compounding periods per year for bank #1.
6.7 NOM%	NOM%=6.70	Stores nominal annual interest rate for bank #1.
EFF%	EFF%=6.87	Calculates effective interest rate for bank #1.
12 P	P=12.00	Stores number of compounding periods per year for bank #2.
6.65 NOM%	NOM%=6.65	Stores nominal annual interest rate for bank #2.
EFF%	EFF%=6.86	Calculates effective interest rate for bank #2.
[EXIT] CONT	CONTINUOUS COMPOUNDING	Displays CONT menu. Previous values of *NOM%* and *EFF%* are retained.
EFF%	EFF%=6.88	Calculates effective rate for bank #3.

The calculations show that bank #3 is offering the most favorable interest rate.

Compounding Periods Different from Payment Periods

The TVM menu assumes that the compounding periods and the payment periods are the same. However, regularly occurring savings- account deposits and withdrawals do not necessarily occur at the same time as the bank's compounding periods. If they are not the same, you can adjust the interest rate using the ICNV menu, and then use the adjusted

interest rate in the TVM menu. (You can also use TVM if *PMT* = 0, regardless of the compounding periods.)

1. Call up the periodic interest-rate conversion menu (FIN   ICNV   PER).

2. Calculate the effective annual interest rate from the nominal annual interest rate given by the bank.

   a. Store annual interest rate in NOM% .

   b. Store number of compounding periods per year in P .

   c. Press EFF% .

3. Calculate the nominal annual interest rate that corresponds to your payment periods.

   a. Store the number of regular payments or withdrawals you will be making per year in P .

   b. Press NOM% .

4. Return to the TVM menu (EXIT EXIT TVM).

5. Store the just-calculated nominal interest rate in *I%YR* (press STO I%YR).

6. Store the number of payments or withdrawals per year in P/YR and set the appropriate payment mode.

7. Continue with the TVM calculation. (Remember that money paid out is negative; money received is positive.)

   a. *N* is the total number of periodic deposits or withdrawals.

   b. *PV* is the initial deposit.

   c. *PMT* is the amount of the regular, periodic deposit or withdrawal.

   d. *FV* is the future value.

When the interest rate is the unknown variable, first calculate *I%YR* in the TVM menu. This is the nominal annual rate that corresponds to your payment periods. Next, use the ICNV menu to convert this to the

effective interest rate based on your payment periods. Last, convert the effective rate to the nominal rate based on the bank's compounding periods.

Example: Balance of a Savings Account. Starting today, you make monthly deposits of $25 into an account paying 5% interest compounded daily (365-day basis). At the end of 7 years, how much will you receive from the account?

Keys:	Display:	Description:
FIN ICNV	SELECT COMPOUNDING	
PER	COMPOUNDING P TIMES/YR	Periodic interest-rate conversion menu.
365 P	P=365.00	Stores bank's compounding periods.
5 NOM%	NOM%=5.00	Stores bank's nominal interest rate.
EFF%	EFF%=5.13	**Calculates effective interest rate for daily compounding.**
12 P	P=12.00	Stores number of deposits per year.
NOM%	NOM%=5.01	Calculates equivalent nominal interest rate for monthly compounding.
[EXIT] [EXIT] TVM [←]	5.01	Switches to TVM menu; *NOM%* value is still in calculator line.
[STO] I%YR	I%YR=5.01	Stores adjusted nominal interest rate in *I%YR*.
OTHER 12 P/YR BEG [EXIT]	12 P/YR BEGIN MODE	Sets 12 payments per year; Begin mode.

7 ▭ N			Stores 84 deposit periods,
25 +/− PMT			$25 per deposit, and no
0 PV	PV=0.00		money before the first
			regular deposit.
FV	FV=2,519.61		Value of account in 7
			years.

If the interest rate were the unknown, you would first do the TVM calculation to get *I%YR* (5.01). Then, in the ICNV PER menu, store 5.01 as *NOM%* and 12 as *P* for monthly compounding. Calculate *EFF%* (5.13). Then change *P* to 365 for daily compounding and calculate *NOM%* (5.00). This is the bank's rate.

7

Cash Flow Calculations

The cash flow (CFLO) menu stores and analyzes cash flows (money received or paid out) of *unequal* (*ungrouped*) amounts that occur at regular intervals.* Once you've entered the cash flows into a *list*, you can calculate:

■ The total amount of the cash flows.

■ The internal rate of return (IRR%).

■ The net present value (NPV), net uniform series (NUS), and net future value (NFV) for a specified periodic interest rate (I%).

You can store many separate lists of cash flows. The maximum number depends on the amount of available calculator memory.

The CFLO menu

```
                    FIN    BUS    SUM    TIME   SOLVE  CURRX

            TVM   ICNV   CFLO   BOND   DEPRC

                CALC   INSR   DELET   NAME   GET      #T?

       TOTAL   IRR%   I%   NPV   NUS   NFV
```
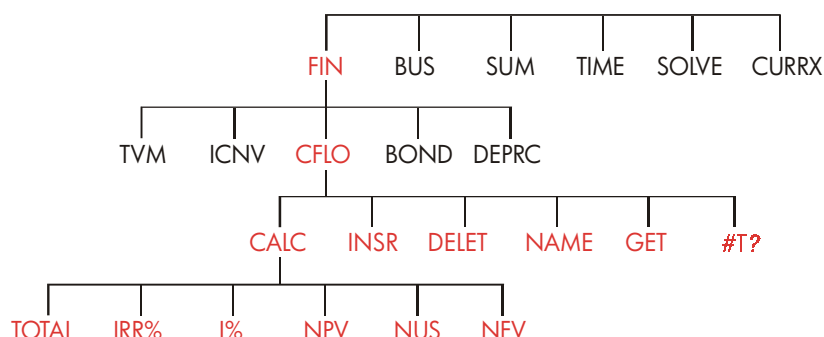
The CFLO menu creates cash-flow lists and performs calculations with a list of cash flows.

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* You can also use CFLO with cash flows of *equal* amounts, but these are usually handled more easily by the TVM menu.

Table 7-1. CFLO Menu Labels

Menu Label	Description
CALC	Accesses the CALC menu to calculate *TOTAL, IRR%, NPV, NUS, NFV*.
INSR !	Allows you to insert cash flows into a list.
DELET !	Deletes cash flows from a list.
NAME !	Allows you to name a list.
GET !	Allows you to switch from one list to another or create a new list.
#T? !	Turns the prompting for *#TIMES* on and off.

To see the calculator line when this menu is in the display, press [INPUT] once. (This does not affect number entry.)

To see this menu when the calculator line is in the display, press [EXIT].

Cash Flow Diagrams and Signs of Numbers

The sign conventions used for cash flow calculations are the same as those used in time-value-of-money calculations. A typical series of cash flows is one of two types:

■ *Ungrouped cash flows.* These occur in series of cash flows *without* "groups" of equal, consecutive flows.* Because each flow is different from the one before it, the *number of times* each flow occurs is one.

* Any cash flow series can be treated as an ungrouped one if you enter each flow individually.
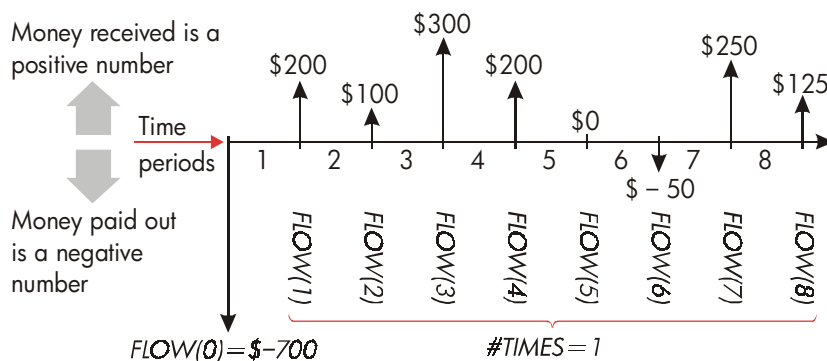
Figure 7-1. Cash Flows (Ungrouped)

The horizontal timeline is divided into equal compounding periods. The vertical lines represent the cash flows. For money received, the line points up (positive); for money paid out, the line points down (negative). In this case, the investor has invested $700. This investment has generated a series of cash flows, starting at the end of the first period. Notice that there is no cash flow (a cash flow of zero) for period five, and that the investor *pays* a small amount in period six.

