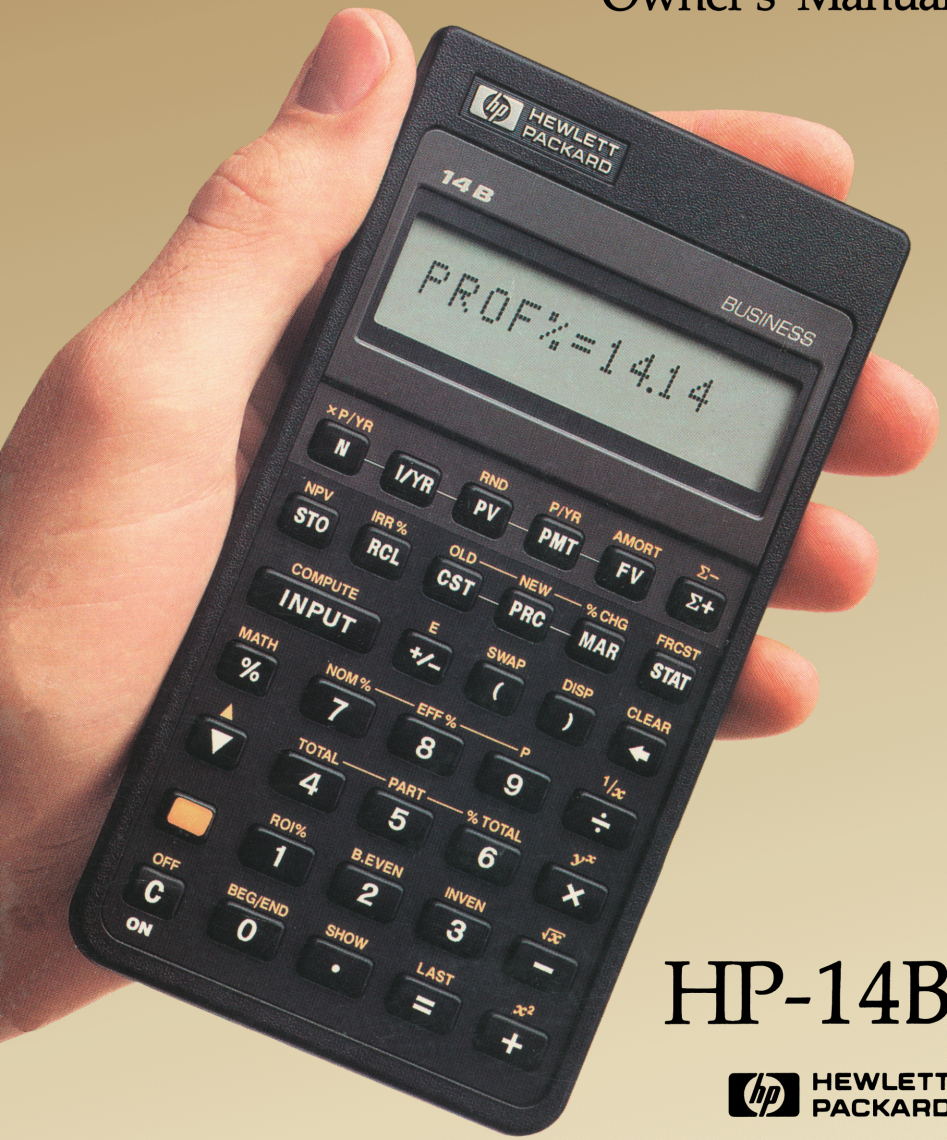
HEWLETT-PACKARD

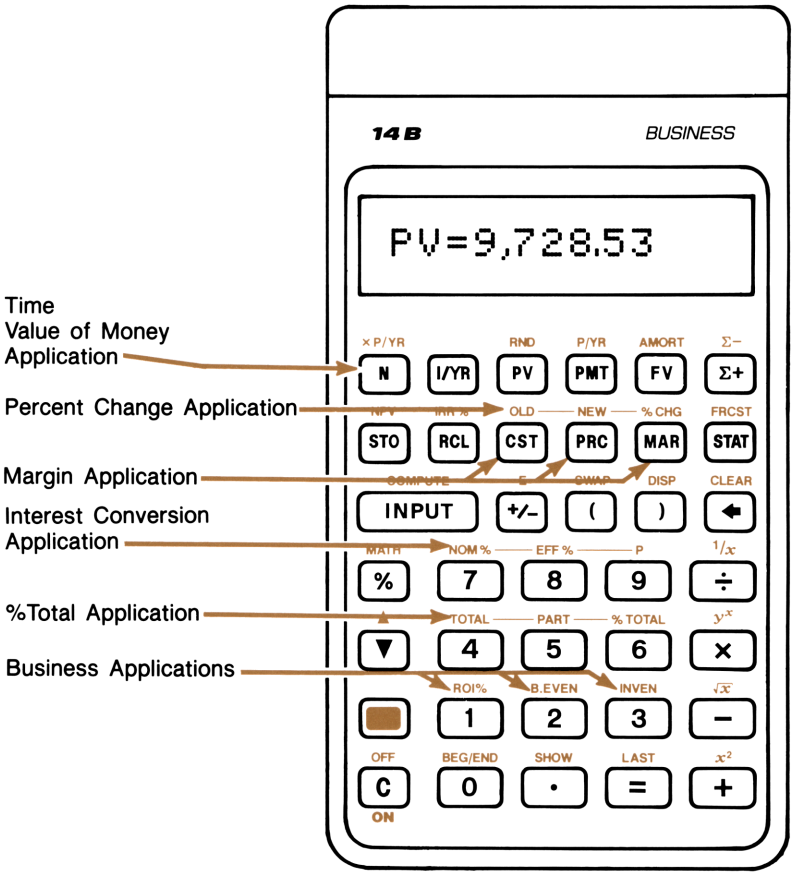
Business Calculator

Owner's Manual



HP-14B

HEWLETT PACKARD


14B
BUSINESS
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Time
Value of Money
Application
Percent Change Application
Margin Application
Interest Conversion
Application
%Total Application
Business Applications
× P/YR
RND
P/YR
AMORT
Σ−
N
I/YR
PV
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FV
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Help Us Help You!

By taking a moment to fill out this card, you can help HP to better understand your needs. Please read all questions first, then fill them out. Thank you.

HELP US HELP YOU!

Model: HP-14B Date acquired _____

Name _____

Address _____

City, State, Zip _____

Age _____ Phone (_____) _____ Business ___ or Home ___

1. What is your POSITION OR OCCUPATION? **(Please check only one)**

101 ☐ Student
102 ☐ Educator, Researcher
103 ☐ Professional Staff
104 ☐ Middle Manager
105 ☐ Top Manager
106 ☐ Owner, Principal, VP
107 ☐ Field Agent, Rep
108 ☐ Technician
109 ☐ Independent, self-employed
110 ☐ Retired
111 ☐ Other _____

2. What is your AREA OF ACTIVITY or FIELD OF WORK/STUDY? **(Please check only one)**

201 ☐ Mechanical Engineering
202 ☐ Civil Engineering
203 ☐ Electrical Engineering
204 ☐ Chemical Engineering
205 ☐ Other Engineering _____
206 ☐ Surveying
207 ☐ Data Processing
208 ☐ Quality Control
209 ☐ Purchasing, Scheduling, Inventory Cntrl.
210 ☐ Accounting, Auditing
211 ☐ Finance, Investment Analysis
212 ☐ General Administration/Management
213 ☐ Marketing
214 ☐ Sales
215 ☐ Customer Service, Maintenance
216 ☐ Other _____

3. In what INDUSTRY do you work? **(Skip if Student or Retired. Please check only one)**

301 ☐ Education
302 ☐ Banking, Finance, Investment
303 ☐ Insurance
304 ☐ Real Estate
305 ☐ Business/Consulting Services
306 ☐ Technical Consulting
307 ☐ Software, Computer Services
308 ☐ Construction, Architectural
309 ☐ Mining, Oil Drilling, Exploration
310 ☐ Chemical, Refining
311 ☐ Agriculture, Forestry, Livestock
312 ☐ Food Processing/Distribution
313 ☐ Manufacturing Industrial Goods
314 ☐ Manufacturing Consumer Goods
315 ☐ Transportation
316 ☐ Communication, Utilities
317 ☐ Public Admin./Government/Military
318 ☐ Other _____

4. Where did your purchase your HP calculator? **(Please check only one)**

401 ☐ Retail Computer Store
402 ☐ Office Equipment Store
403 ☐ Bookstore
404 ☐ Department Store
406 ☐ Catalog Store
407 ☐ Mail Order
408 ☐ Specialty Store
409 ☐ Purchased by Company/School
410 ☐ Directly from HP
411 ☐ Other _____

5. How did you first hear about this model?

501 ☐ Previous HP Owner
502 ☐ Advice of Friends, Collegues, Professor
503 ☐ Magazine or Newspaper Advertising
504 ☐ Press Articles
505 ☐ Direct Mail
506 ☐ Salesperson
507 ☐ Brochure or In Store Literature
508 ☐ Other _____

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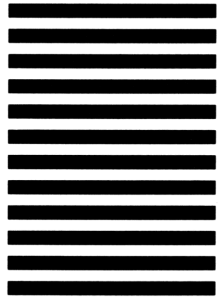
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL

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INQUIRIES DEPARTMENT
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CORVALLIS OR 97330-9988

Comments on the HP-14B Owner's Manual

We welcome your evaluation of this manual. Your comments and suggestions help us improve our publications.

HP-14B Owner's Manual

Printing date of the manual (from the title page) _____

Please circle a response for each of the statements below. You can use the **Comments** space to provide additional opinions.

1 = Strongly Agree
2 = Agree
3 = Neutral
4 = Disagree
5 = Strongly Disagree

- The manual is well organized. 1 2 3 4 5
- I can find the information I want. 1 2 3 4 5
- The information in the manual is accurate. 1 2 3 4 5
- I can easily understand the instructions. 1 2 3 4 5
- The manual contains enough examples. 1 2 3 4 5
- The examples are appropriate and helpful. 1 2 3 4 5
- The layout and format are attractive and useful. 1 2 3 4 5
- The illustrations are clear and helpful. 1 2 3 4 5
- The manual length is: too long appropriate too short.
- The chapter(s) and appendixes I refer to most frequently are:

  1 2 3 4 5 6 7 8 A B

Comments: _____

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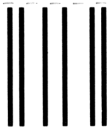
Name: _____

Address: _____

City/State/Zip: _____

Occupation: _____



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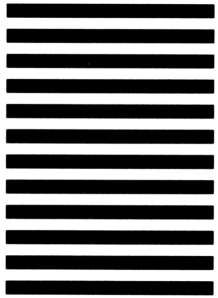

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PORTABLE COMPUTER DIVISION
1000 NE CIRCLE BLVD.
CORVALLIS OR 97330-9988

HP-14B
Business Calculator

Owner's Manual

Edition 1 October, 1988
Reorder Number 00014-90001

Notice

For warranty and regulatory information for this calculator, see pages 160 and 164.

This manual and any keystroke procedures herein are provided **"as is"** and are subject to change without notice. **Hewlett-Packard Company makes no warranty of any kind with regard to this manual or the keystroke procedures contained herein, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.** Hewlett-Packard Co. shall not be liable for any errors or for incidental or consequential damages in connection with the furnishing, performance, or use of this manual or the keystroke procedures contained herein.

Corvallis Division
1000 N.E. Circle Blvd.
Corvallis, OR 97330, U.S.A.

Printing History

Edition 1 October 1988 Mfg. No. 00014-90002

Welcome to the HP-14B

Your HP-14B reflects the superior quality and attention to detail in engineering and manufacturing that have distinguished Hewlett-Packard products for more than 40 years. Hewlett-Packard stands behind this calculator: we offer expertise to support its use (see inside the back cover) and worldwide service.

Hewlett-Packard Quality

Our calculators are made to excel, to last, and to be easy to use.

- This calculator is designed to withstand the drops, vibrations, pollutants (smog, ozone), temperature extremes, and humidity variations that it may encounter in everyday work life.
- The calculator and its manual have been designed and tested for ease of use. We selected spiral binding to let the manual stay open to any page, and we added many examples to highlight the varied uses of this calculator.
- Advanced materials and permanent, molded key lettering provide a long keyboard life and a positive feel to the keyboard.
- CMOS (low-power) electronics and a liquid-crystal display allow data to be retained indefinitely and the batteries to last a long time.
- The microprocessor has been optimized for fast and reliable computations using 15 digits internally for precise results.
- Extensive research has created a design that has minimized the adverse effects of static electricity, a potential cause of malfunctions and data loss in calculators.

Features

The feature set of the HP-14B reflects needs and wishes we solicited from many customers. This calculator includes:

- A 12-character display that can include messages, prompts, and labels along with numbers.
- Menus and messages that show you options and guide you through problems.
- *Built-in applications* to 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.
  - **Business Percentages.** Percent change, percent total, and margin calculations.
  - **Business Applications.** For return on investment, break-even analysis, and inventory turnover rate calculations.
  - **Statistics.** Mean, correlation coefficient, and forecasting, plus other statistical calculations.
- Plenty of memory is included in the HP-14B, allowing you to store a cash-flow list with up to 21 cash-flow groups and up to 999 cash flows per group. Four numbered storage registers and several other application registers are available for storing data.

Contents

List of Examples

The following list groups the examples by category.