■ *Grouped cash flows.* These occur in a series containing "groups" of equal, consecutive flows. Consecutive, equal cash flows are called *grouped cash flows.* The series shown here is grouped into two sets of consecutive, equal cash flows:

FLOW(3) = $1,950
#TIMES(3) = 1

FLOW(1) = $-100
#TIMES(1) = 5

FLOW(2) = $-200
#TIMES(2) = 3
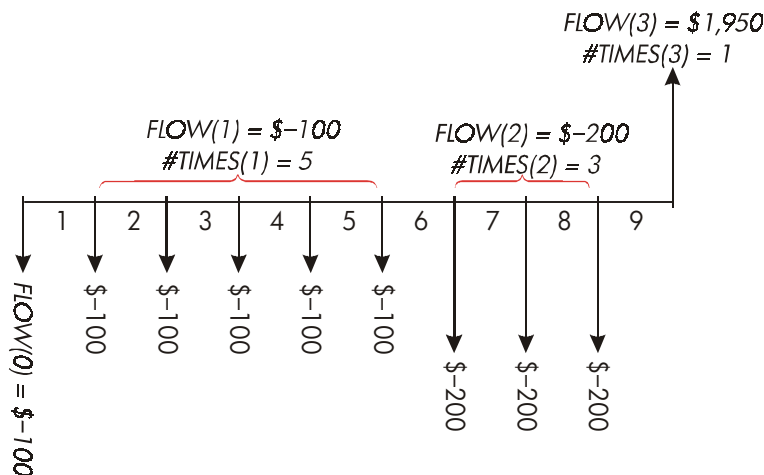
Figure 7-2. Grouped Cash Flows

After an initial payment of $100, the investor pays $100 at the end of periods 1 through 5, and $200 at the end of periods 6 through 8. The investment returns $1,950 at the end of period 9. For every cash flow you enter, the calculator prompts you to indicate how many times (*#TIMES*) it occurs.

Creating a Cash-Flow List

To use CFLO, be sure your cash flows are occurring at regular intervals and at the *end* of each period.* If a period is skipped, enter zero for its cash flow. If there are any *grouped* (consecutive and equal) cash flows, the *#TIMES* prompting makes entering the data easier.

---

* If the cash flows occur at the beginning of each period, then combine the first flow with the initial flow (which can increase or decrease the flow), and move each cash flow up one period. (Remember: a payment made at the beginning of period 2 is equivalent to the same payment made at the end of period 1 and so on. Refer to pages 64-92.)

Entering Cash Flows

To enter cash flows into a CFLO list:

1. Press `FIN` `CFLO`. You will see either `FLOW(0)=?` if the current list is empty, or `FLOW(1 or more)=?` if the list is not empty. This is the *bottom* of the current list.

```
FLOW(0)=?
CALC INSR DELET NAME  GET  #T?
```

2. If the list is *not* empty, you can do either **a** or **b**:

   a. Clear the list by pressing `CLR DATA` `YES` (see also page 99.)

   b. Get a new list by pressing `GET` `*NEW` (The old list must be named first. Press `NAME` or see page 97.)

3. If the cash flows are *ungrouped* (that is, they are all different), then press `#T?` to turn `#TIMES PROMPTING OFF`. For grouped cash flows, leave this prompting on. (For more information, see "Prompting for #TIMES," next page.)

4. Key in the value of the initial cash flow, *FLOW(0)* (remember that money paid out is negative — use `+/-` to change the sign), and press `INPUT`.*

5. After briefly showing *FLOW(0)*, the display shows `FLOW(1)=?`. (To view *FLOW(0)* longer, *hold* down `INPUT` before releasing it.) Key in the value for *FLOW(1)* and press `INPUT`. The prompt for the next item appears.

6. **For grouped cash flows:** The display now shows `#TIMES(1)=1`. If it does not, press `EXIT` `#T?` to turn the *#TIMES* prompting on. (See "Prompting for *#TIMES*," below.) *#TIMES* is the number of consecutive occurrences of *FLOW(1)*. *#TIMES* has

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* You can do calculations with a number before entering it. This does not interfere with the list. When you press `INPUT`, the evaluated expression or number is entered into the list.

been automatically set to 1, and `1.00` is displayed on the calculator line. Do either **a** or **b**:

a. To retain the value 1 and go on to the next flow, press [INPUT] (or [▼]).

b. To change *#TIMES*, key in the number and press [INPUT].*

Given *#TIMES*

```
#TIMES(1)=1
1.00
```
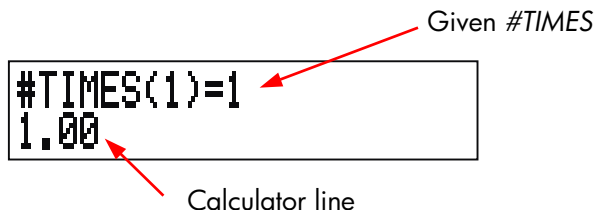
Calculator line

7. Continue entering each cash flow and, for grouped flows, the number of times it occurs. The calculator recognizes the end of the list when a flow is left blank (no value is entered).

8. Press [EXIT] to end the list and restore the CFLO menu. You can now proceed to correct the list, name the list, get another list, or do calculations with the values.

Use these same instructions to enter additional lists.

Prompting for #TIMES (#T?). When the calculator displays `#TIMES(1)=1`, it is *prompting* you for the number of times the current flow occurs. If *all* your cash flows are different (*#TIMES* always 1), then you don't need the `#TIMES` prompt. You can turn the prompting for *#TIMES* on and off by pressing #T? in the CFLO menu. This produces a brief message: either `#TIMES PROMPTING: OFF`, or `#TIMES PROMPTING: ON`.

While prompting is off, all cash flows you enter will have *#TIMES* = 1.

When you are viewing a cash-flow list with the *#TIMES* prompting off, the calculator displays only those *#TIMES* values that are *not* 1.

---

* The maximum *#TIMES* for each cash flow is 999.

The *#TIMES* prompting is usually *on*, because it is automatically turned on whenever you clear or get a cash-flow list.

Example: Entering Cash Flows. Enter the following ungrouped cash flows in a list and find the percentage internal rate of return (IRR).

0:	$-500	2:	$ 275
1:	125	3:	200

Keys:	Display:	Description:
FIN CFLO		
▅ CLR DATA	CLEAR THE LIST?	Asks for confirmation.
YES	FLOW(0)=?	Clears data from list and prompts for initial flow.
#T?	#TIMES PROMPTING: OFF	Sets prompting off because it is not needed.
500 +/- INPUT	FLOW(1)=? −500.00	Enters initial flow; then immediately prompts for next flow.
125 INPUT	FLOW(2)=? 125.00	Enters *FLOW(1)*; prompts for next flow.
275 INPUT	FLOW(3)=? 275.00	Enters *FLOW(2)*; prompts for next flow.
200 INPUT	FLOW(4)=? 200.00	Enters *FLOW(3)*; prompts for next flow.
EXIT CALC	NPV, NUS, NFV NEED I%	Ends list and displays CALC menu.
IRR%	IRR%=9.06	Calculates IRR.

Viewing and Correcting the List

To display a particular list, use GET (see page 99).

The ▲ and ▼ keys move up and down one number at a time. �▲ and �▼ display the beginning and end of the list.

Changing or Clearing a Number. To change a number after it's been entered: display the number, key in the new value, and press INPUT .

Use this same method to clear a number to zero. (Do not press CLR or ◀, which clear the calculator line, not the cash-flow entry.)

Inserting Cash Flows into a List. Insertion occurs *before* (*above*) the current flow. Pressing INSR inserts a zero cash flow and renumbers the rest of the list. You can then enter a new cash flow and its *#TIMES*.

For example, if *FLOW(6)* is in the display, pressing INSR puts a new, zero flow between the previously numbered *FLOW(5)* and *FLOW(6)*.

Deleting Cash Flows from a List. Pressing DELET deletes both the current flow and its *#TIMES*.

Copying a Number from a List to the Calculator Line

To copy a number from the list into the calculator line, use ▼ or ▲ to display the number, then press RCL INPUT .

Naming and Renaming a Cash-Flow List

A new list has no name. You may name it before or after filling the list, but you *must* name it in order to store another list.

To name a list:

1. Press NAME from the CFLO menu.
2. Use the ALPHA menu to type a name. (The ALPHA and ALPHA-Edit menus are covered on pages 30 - 32.) To clear a name, press CLR .
3. Press INPUT .

The name can be up to 22 characters long and include any character except: $+$ $-$ x $\div$ ( ) < > : = *space* *

But only the first three to five characters (depending on letter widths) of the name are used for a menu label. Avoid names with the same first characters, since their menu labels will look alike.

Viewing the Name of the Current List. Press `NAME` , then `EXIT` .

Starting or GETting Another List

When you press `CFLO` , the cash-flow list that appears is the same as the last one used.

To start a new list or switch to a different one, the current list must be named or cleared. If it is named, then:

1. Press `GET` .The GET menu contains a menu label for each named list plus `*NEW` .
2. Press the key for the desired list. (`*NEW` brings up a new, empty list.)

Clearing a Cash-Flow List and Its Name

To clear a list's numbers and name:

1. Display the list you want to clear, then press ◼ `CLR DATA` `YES` . This removes the numbers.
2. If the list is named, you'll see `ALSO CLEAR LIST NAME?` Press `YES` to remove the name. Press `NO` to retain the name with an empty list.

---

* CFLO does accept these exceptional characters in list names, but the Solver functions SIZEC, FLOW, and #T do not.

To remove just one value at a time from a list, use DELET .

Cash-Flow Calculations: IRR, NPV, NUS, NFV

Once you have entered a list of cash flows, you can calculate the following values in the CALC menu.

- Sum (*TOTAL*).

- Internal rate of return (*IRR%*). This is a *periodic* rate of return. To calculate an *annual* nominal rate when the period is not a year, multiply the *IRR%* by the number of periods per year.
  If you want the *IRR%* as an *effective* annual rate, then use the FIN ICNV menu to convert from the nominal annual rate to the effective annual rate.

- Net present value (*NPV*), net uniform series (*NUS*), and net future value (*NFV*) for a specified, *periodic* interest rate, *I%*.

Table 7-2. The CALC Menu for CFLO Lists

Menu Label	Description
`TOTAL`	Calculates the sum of the cash flows.
`IRR%` * !	Calculates the *internal rate of return*—the interest (discount) rate at which the net present value of the cash flows equals zero.
`I%` !	Stores the *periodic interest rate*, expressed as a percentage (sometimes called *cost of capital*, *discount rate*, or *required rate of return*).
`NPV` !	Given *I%*, calculates the net present value—the present value of a series of cash flows.
`NUS` !	Given *I%*, calculates the *net uniform series*—the dollar amount of constant, equal cash flows having a present value equivalent to the net present value.
`NFV` !	Given *I%*, calculates the *net future value* of a series of cash flows by finding the future value of the net present value.

* The calculations for internal rate of return are complex and may take a relatively long time. To interrupt the calculation, press any key. In certain cases, the calculator displays a message indicating that the calculation cannot continue without further information from you, or that there is no solution. Refer to appendix B for additional information about calculating *IRR%*.

About the Internal Rate of Return (IRR%). A "conventional investment" is considered attractive if *IRR%* exceeds the cost of capital. A conventional investment meets two criteria—(1) the sequence of cash flows changes sign only once, and (2) the sum (*TOTAL*) of the cash flows is positive.

Remember that the calculator determines a periodic *IRR%*. If the cash flows occur monthly, then *IRR%* is a monthly value, too. Multiply it by 12 for an annual value.

Example: Calculating IRR and NPV of an Investment. An investor makes an initial investment of $80,000, and expects returns over the next five years as illustrated below.

FLOW(0) =$ − 80,000
  (Initial flow)
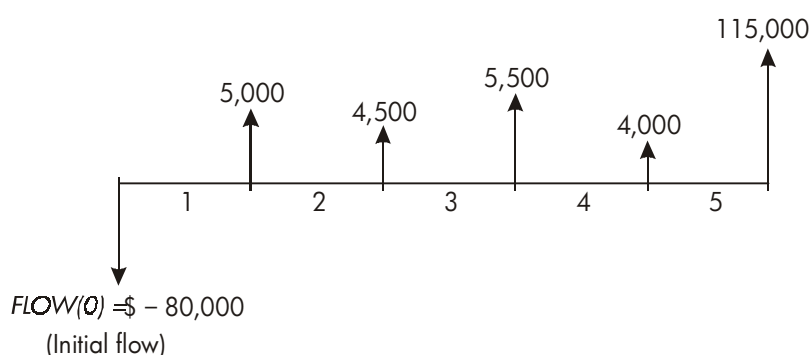
Calculate the total of the cash flows and the internal rate of return of the investment. In addition, calculate the net present value and net future value, assuming an annual interest rate of 10.5%.

Start the problem with an empty cash-flow list. Since the cash flows are ungrouped, each one occurs just once. Turn off the *#TIMES* prompt to make cash-flow entry faster.

Keys:	Display:	Description:
FIN		Displays current cash-flow
CFLO		list and CFLO menu keys.
▬ CLR DATA		Clears current list or gets a
YES		new one. The empty list
or		prompts for its initial cash
GET #NEW	FLOW(0)=?	flow.
#T?	#TIMES PROMPTING:	*Briefly* shows the status of
	OFF	#T? then returns to the list. With prompting off, all cash flows are

		assumed to occur just once.
80000 [+/-] [INPUT]	FLOW(1)=? -80,000.00	Prompts for next cash flow. Calculator line shows last number entered.
5000 [INPUT]	FLOW(2)=?	Stores $5,000 for *FLOW(1)*, prompts for next flow.
4500 [INPUT]	FLOW(3)=?	Stores *FLOW(2).*
5500 [INPUT]	FLOW(4)=?	Stores *FLOW(3).*
4000 [INPUT]	FLOW(5)=?	Stores *FLOW(4).*
115000 [INPUT]	FLOW(6)=?	Stores final cash flow and shows end of list.
[EXIT] CALC TOTAL	TOTAL=54,000.00	Calculates sum of the cash flows.
IRR%	IRR%=11.93	Calculates internal rate of return.
10.5 I%	I%=10.50	Stores periodic interest rate.
NPV	NPV=4,774.63	Calculates *NPV*.
NFV	NFV=7,865.95	Calculates *NFV*.

Now calculate the net present value at an interest rate of 10.5% if cash flow #4 is reduced to $1,000.

[EXIT]	FLOW(6)=?	Displays the bottom of the list.
[▲][▲]	FLOW(4)=4,000.00	Moves to cash flow #4.
1000 [INPUT]	FLOW(5)=115,000.00	Changes cash flow #4 to $1,000.

EXIT CALC		NPV=2,762.43	Calculates new *NPV*.
NPV			

Example: An Investment with Grouped Cash Flows. You are considering an investment that requires a cash outlay of $9,000, with the promise of monthly cash flows as shown. Calculate *IRR%*. Also find *NPV* and *NFV* at an annual interest rate of 9%.

FLOW(0) = $ − 9,000
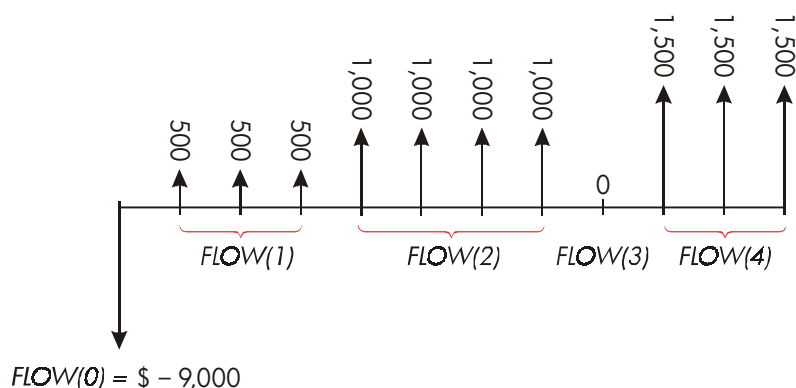
Since some of these cash flows are *grouped* (consecutive and equal), the *#TIMES* prompting must be on so you can specify a number other than 1.

Group Number	Amount	Number of Times
Initial	−9,000	—
1	500	3
2	1,000	4
3	0	1
4	1,500	3

Keys:	Display:	Description:
FIN		Current cash-flow list and
CFLO		CFLO menu.
▱ CLR DATA		Clears current list. *#TIMES*

YES	FLOW(0)=?	prompting is turned on.
9000 [+/-] [INPUT]	FLOW(1)=?	Stores the initial cash flow.
500 [INPUT]	#TIMES(1)=1	Stores *FLOW(1)* and prompts for *#TIMES(1)*.
3 [INPUT]	FLOW(2)=?	*FLOW(1)* occurs 3 times; prompts for next cash flow.
1000 [INPUT] 4 [INPUT]	FLOW(3)=?	Stores *FLOW(2)* four times.
0 [INPUT] [INPUT]	FLOW(4)=?	Stores *FLOW(3)* one time (the 1 is automatically entered).
1500 [INPUT] 3 [INPUT]	FLOW(5)=?	Stores *FLOW(4)* three times.
[EXIT] CALC		Displays the CALC menu.
IRR%	IRR%=1.53	Calculates monthly IRR%.
✓9 [÷] 12		Stores the periodic, monthly interest rate.
I%	I%=0.75	
NPV	NPV=492.95	Calculates *NPV*.
NFV	NFV=535.18	Calculates *NFV*.

Example: An Investment with Quarterly Cash Returns. You have been offered an opportunity to invest $20,000. The investment returns quarterly payments over four years as follows:

Year 1	4 payments of $500
Year 2	4 payments of $1,000
Year 3	4 payments of $2,000
Year 4	4 payments of $3,000

$FLOW(0) = -20,000$
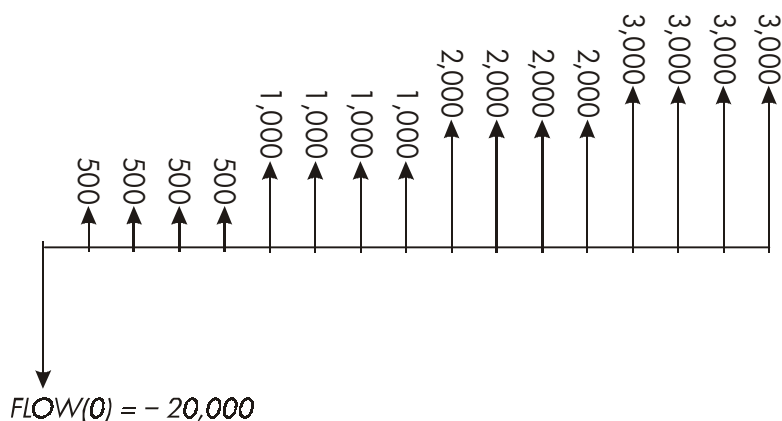
Calculate the annual rate of return for this investment. (The prompting for *#TIMES* should be on.)