How to Use This Manual

Here are some suggestions to help you learn to use the HP-14B as quickly as possible:

- 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 features.
- Match the problem you need to solve with the calculator capabilities, and read the related topic. You can locate information about the calculator features using the table of contents, the subject index, function index, and the list of examples.
- Before doing any time value of money or cash-flow problems, read chapter 4 to learn how cash-flow diagrams can simplify these problems and how the calculator uses positive and negative numbers in financial calculations.
- For a more extensive treatment of specific types of calculations, refer to chapter 8, "Additional Examples." If you especially like learning by example, this is a good reference spot for you.

1

Getting Started

Power On & Off

To turn on the HP-14B, press the [C] key in the lower left corner. To turn the HP-14B off, press the ■ (shift) key right above the [C] key and then press [C]. (Notice that ON is printed below and OFF is printed above the [C] key).

To conserve energy, the HP-14B turns itself off after about 10 minutes of no use.

If you see the low battery symbol (▭) in the display, you should replace the batteries as soon as possible. Follow the instructions in appendix A.

Continuous Memory

Since the HP-14B has *Continuous Memory,* turning it off does not clear it. When you turn the HP-14B off or when it turns itself off after 10 minutes of no use, everything is preserved. When you turn the calculator back on, it will be just as if you never turned it off.

Adjusting the Display Contrast

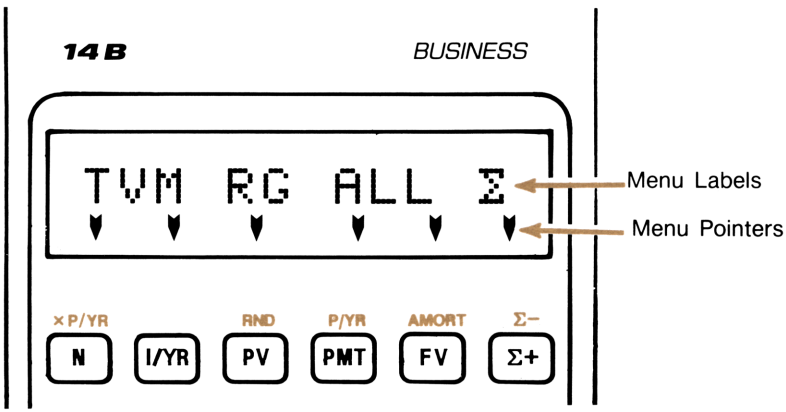
The brightness of the display depends on lighting, your viewing angle, and the display contrast setting. To change the display contrast, hold down the [C] key and press [+] or [−].

What You See in the Display

The display on the HP-14B shows you more than just numbers. It clearly labels the results of many calculations. And it sometimes uses symbols called "annunciators" to remind you when you have pressed certain keys or to tell you what keys it is expecting.

Menus

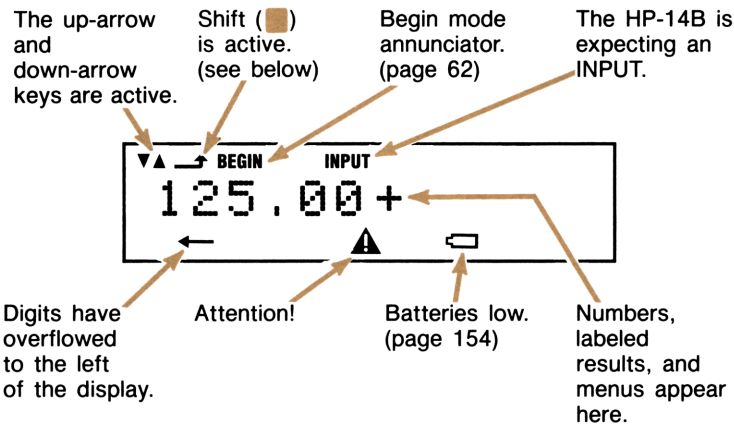
Some of the keys on the calculator (for example, [CLEAR]) bring menus into the display. Pointers in the display show you which key to press to choose one of the operations in the menu.



For example, in the above display, pressing the [N] key clears the TVM application.

Annunciators

The symbols shown in the following figure are called annunciators. Each annunciator in the display has a special significance.



Using the Keyboard

The keyboard diagram on the inside of the front cover indicates the location and the function of most of the keys on the keyboard. By convention in this manual, keys are represented with boxes (for example [I/YR]). Keystrokes in the top row that select a menu label from the display are shown in braces (for example {TVM}).

The Shift Key

Most of the keys on the HP-14B have a second or "shifted" function printed in gold above the key. The gold shift key is used to access these functions.

The shift annunciator ( ) comes on in the display when you press the shift key. This annunciator indicates that the shifted functions are active. Pressing again turns off the ( ) annunciator and restores the main meanings to the keys.

In this manual the shifted functions of keys are preceded by the ■ key (for example ■ COMPUTE is the shifted function of the INPUT key).

The INPUT Key

The INPUT key is used to separate a pair of numbers for a statistical calculation (a colon is used in the display as a separator), or to input numbers in response to prompts from the HP-14B. INPUT completes your arithmetic calculations like the = key. When the calculator is prompting for a number, you can complete your calculation of that number with INPUT rather than = INPUT.

For example, when you press ■ NPV, the calculator prompts for I% which is a periodic interest rate. If you know the annual interest rate is 16.5% and the period is monthly, you can press 16.5 ÷ 12 INPUT in response to the prompt. You can press = before INPUT, but it is unnecessary.

However, INPUT does not work as well as = for chain calculations, so it's best to use the = key to complete your arithmetic calculations unless you are responding to a prompt.

Entering and Clearing Numbers (◄, C)

By now, it is likely that you already know how to enter a number into your HP-14B. For example, to enter 25.645, press 2 5 · 6 4 5. If you make a mistake, you can back out one keystroke at a time using the ◄ key, or you can clear an entire number by pressing C.

	Keys for Clearing
◄	Back space: erases one digit, decimal point, or operator at a time. Also backs out of applications or menus one level at a time.
C	Cancel: clears the number you are keying in or, if you aren't keying in a number, clears the display or cancels the application you are using.
■ CLEAR	The CLEAR menu: allows you to clear parts of HP-14B memory.

Using the CLEAR Menu

Pressing [CLEAR] displays the CLEAR menu.

TVM RG ALL Σ

Key	Meaning
{TVM}	Clears the time value of money application.
{RG}	Clears the numbered registers and the business and percentage registers.
{ALL}	Clears all of memory.
{Σ}	Clears statistics memory.

To clear everything stored in memory, press [CLEAR] to display the CLEAR menu, press the {ALL} key (the [PMT] key), then press {Y} (the [FV] key) to confirm that you want to clear everything.

Entering Negative Numbers ([+/−])

To change the sign of the number in the display from positive to negative or vice versa, press the [+/−] key. For example, to enter −450.00 into the display, press 450 [+/−]. The [+/−] key changes the sign of the last number keyed in.

It is important to know how to enter negative numbers because they are frequently used in time value of money and cash-flow calculations to represent money paid out.

Doing Arithmetic

This is a brief introduction to doing arithmetic with your HP-14B. More information on arithmetic is in chapter 2. Remember that you can erase errors by pressing [←] or [C].

To calculate 21.1 + 23.8:

Keys:	Display:	Description:
21.1 [+]	21.10+	Displays the pending operator.
23.8	+23.8	Enters the second number.
[=]	44.90	Completes the calculation.

Doing One Calculation After Another

Once a calculation has been completed by pressing the [=] key, pressing a number key *starts* a new calculation. Pressing an operator key *continues* the calculation you just completed.

Use the following keystrokes to calculate 77.35 − 90.89 then calculate $\frac{\sqrt{65} \times 12}{3.5}$.

Keys:	Display:	Description:
77.35 [-]	77.35-	
90.89 [=]	-13.54	Calculates 77.35 − 90.89.
65 [2nd] [√x] [×] 12 [=]	96.75	Entering 65 begins a new calculation.
[÷] 3.5 [=]	27.64	Continues your calculation.

You can also do long calculations without pressing [=] after each intermediate calculation. Just press it at the end.

Calculate $\frac{65 + 12}{3.5}$.

Keys:	Display:	Description:
65 [+] 12 [÷] 3.5 [=]	22.00	Operations occur in the order you key them in.

Now use the parentheses keys to calculate $65 + \frac{12}{3.5}$.

65 [+] [(] 12 [÷] 3.5 [)] [=]	68.43	Parentheses dictate the order of calculation.

The Six HP-14B Menus

Six keys on the HP-14B bring menus into the display. A menu is a group of two or more labels shown in the display with pointers indicating the keys that activate them.

The six menu keys are:

[STAT] Leads you to the powerful statistics capabilities of the HP-14B. (Refer to page 107)

[FRCST] Automatically fits your two-variable statistical data to the best available model and allows you to forecast values based on that fit. (Refer to page 113.)

[CLEAR] Allows you to clear parts of the HP-14B memory. (Refer to page 19.)

[DISP] Allows you to select the way you want numbers to be displayed. (Refer to page 24.)

[MATH] Brings up the math functions {e^x}, {LN}, and {n!}. (Refer to page 34.)

[BEG/END] A menu that allows you to select payments at the beginning or end of the period for your TVM calculations. (Refer to page 62.)

HP-14B Applications

The HP-14B offers you a number of *applications* to solve many common business and financial questions. An application is a set of keys that allow you to calculate any one unknown value in a particular problem involving several values. The TVM application is one of the most popular for financial calculations.

The TVM Application

The time value of money application consists of five keys in the top row [N], [I/YR], [PV], [PMT], and [FV]. The TVM application is used for loan and investment calculations with regular even payments or cash-flows. It is a five-value application: if you input any four of the values, you can solve for the fifth.

Example: A Mortgage Payment Calculation. Calculate the payment on a $65,000.00, 30-year mortgage at 9.83% annual interest with monthly payments and monthly compounding.

Keys:	Display:	Description:
12 [P/YR]	P/YR = 12.00	Sets the number of payments per year.
[CLEAR]	TVM RG ALL Σ	Displays the CLEAR menu.
{TVM}	12 P/YR	Clears the TVM application and displays the number of payments per year.
65000 [PV]	PV=65,000.00	Enters the loan amount as Present Value.
9.83 [I/YR]	I/YR=9.83	Enters annual interest rate.

30 [f] [xP/YR]	N=360.00	Enters the number of periods (30 × 12).
[PMT]	PMT=-562.27	Calculates the loan payment.

If you got PMT = −557.70, your HP-14B is in *Begin mode.* Press [f] [BEG/END] {END} [PMT] to get the correct result. For more information on TVM calculations refer to chapter 5.

The TVM application applies to problems with equal, periodic payments. For uneven payments, use the cash-flow list and the [f] [NPV] (net present value) and [f] [IRR%] (internal rate of return) functions. Chapters 4 and 6 describe using these cash-flow functions.

The Percentage Applications

Three common percentage calculations are on your HP-14B in the form of three-value applications. The percentage applications are:

[CST], [PRC], [MAR]	Cost, price, and margin.
[f] [OLD], [f] [NEW], [f] [%CHG]	Old, new, and percent change (which can also be used for markup calculations).
[f] [TOTAL], [f] [PART], [f] [%TOTAL]	Total, part, and percent total.

If you know any two of the values, you can solve for the third.

Example: A %TOTAL Calculation. 75 is what percent of 90?

Keys:	**Display:**	**Description:**
75 [f] [PART]	PART=75.00	Enters the *PART.*
90 [f] [TOTAL]	TOTL=90.00	Enters the *TOTAL.*
[f] [%TOTAL]	%TOTL=83.33	Calculates the *%TOTAL.*

The Business Applications

Three business applications are included in your HP-14B:

[ROI%]	Return on investment.
[B.EVEN]	Break even analysis.
[INVEN]	Inventory turnover.

More description of the Business and Percentage applications is given in chapter 3.

The Interest Rate Conversion Application

Sometimes, to arrive at a solution to a financial problem, it is necessary to convert an interest rate that applies to one compounding period to an equivalent interest rate that applies to another compounding period. The Interest Conversion application allows you to quickly make these type of conversions. It is made up of the following keys.

[NOM%]	Nominal percent.
[EFF%]	Effective annual percent.
[P]	Number of periods in a year.

Examples of using the Interest Conversion application are included in chapter 5.

Controlling the Display Format

Pressing [DISP] brings up a menu that allows you to control the number of displayed decimal places and allows you to choose a period or a comma as the decimal point.

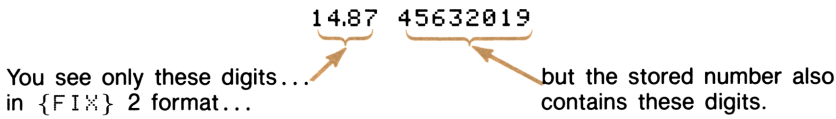
Decimal Places

As a financial calculator owner, it is likely you will want to see most of your numbers displayed with just two decimal places (for dollars and cents). But if you wish to change the display format, either:

- Press [DISP] {FIX} followed by the number of decimal places to display. If you wish to display 10 or 11 decimal places, follow {FIX} with .0 or .1, respectively.
- Press [DISP] {ALL} to see all the decimal places except trailing zeros.

Internal Precision

Changing the number of displayed decimal places affects what you see but does not affect the stored number. The number stored in the calculator always has 12 digits.



Temporarily SHOWing All ([SHOW])

To temporarily see all 12 digits of a number, press [SHOW]. This shows you all 12 digits in the stored number (including trailing zeros) for as long as you hold down the [SHOW] key.

Also, if a label and result to a calculation are too long to fit in the display, the label is flashed for a moment, then the result is displayed. To view the label again, press [SHOW].

Starting with two displayed decimal places:

Keys:	Display:	Description:
45 ÷ 8 =	5.63	Displays two decimal places of the result.
DISP {FIX} 4	5.6250	Displays four decimal places.
DISP {ALL}	5.625	Displays all digits except trailing zeros.
SHOW (hold)	5.62500000000	Displays all digits for as long as you hold down the SHOW key.
DISP {FIX} 2	5.63	Fixes the display to two decimal places.