Keys:	Display:	Description:
FIN CFLO		Current cash-flow list.
◼ CLR DATA		Clears the current list or
YES		gets a new one. This sets
or		the *#TIMES* prompting on.
GET *NEW	FLOW(0)=?	
20000 +⁄–		Stores the initial cash
INPUT	FLOW(1)=?	flow.
500 INPUT	#TIMES(1)=1	Stores *FLOW(1)*, then
		prompts for number of
		times this flow occurs.
4 INPUT	FLOW(2)=?	*FLOW(1)* occurs four
		times.
1000 INPUT 4		Stores *FLOW(2)*, *FLOW(3)*
INPUT		and *FLOW(4)*, and the
2000 INPUT 4		number of times each flow
INPUT		occurs.
3000 INPUT 4		

[INPUT]	`FLOW(5)=?`	
[EXIT] CALC		Calculates quarterly rate
IRR%	`IRR%=2.43`	of return.
✓[×] 4 [=]	`9.72`	Calculates nominal annual
		rate of return from
		quarterly rate.

Doing Other Calculations with CFLO Data

If you would like to do other calculations with cash flows besides those
in the CALC menu, you can do so by writing your own Solver equations.
There are Solver functions that can access data stored in CFLO lists, and
there is a summation function that can combine all or part of the values
stored in specific lists.

Refer to "Accessing CFLO and SUM Lists from the Solver" in chapter 12.

8

Bonds

The BOND menu calculates the *yield to maturity* or *price* of a bond. It also calculates *yield to call* on a coupon date and *accrued interest*. You can specify the:

- *Calendar basis*: 30/360 or actual/actual (days per month/days per year). Municipal, state, and corporate bonds issued in the United States are typically 30/360. U.S. Treasury bonds are actual/actual.
- *Coupon payments*: semi-annual or annual. Most U.S. bonds are semi-annual.

The BOND Menu

```
         FIN    BUS    SUM    TIME   SOLVE   CURRX
          |
    TVM   ICNV   CFLO   BOND   DEPRC
          |
   TYPE   SETT   MAT   CPN%   CALL   MORE
                                      ↕
   YLD%  PRICE  ACCRU                MORE
```
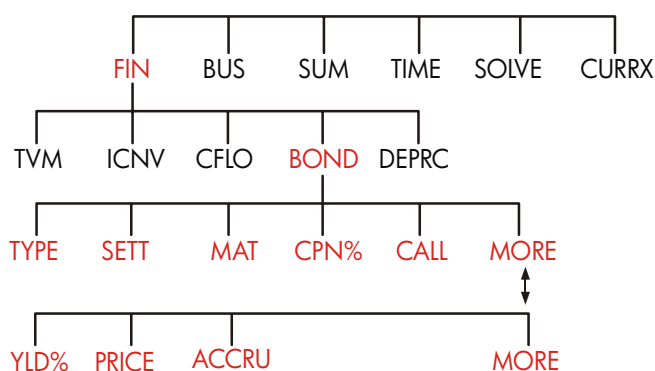
Pressing `BOND` shows you the BOND menu and the type of bond currently specified: `30/360` or `A/A`; `SEMIANNUAL` or `ANNUAL`.

Table 8-1. BOND Menu Labels

Menu Label	Description
TYPE	Displays a menu of bond types: 30/360 or actual/actual, semi-annual or annual.
SETT !	Stores the settlement (purchase) date according to the current date format (*MM.DDYYYY* or *DD.MMYYYY*; see page 143).
MAT !	Stores the maturity date *or* call date according to the current date format. The call date must coincide with a coupon date.
CPN% !	Stores the annual coupon rate as a percentage.
CALL !	Stores the call price per $100 face value. For a yield to *maturity*, make sure *CALL* equals 100. (A bond at maturity has a "call" value that is 100% of its face value.)
	MORE
YLD% !	Stores or calculates the yield (as an annual percentage) to maturity *or* yield to call date.
PRICE !	Stores or calculates the price per $100 face value.
ACCRU !	Calculates the interest accrued from the last coupon-payment date until the settlement date, per $100 face value.

The calculator retains the values of the BOND variables until you clear them by pressing ■ CLR DATA while the BOND menu is displayed. Clearing sets *CALL* to 100 and all other variables to zero.

To see the value currently stored in a variable, press RCL *menu label*.

Doing Bond Calculations

Remember that values in the BOND menu are expressed *per $100 face value* or as a *percentage*. A *CALL* value of 102 means that the bond will be worth $102 for every $100 of face value when called. Some corporate bonds in the United States use the convention that the price of the bond is set to 100 if the coupon rate equals the yield, whether or not the settlement date is a coupon date. The BOND menu does *not* use this convention.

To calculate the price or yield of a bond:

1. Display the BOND menu: press   FIN   BOND .

2. Press ▭ CLR DATA . This sets *CALL*=100.

3. Define the type of bond. If the message in the display does not match the type you want, press   TYPE .

Calendar basis   Interest period

```
30/360 SEMIANNUAL
 360   A/A  SEMI  ANN
```

- ■ Pressing   360   sets the calendar basis to a 30-day month and a 360-day year.

- ■ Pressing   A/A   sets the calendar basis to the actual calendar month and to the actual calendar year.

- ■ Pressing   SEMI   sets semi-annual coupon payments.

- ■ Pressing   ANN   sets annual coupon payments.

   Press EXIT to restore the BOND menu.

4. Key in the settlement date (*MM.DDYYYY* or *DD.MMYYYY* depending on the date format; see chapter 11) and press   SETT .

5. Key in the maturity date *or* call date and press   MAT .

6. Key in the coupon rate as an annual percent and press   CPN% .

7. Key in the call value, if any, and press   CALL . For a bond held to

maturity, the *CALL* value must equal 100. (See step 3.)

8. To calculate a result, first press `MORE` to access the remaining menu labels. Do either **a** or **b**:

   a. Key in the yield and press `YLD%`. Press `PRICE` to calculate the price.

   b. Key in the price and press `PRICE`. Press `YLD%` to calculate the yield.

To calculate the accrued interest, press `ACCRU`. The *total* amount owed the seller is *PRICE + ACCRU*, that is: `PRICE` `+` `ACCRU` `=`.

Calculating Fractional Values. When given a fractional value that must be entered in decimal form, do the arithmetic and then store the result *directly* into a variable. Do not clear the arithmetic and then retype the result before storing it—this is an unnecessary step that can cause incorrect answers due to rounding. See how the following example stores $8^3/_8$ in *YLD%*.

Example: Price and Yield of a Bond. What price should you pay on August 10, 2003 for a 6¾% U.S. Treasury bond that matures on May 1, 2018 if you wish a yield of $8^3/_8$%? The calendar basis is actual/actual and the coupon payments are semi-annual. (The example assumes *MM.DDYYYY* date format.)

Keys:	Display:	Description:
`FIN` `BOND`		Since there is no call on
🔴`CLR DATA`		this bond, set *CALL* = 100
		by clearing variables.
`TYPE` `A/A`		Sets bond type, if
`SEMI` `EXIT`	A/A SEMIANNUAL	necessary.
8.102003		Stores settlement
`SETT`	SETT=	(purchase) date.
	08/10/2003 SUN	
5.012018		Stores maturity date.

MAT	MAT=05/01/2018	
	TUE	
6.75 CPN%	CPN%=6.75	Stores annual coupon rate.
MORE		Stores desired yield (displayed rounded to two decimal places).*
✓3 ÷ 8 + 8		
YLD%	YLD%=8.38	
PRICE	PRICE=86.38	Result: price is $86.38 per $100 face value.
✓+ ACCRU	86.38+1.85	Adds accrued interest owed the seller.
✓=	88.23	Net price.

Suppose that the market quote for the bond is 88¼. What yield does it represent?

88.25 PRICE	PRICE=88.25	Stores quoted price.
YLD%	YLD%=8.13	Result: yield to maturity.

Example: A Bond with a Call Feature. What is the price of a 6% corporate bond maturing on March 3, 2022 and purchased on May 2, 2003 to yield 5.7%? It is callable on March 3, 2006 (a coupon date), at a value of 102.75. What is the yield to the call date? Use a 30/360 calendar with semi-annual coupon payments.

Keys:	Display:	Description:
FIN BOND		Displays BOND menu, clears variables.
■ CLR DATA		
TYPE 360		Sets bond type, if
SEMI EXIT	30/360 SEMIANNUAL	necessary.

* To see the full precision of the number, press ■ SHOW.