Notice above that when two decimal places are displayed, the number is rounded. This rounding does not affect the way the number is stored in the calculator; it only affects the displayed version of the number.

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 DISP to display the DISP menu.
2. Press {.} or {,} to specify the decimal point that you prefer. Outside the U.S.A. the preference is generally for a comma as the decimal point (for example 5.000.000,00). In the U.S.A. the preference is generally for a period as a decimal point (for example 5,000,000.00).

Scientific Notation [gold] [E]

Scientific notation is used to represent numbers that are too large or too small to fit in the display. For example, if you key in the number 10,000,000 × 10,000,000 [=], the result is 1.00E14, which means "one times ten to the fourteenth power" or "1.00 with the decimal point moved fourteen places to the right." You can key this number in by pressing 1 [gold] [E] 14. The E stands for "exponent of ten."

Exponents can also be negative for very small numbers. The number 0.000000000004 would be displayed by the HP-14B as `4.00E-12`, which means "four times ten to the *negative* twelfth power" or "4.0 with the decimal point moved 12 places to the left." You can key this number in by pressing 1 [gold] [E] [+/-] 12.

Messages in the Display

Sometimes the HP-14B cannot do what you "ask," such as when you press the wrong key or neglect to supply a number for a calculation. To help you correct the situation, the calculator displays a message.

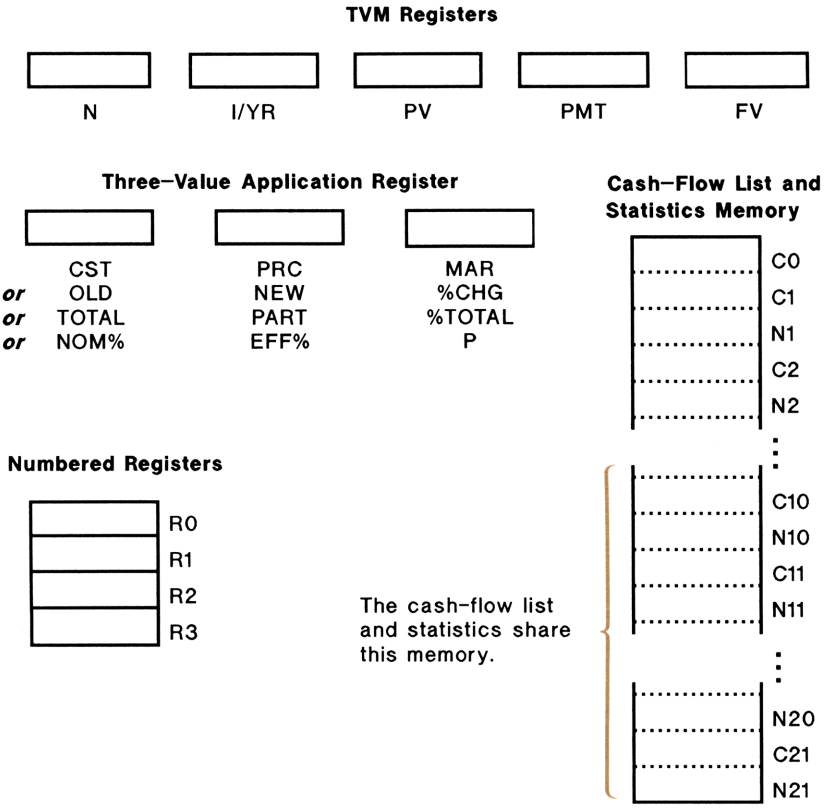
- Press [←] or [C] to clear the message.
- Press any other key to clear the message *and* perform the function of that key.

For more information, refer to the list of displayed messages just before the function index.

Using Calculator Memory

How to Picture Memory

The memory that you use in the HP-14B consists of 12 memory registers and a cash-flow list for storing numbers. You can picture memory in the following fashion.



Each register can be pictured as a separate box and the cash-flow list can be pictured as a single unit of memory divided into registers. Each register is labeled with its unique name, and each register can hold one number at a time. If you store a number in a register, you write over the number that was stored there.

Notice that the three-value business and percentage calculations all share the same three registers. Also notice that the cash-flow list shares memory with statistics. The details of how this memory is shared are described in chapters 6 and 7.

Storing and Recalling Numbers

The [STO] key copies a number from the display to the designated register. To store a number into any register, key in the number, press the [STO] key, then press a key to name the register. For example, to store a 12 in R3, key in 12 [STO] 3. To store a 7 in register *I/YR*, you can key in 7 [STO] [I/YR]. However, with all registers except the numbered registers, you don't need to use the [STO] key; you can just key in 7 [I/YR]. (Also refer to the section "HP-14B Applications" in this chapter.)

Likewise, to recall a number from a register, use the [RCL] key. When you recall a number from a register, the number is copied into the display. The contents of the register don't change. For example, to recall that 12 from register 3, press [RCL] 3. To recall that 7 from *I/YR*, press [RCL] [I/YR].

The [STO] and [RCL] keys are used only with registers. Using the cash-flow list is described in chapter 6.

2

Arithmetic Calculations

Labeled Results in the Display

Whenever a number is shown in the display, you can use that number in your calculations by simply pressing the operator or function key that you wish to use. Sometimes the display contains results that are labeled, such as PMT=160.75. Even in this case, you can use the number for a calculation. For example, pressing [÷] 3 [=] would calculate 160.75 ÷ 3 and the HP-14B would display the answer, 53.58.

Simple Arithmetic

Simple calculating was introduced in chapter 1. 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 example, to calculate $\frac{750 \times 12}{360}$ you can key in either:

750 [×] 12 [=] [÷] 360 [=]

or

750 [×] 12 [÷] 360 [=].

In the second case, the [÷] key acts like the [=] key by displaying the result of 750 × 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 × 68 ÷ 1.9.

Intermediate results are calculated whenever you press the next operation key. Observe the display as you key in this calculation:

Keys:	**Display:**
456 [−] 75 [÷]	381.00÷
18.5 [×]	20.59×
68 [÷]	1,400.43÷
1.9 [=]	737.07

Using [SHIFT] [SWAP] with [−] and [÷]

When you want to subtract the number in the display from some other number or divide some other number by the number in the display, you can use the [SHIFT] [SWAP] key to reverse the order of the numbers in the calculation.

For example, after completing the previous example chain calculation, to subtract 737.07 from 1000, press [−] 1000 [SHIFT] [SWAP] [=]. To divide 1000 by the resulting 262.93, press [÷] 1000 [SHIFT] [SWAP] [=]. The final result is 3.80.

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 [−]	85.00-	No calculation has taken place so far.
12 [)]	÷73.00	Calculates 85 − 12.
[×]	0.41×	Calculates 30 ÷ 73.
9 [=]	3.70	Calculates 0.41 × 9.00.

The Percent Key [%]

The [%] key has two functions:

Finding a Percentage

In most cases, [%] 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 example, 25 [%] results in 0.25.

To find 25% of 200, press 200 [×] 25 [%] [=]. (Result is 50.00.)

Adding or Subtracting a Percentage

You can add or subtract a percentage in one calculation:

For example, to decrease 200 by 25%, just enter 200 [−] 25 [%] [=]. (Result is 150.00.)

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

Keys:	Display:	Description:
1250 [+] 7 [%]	+87.50	Interest on the loan is $87.50
[=]	1,337.50	You must repay this amount at the end of one year.

The Mathematics Functions

Some of the math functions appear on the keyboard; others are in the menu that comes up when you press [MATH]. Math functions act on the last number in the display.

The Math Keys [x^2], [$\sqrt{x}$], and [1/x]

Example: Calculate ¼, then calculate $(\sqrt{20} + 47.2) \times 1.1^2$.

Keys:	Display:	Description:
4 [1/x]	0.25	Calculates the reciprocal of 4.
20 [$\sqrt{x}$]	4.47	Calculates $\sqrt{20}$.
[+] 47.2 [×]	51.67×	Calculates 4.47 + 47.20.
1.1 [x^2]	×1.21	Calculates 1.1^2.
[=]	62.52	Completes the calculation.

The Power Operator (y^x)

The power operator, 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 1/x =	5.00	Calculates the cube root of 125, which is the same as $125^{1/3}$.

The MATH Menu Key

When you press the MATH key, a menu containing the three functions {e^x}, {LN}, and {n!} is displayed. Like the other mathematical functions, these functions operate on only the last number in the display.

Keys:	Display:	Description:
2.5 MATH {e^x}	12.18	Calculates $e^{2.5}$.
MATH {LN}	2.50	Calculates the natural logarithm of 12.18.
790 + 4 MATH {n!}	+24.00	Computes 4 factorial.
=	+814.00	Completes calculation.

You can access the MATH menu from any application.

Rounding Numbers RND

As described in the section "Internal Precision" in chapter 1, the calculator always stores and calculates with 12 digit numbers. There are times in real world calculations when 12 digit accuracy is not desirable. The RND key is used to round a number to the displayed format before using it in a calculation.

Keys:	Display:	Description:
9.87654321	9.87654321	Enters a number with more than two non-zero decimal places.
[DISP] {FIX} 2	9.88	Displays just two decimal places.
[SHOW]	9.87654321000	Displays all decimal places. Display rounding did not affect stored number.
[RND]	9.88	Rounds to two decimal places.
[SHOW]	9.88000000000	Shows that the RND function rounded the stored number.

The [LAST] Key

On the HP-14B, beginning a new calculation does not mean that the result to the previous calculation is gone for good. The [LAST] key can be used to recall the previous result and, if you wish, to use it in your current calculation. Starting a new operation stores the displayed result in *LAST.*

Example: Using the [LAST] Key. Calculate

$$(6 + 5 + 7) \times \frac{9}{2}$$

then divide 729 by the result.

Keys:	Display:	Description:
6 [+] 5 [+] 7 [×]	18.00×	Calculates the sum.
[(] 9 [÷] 2 [=]	81.00	Completes the first calculation.
729 [÷] [LAST] [=]	9.00	Divides 729 by the retrieved result.

Using Stored Numbers in Calculations

The [STO] key is used to copy the last number in the display to a register. The [RCL] key is used to copy a number from a register into the display.

To store or recall a number:

1. Press [STO] or [RCL]. (To cancel this step, press [◄] or [C].)
2. Key in the register number (0 through 3) or press the key to specify the register.

In the following example, two storage registers are used while doing the following two calculations that share 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	STO R1	Temporarily displays register name.
	475.60	475.6 is stored in register 1.
[÷] 39.15 [STO] 2	÷39.15	Stores 39.15 (the last number in the display) into register 2.
[=]	12.15	Completes calculation.

560.1 [+] [RCL] 1	+475.60	Recalls the contents of register 1.
[÷] [RCL] 2	÷39.15	Recalls register 2.
[=]	26.45	Completes calculation.

The [STO] and [RCL] keys can also be used with the application registers. For example, [STO] [I/YR] stores the last number in the display into the register *I/YR*. [RCL] [I/YR] copies the contents of *I/YR* into the display. If there is a calculation in progress (so the display shows, for example +475.6), the recalled number replaces the displayed number in the calculation.

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

Doing Arithmetic Inside Registers

You can also do arithmetic inside storage registers.

Keys:	**Display:**	**Description:**
45.7 [STO] 3	45.70	Stores 45.7 in register 3.
2.5 [STO] [×] 3	2.50	Multiplies the 45.7 in register 3 by 2.5 and stores the result (114.25) in register 3.
[RCL] 3	114.25	Displays register 3.

	Arithmetic in Registers
STO +	old register contents + displayed number
STO −	old register contents − displayed number
STO ×	old register contents × displayed number
STO ÷	old register contents ÷ displayed number

You can also do arithmetic with the values stored in application registers. For example, 2 STO × CST multiplies the current contents of the *CST* register by 2 and stores the result back in *CST*.

3

General Business Calculations

Percentage Applications

The HP-14B has three percentage applications to solve your common business percentage problems. Each percentage application consists of three keys on the calculator. You can solve for any one of the three values that the keys represent if you know the other two values. The three are:

Application	Description
Margin Calculations	The three keys [CST] (Cost), [PRC] (Price), and [MAR] (Margin) allow you to do margin percentage calculations. The margin is the markup expressed as a percentage of the price.
Percent Change	The three keys [OLD], [NEW], and [%CHG] allow you to do percent change calculations. This application is also useful for doing markup on cost calculations.
Percent of Total	The three keys [TOTAL], [PART], and [%TOTAL] allow you to do percent of total calculations.

The three business percentage applications share the same three storage registers:

	CST	PRC	MAR
or	OLD	NEW	%CHG
or	TOTAL	PART	%TOTAL

The calculator retains the values stored in the three application registers until you change them or clear them by pressing [CLEAR] {RG}. However, because the three percentage applications share the same three storage registers, the data for one percentage application is not preserved if you use another percentage application.

To see any value used by the business percentage applications, simply press [RCL] and then the key you are interested in. For example, to see the value stored as *MAR*, press [RCL] [MAR].

Margin Calculations

Example. Kilowatt Electronics purchases televisions for $255. The televisions are sold for $300. What is the *margin?* (Margin is the markup of the cost as a percent of the selling price)?

Keys:	Display:	Description:
255 [CST]	CST=255.00	Stores the cost in *CST*.
300 [PRC]	PRC=300.00	Stores the selling price in *PRC*.
[MAR]	MAR=15.00	Calculates the margin.