5.022003	SETT	SETT= 05/02/2003 FRI	Stores purchase date (*MM.DDYYYY* format).
3.032022	MAT	MAT=03/03/2022 THU	Stores maturity date.
6	CPN%	CPN%=6.00	Stores annual coupon rate.
	MORE		Stores yield.
5.7	YLD%	YLD%=5.70	
	PRICE	PRICE=103.43	Calculates price.
	MORE	3.032006	Changes maturity date
	MAT	102.75	to call date and stores
	CALL	CALL=102.75	a call value.
	MORE YLD%	YLD%=5.58	Calculates yield to call.

Example: A Zero-Coupon Bond. Calculate the price of a zero-coupon, semi-annual bond using a 30/360 calendar basis. The bond was purchased on May 19, 2003 and will mature on June 30, 2017, and has a yield to maturity of 10%.

Keys:	Display:	Description:
FIN BOND █ CLR DATA		Clears BOND variables, setting *CALL* to 100.
TYPE 360 SEMI EXIT	30/360 SEMIANNUAL	Sets type if necessary (check the display).
5.192003 SETT	SETT= 05/19/2003 MON	Purchase date (*MM.DDYYYY* format).
6.302017		Maturity date.
MAT	MAT=06/30/2017 FRI	
0 CPN%	CPN%=0.00	Coupon rate is zero.
MORE 10 YLD%	YLD%=10.00	Yield to maturity.
PRICE	PRICE=25.23	Calculates price.

9

Depreciation

The DEPRC (*depreciation*) menu calculates depreciation values and remaining depreciable values one year at a time. The methods available are:

- Declining balance.
- Sum-of-the-years' digits.
- Straight line.
- Accelerated Cost Recovery System.

The DEPRC Menu
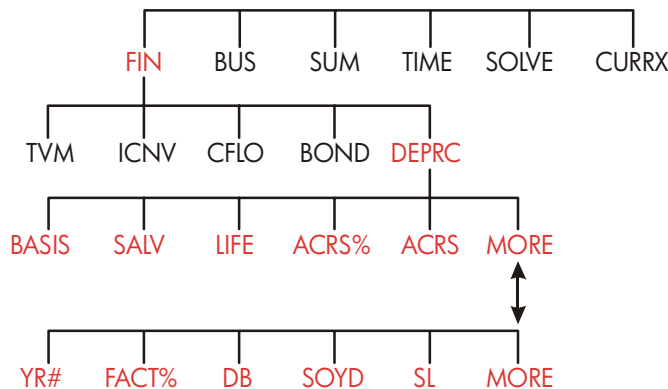
Pressing DEPRC displays the DEPRC menu.

Table 9-1. DEPRC Menu Labels

Menu Label	Description
BASIS	Stores the depreciable cost basis of the asset at acquisition.
SALV !	Stores the salvage value of the asset at the end of its useful life. If there is no salvage value, set *SALV*=0.
LIFE !	Stores the expected useful life (in whole years) of the asset.
ACRS% !	Stores the appropriate Accelerated Cost Recovery System percentage from the published ACRS tables.
ACRS !	Calculates the ACRS deduction based on *BASIS* and *ACRS%*. (The values in *SALV*, *LIFE*, *FACT%*, and *YR#* do not matter.)
	↓ MORE ↑
YR# !	Stores the number of the year for which you want the depreciation (1, 2, etc.).
FACT% !	Stores the declining-balance factor as a percentage of the straight-line rate. *This is for the DB method only.* For example, for a rate 1¼ times (125%) the straight-line rate, enter 125.
DB !	Calculates the declining-balance depreciation for the year.
SOYD !	Calculates the sum-of-the-years'-digits depreciation for the year.
SL !	Calculates the straight-line depreciation for the year.
▼!	Displays the remaining depreciable value, *RDV*, *after* you have pressed DB , SOYD , or SL .

The calculator retains the values of the DEPRC variables until you clear them by pressing ▢[CLR DATA] while the DEPRC menu is displayed.

To see the value currently stored in a variable, press $\boxed{\text{RCL}}$ *menu label*.

Doing Depreciation Calculations

DB, SOYD, and SL Methods

To calculate the depreciation for an asset: *

1. Display the DEPRC menu: press `FIN` `DEPRC` .

2. Define the characteristics of the asset:

    a. Key in the cost basis and press `BASIS`

    b. Key in the salvage value and press `SALV` . If there is no salvage value, enter zero.

    c. Key in the useful life and press `LIFE` .

3. Press `MORE` for the rest of the DEPRC menu.

4. Key in the number for the year of depreciation you want to calculate (1, 2, 3, etc.) and press `YR#` .

5. If you are using the declining-balance method, enter the DB factor (a percentage) and press `FACT%` .

6. Press `DB` , `SOYD` , or `SL` to calculate the appropriate depreciation.

7. To see the remaining depreciable value (basis — salvage value — accumulated depreciation), press $\boxed{\blacktriangledown}$.

8. To calculate the depreciation for another year, just change *YR#* and press `DB` , `SOYD` , or `SL` again.

---

* The calculated values of *RDV, DB, SOYD,* and SL are rounded internally to the number of decimal places specified by the current display setting. A setting of `FIX` 2 means that these values will be rounded internally to two decimal places.

Example: Declining-Balance Depreciation. A metalworking machine, purchased for $10,000, is to be depreciated over 5 years. Its salvage value is estimated at $500. Find the depreciation and remaining depreciable value for each of the first 3 years of the machine's life using the double-declining-balance method (200% of the straight-line rate). For comparison, find the straight-line depreciation, as well.

Keys:	Display:	Description:
FIN DEPRC		Displays DEPRC menu.
10000 BASIS	BASIS=10,000.00	Cost basis.
500 SALV	SALV=500.00	Salvage value.
5 LIFE	LIFE=5.00	Useful life.
MORE 1 YR#	YR#=1.00	First year of depreciation.
200 FACT%	FACT%=200.00	DB percentage factor.
DB	DB=4,000.00	Depreciation in first year. (Salvage value ignored at this point.)
▼	RDV=5,500.00	Remaining depreciable value after first year (*BASIS - SALV* - 4,000).
2 YR# DB	DB=2,400.00	Depreciation in second year.
▼	RDV=3,100.00	Remaining depreciable value after second year.
3 YR# DB	DB=1,440.00	Depreciation in third year.
▼	RDV=1,660.00	Remaining depreciable value after third year.
SL	SL=1,900.00	Straight-line depreciation for each year.

▼	RDV=3,800.00	Remaining depreciable value after third year using SL.

The ACRS Method

To calculate the amount of tax deduction under the U.S. Accelerated Cost Recovery System:

1. Display the DEPRC menu: press FIN   DEPRC .

2. Enter the cost basis of the asset and press BASIS

3. The Internal Revenue Service publishes tables that list the percentage of an asset's basis that can be deducted each year of its prescribed life. Look up that value, enter it, and press ACRS% .

4. Press ACRS to calculate the value of the deduction.

Example: ACRS Deductions. Use the ACRS method to find the income-tax deduction for a $25,000 asset over 3 years of a 5-year life. Use this hypothetical ACRS table:

Year	Percentage Deductible
1	15
2	25
3	20
4	20
5	20

Keys:	Display:	Description:
FIN DEPRC		DEPRC menu.
25000 BASIS	BASIS=25,000.00	Enters basis.
15 ACRS%	ACRS%=15.00	Tabular value, year 1.
ACRS	ACRS=3,750.00	Deduction in first year.

25 `ACRS%`	`ACRS%=25.00`	Tabular value, year 2.
`ACRS`	`ACRS=6,250.00`	Deduction in second year.
20 `ACRS%`	`ACRS%=20.00`	Tabular value, year 3.
`ACRS`	`ACRS=5,000.00`	Deduction in third year.

Partial-Year Depreciation

When the acquisition date of an asset does not coincide with the start of the tax or fiscal year, then the amounts of depreciation in the first and last years are computed as fractions of a full year's depreciation. Except in SL, the intermediate years are computed as sums of fractions. This does not apply to the ACRS method.

Suppose you acquired an asset in October and wanted to depreciate it for 3 years. (Your fiscal year begins January 1st.) The depreciation schedule would affect parts of 4 years, as shown in the illustration. The 3 months from October to December equal ¼ year.
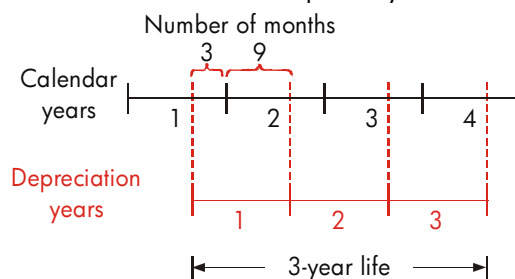
For SL depreciation, partial-year calculations are easy: calculate the SL value, then use ¼ of that value for the first year, the full amount the second and third years, and ¾ of that amount the fourth year.