Percent Change (or Markup) Calculations

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:
90000 [OLD]	OLD=90,000.00	Stores last years sales in *OLD*.
95000 [NEW]	NEW=95,000.00	Stores this years sales in *NEW*.
[%CHG]	%CHG=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 *%CHG* and ask for *NEW*.

12 [%CHG]	%CHG=12.00	Stores 12 in *%CHG*.
[NEW]	NEW=100,800.00	Calculates the sales projected for this year.

Markup on Cost Calculations

Example: Markup as a Percent of Cost. The standard *markup* on costume jewelry at Kleiner's Kosmetique is 60%. They just received a shipment of chokers costing $19.00 each. What is the retail price per choker?

Keys:	Display:	Description:
19 [OLD]	OLD=19.00	Stores the cost in *OLD*.
60 [%CHG]	%CHG=60.00	Stores the markup in *%CHG*.
[NEW]	NEW=30.40	Calculates *NEW*, which corresponds to retail price.

Percent of Total Calculations

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

Keys:	Display:	Description:
67584 [TOTAL]	TOTL=67,584.00	Stores assets in *TOTAL*.
23457 [PART]	PART=23,457.00	Stores inventories in *PART*.
[%TOTAL]	%TOTL=34.71	Calculates the percent that *PART* is of *TOTAL* for the percent of total assets.

Sharing Numbers Between Margin and Markup

The percent change (*%CHG*) application can also be used for *markup* calculations, and because the applications all use the same three registers, you can easily move numbers from one application to another.

Example. 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*, for what price should it sell a case of soup?

Keys:	Display:	Description:
9.6 [OLD]	OLD=9.60	Stores invoice cost in *OLD*.
15 [%CHG]	%CHG=15.00	Stores markup in *%CHG*.
[NEW]	NEW=11.04	Calculates *NEW*, which is the price on the case of soup.

What is the *margin* (or markup as a percent of price)? *OLD* and *NEW* now become *CST* and *PRC* (they both use the same registers), so you don't need to re-store those values. All you need to do is press [MAR] twice to calculate a result.

MAR MAR	MAR=13.04	Computes the *margin*.

The first time you press MAR, the HP-14B assumes you want to store the 11.04 that's in the display. The second time you press MAR, the HP-14B knows you want to calculate.

Business Applications

The three business applications on the HP-14B are as follows:

Business Applications

Key	Description
ROI%	Allows you to perform a return on investment analysis. The analysis consists of four values: Revenue (*REV*), Profit (*PROF%*), Capital Investment (*INVS*), and return on investment (*ROI%*). You can compute any one of these values given the other three.
B.EVEN	Allows you to perform a break even analysis. The analysis consists of five values: Number Sold (*#SLD*), Price (*PRC*), Fixed Costs (*FIXC*), Variable Costs (*VARC*), and Profit (*PROF*). You can compute any one of these values given the other four.
INVEN	Allows you to perform a stockturn or inventory turnover rate analysis. The analysis consists of four values: Beginning Inventory (*BEGI*), Ending Inventory (*ENDI*), Dollar Amount Sold (*SOLD*), and Inventory Turnover Rate (*INVEN*). You can compute any one of these values given the other three.

When you press any of these three business application keys, you are shown one label in a list of the four or five values involved in the application. Use the ▼ and ▲ keys to move through the list. To do an analysis, follow these two simple steps:

1. When you know the value of the label showing in the display, key in the known number and press INPUT.
2. When you have input all the known values, use the ▼ or ▲ key to move the one unknown label into the display and press COMPUTE.

Return On Investment

One way of evaluating a new investment is through a simple return on investment (*ROI*) analysis. Return on investment is the ratio of net profit after taxes to the assets used to make the net profit.

Example: Part 1. A new department in your store requires $4,800 in new assets. The anticipated revenues the first year are $10,000. Your net profit goal is 10%. Assuming the net profit goal is met, calculate the return on investment.

Keys:	Display:	Description:
ROI%	REV?0.00	Enters the *ROI%* application. The first value requested is revenue.
10000 INPUT	REV=10,000.00	Enters 10,000 as expected revenue. This display remains until you release the INPUT key.
	PROF%?0.00	Prompts for profit.
10 INPUT	INVS?0.00	Enters 10% as profit. The next value requested is capital investment.
4800 INPUT	ROI%?0.00	Enters 4,800 as capital investment. The next value requested is return on investment.
COMPUTE	ROI%=20.83	Calculates return on investment.

Part 2. The department sales are actually $7,500 in the first year. Calculate the *ROI%*.

[ROI%]	REV?10,000.00	Re-enters the *ROI%* application. The first value requested is revenue, which you want to change.
7500 [INPUT]	PROF%?10.00	All of the rest of the values don't need to be changed.
[▼] [▼]	ROI%?20.83	Moves the *ROI%* value into the display.
[COMPUTE]	ROI%=15.63	Calculates return on investment based on the other three values.

Part 3. At the level of revenues in part 2, what total investment can you sustain to achieve an *ROI%* of 18%?

[ROI%]	REV?7,500.00	Re-enters the *ROI%* application.
[▲]	ROI%?15.63	Moves the old *ROI%* value into the display.
18 [INPUT]	REV?7,500.00	Inputs the new value for *ROI%*.
[▼] [▼]	INVS?4,800.00	Moves the old *INVS* value into the display.
[COMPUTE]	INVS=4,166.67	Calculates capital investment based on the other three values.

Break-Even Analysis

Break-even analysis (*B.EVEN*) is a technique for analyzing the relationships among fixed costs, variable costs, and income. Until the break-even point is reached (total costs equal total income), you operate at a loss. After the break-even point, each unit sold makes a profit.

Example: Part 1. Your product sells for $13. The fixed costs are $12,000. Variable costs are $6.75 per unit. Calculate the number of units that must be sold to break-even (profit equals zero).

Keys:	Display:	Description:
[B.EVEN]	#SLD?0.00	Enters the *B.EVEN* application. The first value requested is number sold, which is what you want to calculate.
[▼]	PRC?0.00	Moves to the next value in the list, which is price.
13 [INPUT]	FIXC?0.00	Enters 13.00 as the price. The next value requested is fixed costs.
12000 [INPUT]	VARC?0.00	Enters 12,000 as fixed costs. Variable costs is requested next.
6.75 [INPUT]	PROF?0.00	Enters 6.75 as the variable costs per unit. The next value requested is profit.

INPUT	#SLD?0.00	Enters 0.00 as the profit (the break-even point). The next value requested is number sold, which is what you want to compute.
COMPUTE	#SLD=1,920.00	You have to sell 1,920 units to break even.

Part 2. Calculate the gross profit if 2,500 units are sold.

B.EVEN	#SLD?1,920.00	Re-enters the *B.EVEN* application. The first value in the list is the number sold, which you want to change.
2500 INPUT	PRC?13.00	Enters 2,500 as the number of units sold. The HP-14B moves down the list.
▼ ▼ ▼	PROF?0.00	Displays the *PROF* label.
COMPUTE	PROF=3,625.00	Calculates profit based on the other stored values.