For DB and SOYD depreciation, each year's depreciation value is different, as shown in the table:

Calendar Year	Depreciation Value
1 (Oct.-Dec.)	¼ x year 1
2	(¾ x year 1) + (¼ x year 2)
3	(¾ x year 2) + (¼ x year 3)
4 (Jan.-Sept.)	¾ x year 3

Example: Partial-Year Depreciation. A movie camera bought for $12,000 has a useful life of 10 years with a salvage value of $500. Using the sum-of-the-years'-digits method, find the amount of depreciation for the fourth year. Assume the first depreciation year was 11 months long.

Keys:	Display:	Description:
FIN DEPRC		Displays DEPRC menu.
12000 BASIS		Stores known values.
500 SALV		
10 LIFE		
MORE 3 YR#	YR#=3.00	
SOYD	SOYD=1,672.72	Calculates depreciation for year 3.
÷ 12 = STO 1	139.39	Stores 1 month's depreciation from year 3.
4 YR# SOYD	SOYD=1,463.64	Calculates depreciation for year 4.
× 11 ÷ 12 =	1,341.67	Figures 11 months' depreciation from year 4.
+ RCL 1 =	1,481.06	Figures total depreciation for year 4.

10

Running Total and Statistics

The SUM menu stores and statistically analyzes sets of numbers. As you enter the numbers, the calculator displays their running total. Once you've entered the numbers into a *list*, you can:

- Calculate the mean, median, standard deviation, and range.
- Display the largest and smallest number in the list.
- Sort the list from smallest number to largest number.

With two lists of numbers, you can:

- Do curve-fitting and forecasting calculations using two SUM lists and one of four models—linear, exponential, logarithmic, and power. (Curve fitting for the linear model is called *linear regression*.)
- Calculate the weighted mean and grouped standard deviation.
- Find the summation statistics (Σx, Σx^2, Σy, Σy^2, Σxy).

You can store many separate lists of numbers in SUM. The maximum number depends on the amount of available calculator memory.

The SUM Menu
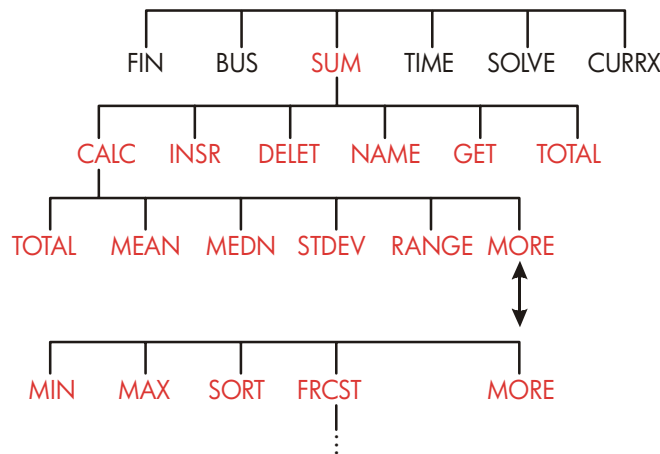
The SUM menu creates lists of numbers and performs calculations with a SUM list.

Table 10-1. SUM Menu Labels

Menu Label	Description
CALC	Accesses the CALC menu to calculate the total, mean, median, standard deviation, range, minimum, maximum, sorting, and linear regression (including weighted mean and summation statistics).
INSR !	Allows you to insert numbers into the list.
DELET !	Deletes numbers from the list.
NAME !	Allows you to name the list.
GET !	Allows you to switch from one named list to another or to create a new list.
TOTAL !	Displays the total of all the items in the list.

To see the calculator line when this menu is in the display, press ⌐INPUT⌐ once. (This does not affect number entry.)

To see this menu when the calculator line is in the display, press ⌐EXIT⌐.

Creating a SUM List

To keep a running total of a list of numbers or do statistical calculations with sets of data, first create a SUM list of the values.

Entering Numbers and Viewing the TOTAL

To enter numbers into a SUM list:

1. Press `SUM`. You'll see ITEM(1)=? if the current list is empty, or ITEM(2 or more)=? if the list is not empty. This is the *bottom* of the current list.

```
ITEM(1)=?
CALC INSR DELET NAME  GET  TOTAL
```

2. If the list is empty, start filling it (step 3). If the current list is *not* empty, you can do either **a** or **b**:

   a. Clear the list by pressing ⌐ ⌐CLR DATA⌐ `YES` (see also page 127.)

   b. Get a new list by pressing `GET` `*NEW` (The old list must be named first. Press `NAME` or see page 126.)

3. Key in the value of the first item, *ITEM(1)* (press ⌐+/-⌐ for a negative number), and press ⌐INPUT⌐.* (To view *ITEM(1)* longer, hold down ⌐INPUT⌐ before releasing it.)

---

* Remember that you can do calculations with a number before entering it. This does not interfere with the list. Whenever you press ⌐INPUT⌐, the number (or evaluated expression) in the calculator line is entered into the list. If you need to use the MATH menu, just press ⌐ ⌐MATH⌐, do the calculation, then press ⌐EXIT⌐) to return to where you were in SUM.

After briefly showing *ITEM(1)*, the display shows

`ITEM(2)=?`

`TOTAL=`*number*

TOTAL is the updated, running *TOTAL* of all the numbers in the list (only one number, so far).

4. To enter *ITEM(2)*, key in the value and press `INPUT`. The prompt for *ITEM(3)* and the new, updated total appear.

5. Continue entering values for *ITEM(3)*, *ITEM(4)*, etc. The calculator recognizes the end of the list when an item is left blank (no value is entered).

6. Press `EXIT` to end the list and restore the SUM menu. You can now proceed to correct the list, name the list, get another list, or do statistical calculations.

Use these same instructions to enter additional lists.

Viewing and Correcting the List

To display a particular list, use ` GET ` (see page 127).

The ▲ and ▼ keys move up and down the list one number at a time. ■▲ and ■▼ display the beginning and end of the list.

Changing or Clearing a Number. To change a number after it's been entered: display the number, key in the new value, and press `INPUT`.

Use the same method to clear a number to zero. (Do not press `CLR` or ◀, which clears the calculator line.)

Inserting Numbers into a List. Insertion occurs *before* (or *above*) the current entry. Pressing ` INSR ` inserts a zero item and renumbers the rest of the list. You can then enter a new value.

For example, if *ITEM(6)* is in the display, pressing ` INSR ` puts a new, zero item between the previously numbered *ITEM(5)* and *ITEM(6)*.

Deleting Numbers from a List. Pressing `DELET` deletes the current item.

Example: Updating a Checkbook. On May 31, your checking account balance was $267.82. The transactions for the first 10 days in June are:

Date	Transaction	Amount	Date	Transaction	Amount
6/1	Balance	267.82	6/3	Check	−128.90
6/1	Deposit	837.42	6/7	Check	− 65.35
6/1	Check	−368.23	6/10	Deposit	55.67
6/2	Check	−45.36			

Update the checkbook by calculating the running balance.

Keys:	Display:	Description:
`SUM` *		
`CLR DATA` `YES`	`ITEM(1)=?`	Displays empty SUM list.
267.82 `INPUT`	`ITEM(2)=?`	Enters beginning balance
	`TOTAL=267.82`	and shows running total.
837.42 `INPUT`	`ITEM(3)=?`	Enters deposit on 6/1.
	`TOTAL=1,105.24`	
368.23 `+/−`		Enters remaining
`INPUT`		transactions.
45.36 `+/−`		
`INPUT`		
128.90 `+/−`		
`INPUT`		
65.35 `+/−`		
`INPUT`		

* If you want to preserve the current list, skip the next step (pressing `CLR DATA`).
  Instead, name the list and then press `GET` `*NEW`.

55.67 [INPUT]	ITEM(8)=?	
	TOTAL=553.07	
[EXIT]	ITEM(8)=?	Ends list and displays
		SUM menu again.

Copying a Number from a List to the Calculator Line

To copy a number from the list into the calculator line, use ▼ or ▲ to display the number, then press [RCL] [INPUT].

Naming and Renaming a SUM List

A new list has no name. You may name it before or after filling the list, but you *must* name it in order to store another list.

To name a list:

1. Press NAME from the SUM menu.
2. Use the ALPHA menu to type in a name. (The ALPHA and ALPHA-Edit menus are covered on pages 30 - 32.) To clear a name, press [CLR].
3. Press [INPUT].

The name can be up to 22 characters long and include any character except: $+ - x \div ( ) < > : =$ *space* *

But only the first three to five characters (depending on letter widths) of the name are used for a menu label. Avoid names with the same first characters, since their menu labels will look alike.

Viewing the Name of the Current List. Press NAME , then [EXIT].

---

* SUM does accept these exceptional characters in list names, but the Solver functions SIZES and ITEM do not.

Starting or GETting Another List

When you press ⌑ SUM ⌑, the SUM list that appears is the last one used.

To start a new list or switch to a different one, the current list must be named or cleared. If it is named, then:

1. Press ⌑ GET ⌑. The GET menu contains a menu label for each named list plus ⌑ *NEW ⌑.

2. Press the key for the desired list. (⌑ *NEW ⌑ brings up a new, empty list.)

Clearing a SUM List and Its Name

To clear a list's numbers and name:

1. Display the list you want to clear, then press ⌑ CLR DATA ⌑ ⌑ YES ⌑. This removes the numbers.

2. If the list is named, you'll see ALSO CLEAR LIST NAME? Press ⌑ YES ⌑ to remove the name. Press ⌑ NO ⌑ to retain the name with an empty list.

To remove just one value at a time from a list, use ⌑ DELET ⌑.

Doing Statistical Calculations (CALC)

Once you have entered a list of numbers, you can calculate the following values.

- **For one variable:** the total, mean, median, standard deviation, range, minimum, and maximum. You can also sort the numbers in order of increasing value.

- **For two variables:** *x*-estimates and *y*-estimates (this is also called *forecasting*), the correlation coefficient for different types of curves (this is *curve-fitting*), the slope and *y*-intercept of the line, and summation statistics. You can also find the weighted mean and the grouped standard deviation.

Calculations with One Variable

The CALC menu calculates the following statistical values using one SUM list.

Table 10-2. The CALC Menu for SUM Lists

Menu Key	Description
TOTAL !	Calculates the sum of the numbers in the list.
MEAN !	Calculates the arithmetic mean (average).
MEDN !	Calculates the median.
STDEV !	Calculates the standard deviation.*
RANG !	Calculates the difference between the largest and smallest number.
↓ MORE ↑	
MIN !	Finds the smallest (minimum) number in the list.
MAX !	Finds the largest (maximum) number in the list.
SORT	Sorts the list in ascending order.
FRCST	Displays a series of menus for calculations with two variables for curve fitting, estimation, weighted mean and grouped standard deviation, and summation statistics.

* The calculator finds the *sample* standard deviation. The formula assumes that the list of numbers is a sampling of a larger, complete set of data. If the list is, in fact, the entire set of data, the *true population standard deviation* can be computed by calculating the mean of the original list, placing that value into the list, and then calculating the standard deviation.

Example: Mean, Median, and Standard Deviation. Suppose your shop had the following phone bills during the past six months:

Month	Phone Expense	Month	Phone Expense
1. May	$340	4. August	$780
2. June	$175	5.September	$245
3. July	$450	6. October	$625

Calculate the mean, median, and standard deviation of the monthly phone bills. Then display the smallest value in the list.

Keys:	Display:	Description:
SUM		Displays current SUM list and SUM menu keys.
▬ CLR DATA YES		Clears current list or gets a new one.
or		
GET *NEW	ITEM(1)=?	
340 INPUT	ITEM(2)=? TOTAL=340.00	Stores May's phone bill; shows total.
175 INPUT	ITEM(3)=? TOTAL=515.00	Stores June; updates total.
450 INPUT 780 INPUT 245 INPUT 625 INPUT	ITEM(7)=? TOTAL=2,615.00	Stores phone bills for July-October and keeps a running total.
EXIT CALC	2,615.00	Displays CALC menu.
MEAN	MEAN=435.83	Calculates mean.
MEDN	MEDIAN=395.00	Calculates median.
STDEV	STDEV=231.55	Calculates standard

		deviation.
MORE		Displays rest of CALC menu.
MIN	MIN=175.00	Finds smallest number.

Calculations with Two Variables (FRCST)

The FRCST menu does the following two-variable calculations using two SUM lists:

- Fits *x*- and *y*-data to a linear, logarithmic, exponential, or power curve.
- Forecasts estimated values based on that curve.
- Finds the weighted mean and grouped standard deviation.
- Shows you the summation statistics (Σx, Σx^2, Σy, Σy^2, Σxy, etc.).

```
                              CALC
        ┌──────┬───────┬───────┬───────┬──────┐
      TOTAL   MEAN    MEDN    STDEV   RANGE   MORE ↕

        ┌──────┬───────┬───────┬──────────────┐
       MIN    MAX     SORT    FRCST          MORE
                              (select x and y)

              ┌──────┬───────┬───────┬──────┬──────┐
            x-list  y-list   CORR     M      B     MORE ◄─┐
              ┌──────┬───────┬───────────┬──────┐         │
            MODL    W.MN    G.SD        SIZE   MORE        │
         ┌─────┬──────┬──────┐                            │
        LIN   LOG    EXP    PWR                           │
              ┌──────┬───────┬───────┬──────┬──────┐      │
            ΣX     ΣY      ΣX2     ΣY2    ΣXY    MORE ─────┘
```
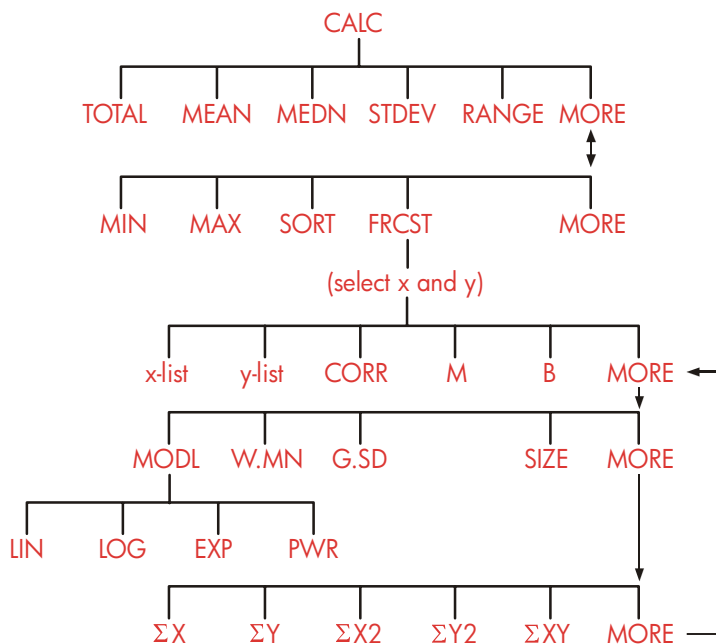
After pressing FRCST , you must specify two previously created lists—one for the *x*-variable and one for the *y*-variable. The two lists must have the same number of items.

Table 10-3. FRCST Menu Labels

Menu Label	Description
list name for x-variable *list name for y-variable*	These specify the two lists of data to be compared. Also used for estimations:store *x* and estimate *y*, or vice-versa. `*CURR` is the menu label for an unnamed current list.
`CORR` *	Calculates the *correlation coefficient*, a number between -1 and $+1$ that measures how closely the *x,y* data points match the calculated curve.
`M` *	Calculates *M*. For the linear model, this is the slope.
`B` *	Calculates *B*. For the linear model, this is the *y*-intercept.
	↓ `MORE`
`MODL`	Displays a choice of the four curve-fitting models: `LIN` , `LOG` , `EXP` , and `PWR` .
`W.MN` !	Calculates the weighted mean of the *x*-values using the weights in the *y*-list.
`G.SD` !	Calculates the standard deviation of a set of *x*-values grouped by frequencies specified in the *y*-list.
`SIZE` !	The number of items in either list.
	↓ `MORE`
`ΣX` !	Sum of items in *x*-list.
`ΣY` !	Sum of items in *y*-list.
`ΣX2` !	Sum of squares of items in *x*-list.
`ΣY2` !	Sum of squares of items in y-list.
`ΣXY` !	Sum of products of items in *x*- and *y*-lists.

* For the non-linear models, the calculation uses the *transformed* data values.

Curve Fitting and Forecasting

Curve fitting is a statistical method for finding a relationship between two variables, *x* and *y*. Based on this relationship, you can *estimate* new values of *y* based on a given *x*-value, and vice-versa. Each SUM list holds the numbers (data values) for one variable. You can select one of four curve-fitting *models*:*

Linear Curve Fit
`LIN`

$y = B + Mx$
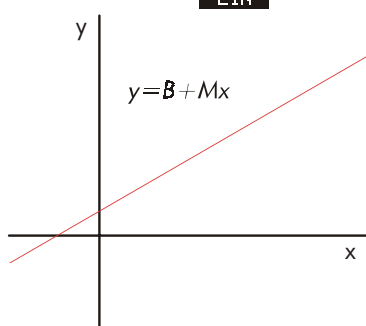
Exponential Curve Fit
`EXP`

$y = Be^{Mx}$
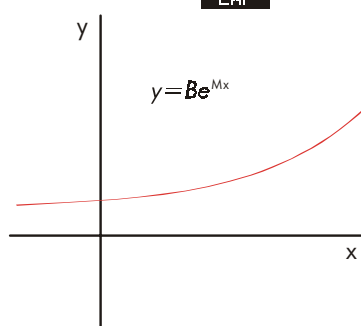
Logarithmic Curve Fit
`LOG`

$y = B + M \ln x$
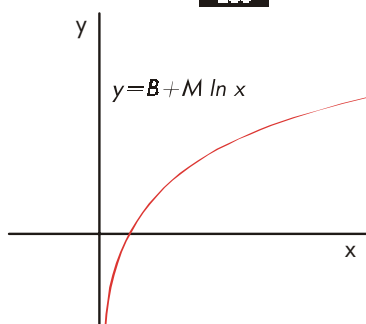
Power Curve Fit
`PWR`

$y = Bx^{M}$
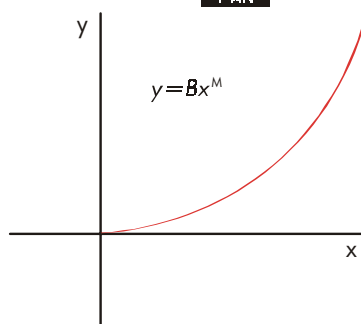
* The exponential, logarithmic, and power models are calculated using transformations that allow the data to be fitted by standard linear regression. The equations for these transformations appear in appendix B. The logarithmic model requires positive *x*-values; the exponential model requires positive *y*-values; and the power curve requires positive *x*- and *y*-values.

To do curve fitting and forecasting :

1. Enter the data into two SUM lists: one for the *x*-values and one for the *y*-values. Make sure each list has the same number of items so that the items are in matched pairs.

2. From the SUM menu, press `CALC` `MORE` `FRCST` to display a menu of SUM-list names. The current list is labeled `*CURR` unless named otherwise.

3. Press a menu key to select a list of *x*-values (*independent variable*).

4. Select a list of *y*-values (*dependent variable*).

5. Now you see the FRCST menu. Whichever curve-fitting model was used last is named in the display. If you want to select a different model, press `MORE` `MODL` , and then the menu key for the model.

```
LINEAR
MENU SALES CORR  M   B  MORE
```

6. **To calculate the curve-fitting results,** press, `CORR` , `M` and `B` .

7. **To forecast (estimate) a value:**

   a. Key in the known value and press the menu key for that variable.

   b. Press the menu key for the variable whose value you want to forecast.

Example: Curve Fitting. BJ's Dahlia Garden advertises on a local radio station. For the past six weeks, the manager has kept records of the number of minutes of advertising that were purchased, and the sales for that week.

	Number of Minutes of Radio Advertising (x-values, *MINUTES*)	Dollar Sales (y-values, *SALES*)
Week 1	2	$1,400
Week 2	1	$ 920
Week 3	3	$1,100
Week 4	5	$2,265
Week 5	5	$2,890
Week 6	4	$2,200

BJ's wants to determine whether there is a linear relationship between the amount of radio advertising and the weekly sales. If a strong relationship exists, BJ's wants to use the relationship to forecast sales. A graph of the data looks like this:
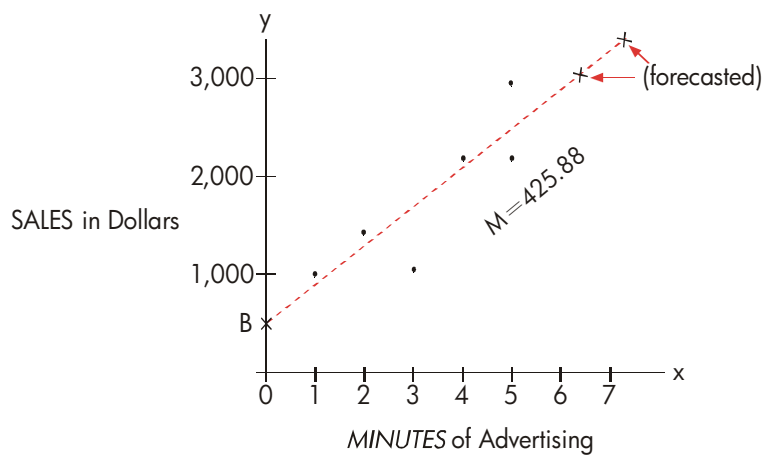
Keys:	Display:	Description:
SUM		Displays current SUM list and SUM menu keys.
▬ CLR DATA		Clears current list.
YES	ITEM(1)=?	
2 INPUT		Stores minutes of
1 INPUT		advertising (*x*-values) into
3 INPUT		a SUM list.
5 INPUT		
5 INPUT		
4 INPUT	ITEM(7)=?	
	TOTAL=20.00	
EXIT NAME	TYPE A NAME:[INPUT]	
MINUTES		Names this list. (See page
INPUT	ITEM(7)=?	30 to use the ALPHA menu.)

Now enter and name the second list.

GET *NEW	ITEM(1)=?	Gets a new, empty list.
1400 INPUT		Stores weekly sales
920 INPUT		(*y*-values) into a second
1100 INPUT		SUM list.
2265 INPUT		
2890 INPUT		
2200 INPUT	ITEM(7)=?	
	TOTAL=10,775.00	
EXIT NAME	TYPE A NAME:[INPUT]	
SALES INPUT	ITEM(7)=?	Names *y*-list.
CALC MORE		Identifies the lists for
FRCST	SELECT X VARIABLE	curve-fitting.

`MINU`	`SELECT Y VARIABLE`	Selects *MINUTES* as *x*-list,
`SALES`	`LINEAR *`	*SALES* as *y*-list, indicates
		current curve-fitting
		model, and displays
		FRCST menu.
`CORR`	`CORR=0.90`	Correlation coefficient for
		linear model.

The correlation coefficient calculated above is acceptable to BJ's. Using the linear model, estimate what the level of sales would be if the business purchased 7 minutes of advertising time per week.

7 `MINU`	`MINUTES=7.00`	Stores 7 in variable
		MINUTES.
`SALES`	`SALES=3,357.38`	Forecasts the sales
		resulting from 7 minutes of
		radio advertising.

How many minutes of advertising should BJ's buy if it wants to attain sales of $3,000?

3000 `SALES`		The business should buy
`MINU`	`MINUTES=6.16`	about 6 minutes of
		advertising for sales of
		$3,000.†

---

* If the model named here is not the one you want to use, press `MORE` `MODL` and select the one you want.

† This result is not the same as it would be if *SALES* were the independent (*x*) variable, and *MINUTES* were the dependent (*y*) variable.

Weighted Mean and Grouped Standard Deviation

Data in one list (*x*) can be weighted or grouped (by frequency) by data in another list (*y*). To find the mean of weighted data and the standard deviation of grouped data:

1. Enter the data values—the *x*-variable—into a SUM list.
2. Enter the corresponding weights or frequencies—the *y*-variables—into another list. (To calculate *G.SD*, the *y*-values should be integers.)
3. From the SUM menu, press `CALC` `MORE` `FRCST` to display a menu of SUM-list names. The current list is `*CURR` unless named otherwise.
4. Press the menu key for the list of *x*-values.
5. Now select the list with the weights (or frequencies) (*y*).
6. To calculate the weighted mean, press `MORE` `W.MN`.
7. To calculate the grouped standard deviation, press `G.SD`.

Example: Weighted Mean. A survey of 266 one-bedroom rental apartments reveals that 54 of them rent for $200 per month, 32 for $205, 88 for $210, and 92 for $216. What is the average monthly rent and its standard deviation?

Create two SUM lists. The first, called RENT, should contain the numbers 200, 205, 210, and 216, in that order. The second can be unnamed and should contain the numbers 54, 32, 88, and 92, in that order.

Keys:	Display:	Description:
`SUM`		
🔴`CLR DATA` `YES`		Clears current list or gets a new one.
or		
`GET` `*NEW`	`ITEM(1)=?`	
200 `INPUT`		Stores rents into a list.
205 `INPUT`		
210 `INPUT`		

216 [INPUT]	ITEM(5)=?	
	TOTAL=831.00	
[EXIT] NAME		Names this list RENT. (See
RENT [INPUT]	ITEM(5)=?	page 30 to use the ALPHA
		menu.)
GET *NEW	ITEM(1)=?	Gets a new, empty list.
54 [INPUT]		Stores frequencies into
32 [INPUT]		second list.
88 [INPUT]		
92 [INPUT]	ITEM(5)=?	
	TOTAL=266.00	
[EXIT] CALC		Displays names of all
MORE FRCST	SELECT X VARIABLE	SUM lists.
RENT	SELECT Y VARIABLE	Specifies *RENT* as the
		x-list.
*CURR	LINEAR	Specifies the current,
		unnamed list as the *y*-list
		and then displays the
		FRCST menu. (Ignore
		model type.)
MORE W.MN	209.44	Average monthly rent.
G.SD	5.97	Standard deviation of the
		rents.

Summation Statistics

The summation values are of interest if you want to perform other statistical calculations besides those provided by the calculator. To find Σx, Σx^2, Σy, Σy^2, $\Sigma(xy)$, and *n*, the number of elements in either list:

1. Display the FRCST menu and select the *x*- and *y*-lists as explained in steps 1-4 of the instructions on page 134. To find the summation

statistics for just one list of data, specify the same list for both *x* and *y*.

2. To see *n*, press `MORE` `SIZE` .

3. Press `MORE` again to display the summation menu, and press the menu label for the value you want.

Doing Other Calculations with SUM Data

If you would like to do other statistical calculations with SUM data besides those in the CALC menu, you can do so by writing your own Solver equation. There are Solver functions that can access data stored in SUM lists, and there is a summation function that can combine all or part of the values stored in specific lists.

Refer to "Accessing CFLO and SUM Lists from the Solver" in chapter 12.