Part 3. You want a gross profit of $4,500 at the sales volume in part 2 (2,500 units). What should be the selling price?

B.EVEN	#SLD?2,500.00	Re-enters the *B.EVEN* application. The first value in the list is the number sold.
▲	PROF?3,625.00	Moves *PROF* (profit) into the display.

4500 INPUT	#SLD?2,500.00	Enters 4,500 as the profit. The HP-14B moves down the list to *#SLD*, which you don't want to change.
▼	PRC?13.00	Displays the old price.
COMPUTE	PRC=13.35	Calculates a new price that compensates for the increase you desire in profits.

Inventory Turnover

The stockturn or inventory turnover rate (*INVEN*) is a measure of the number of times the average inventory is sold in a year. The data needed to compute the inventory turnover rate are beginning and ending inventory in cost dollars and the cost of the goods sold, or the beginning and ending inventory in retail dollars and the retail dollars sold.

Example: Part 1. Last year the cost of the goods that were sold at your business was $30,000, beginning inventory was $8,000, and ending inventory was $7,000. Calculate the stockturn rate.

Keys:	Display:	Description:
INVEN	BEGI?0.00	Enters the *INVEN* application. The first value requested is beginning inventory.
8000 INPUT	ENDI?0.00	Enters 8,000 as beginning inventory. The next value requested is ending inventory.
7000 INPUT	SOLD?0.00	Enters 7,000 as the ending inventory. The next value requested is cost of goods sold.

30000 INPUT	INVEN?0.00	Enters 30,000 as cost of goods sold. Now compute inventory turnover.
COMPUTE	INVEN=4.00	Calculates the inventory turnover rate.

Part 2. Suppose you prefer that inventory with a limited shelf life turn every two months (six times a year). How would this change your ending inventory?

Keys:	**Display:**	**Description:**
INVEN	BEGI?8,000.00	Re-enters the *INVEN* application.
▲	INVEN?4.00	Moves the old *INVEN* rate into the display.
6 INPUT	BEGI?8,000.00	Enters the new *INVEN* rate.
▼	ENDI?7,000.00	Moves to the *ENDI* value.
COMPUTE	ENDI=2,000.00	Calculates the ending inventory.

4

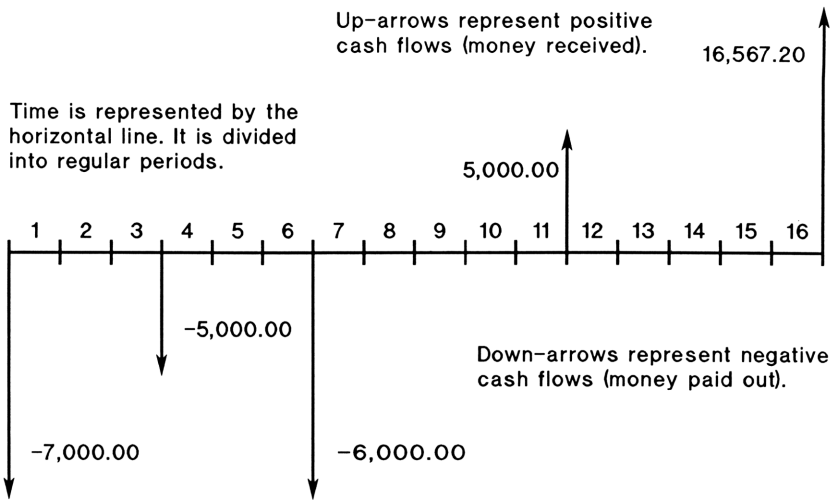
Cash-Flow Diagrams

How to Approach a Financial Problem

The financial vocabulary of the HP-14B is simplified so it can be applied to all financial fields. Every financial field has developed its own terminology for values that, as far as the calculator is concerned, are one and the same. For example, your particular financial field may use the term *balance*, or *balloon payment*, or *residual*, or *maturity value*, or *remaining amount* for a value that the HP-14B knows only as *FV* (future value).

The simplified terminology of the HP-14B is based on the cash-flow diagram. The cash-flow diagram is a picture of a financial problem sketched out over time. Drawing a cash-flow diagram is usually the best first step to solving any financial problem.

The following cash-flow diagram represents investments in a mutual fund account over 16 months. The original investment was $7000.00, $5000.00 was invested at the end of the third month, and $6000.00 at the end of the sixth month. At the end of the 11th month, $5000.00 was withdrawn and the account was closed at the end of the 16th month with a withdrawal of $16,567.20.

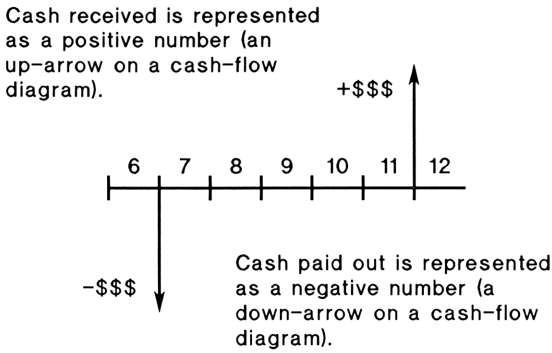


Any cash-flow scenario can be represented on a cash-flow diagram. By drawing a cash-flow diagram for a financial problem, you clarify the problem. The process of drawing the cash-flow diagram helps you to identify what is known and what is unknown about the cash-flow events that take place every period throughout the problem.

Time is represented by the horizontal line on a cash-flow diagram. The horizontal line is divided into regular periods. Cash flows are placed between periods according to when they occur. Where no arrows are drawn, the cash-flow equals zero.

The Signs of Cash Flows

In the previous cash-flow diagram, money invested is shown as being negative and money withdrawn is shown as positive. The arrows representing cash flow amounts are pointing down for negative values and up for positive values. Negative values are preceded by a negative sign. This leads to an important convention in financial calculations on the HP-14B.



As shown in the previous figure, the sign of a cash flow (positive or negative) indicates the direction of the cash flow. Cash flowing *out* is *negative*, cash flowing *in* is *positive*. For example, when a lender loans money, those cash flows are represented as negative cash flows. Likewise, when a lender receives money, those cash flows are represented as positive cash flows. In contrast, from the perspective of a borrower, cash borrowed is positive while cash paid back is negative.

Because of this sign convention, the [+/-] key is used frequently to change the sign of numbers that represent cash-flows in financial calculations.

Periods and Cash Flows

Once you know about the sign convention of the cash-flow diagram, there are three other things you need to be aware of:

1. The length of the period on the cash-flow diagram is always constant. The most common period is the month, but daily, quarterly, and annual periods are also common. The period is normally defined in the contract, and it must be a known value before you can begin calculating.
2. In order to solve a financial problem directly, cash flows can only occur at the beginning or at the end of a period.

3. If more than one cash flow occurs at exactly the same place on the cash-flow diagram, they are generally added together before being input to the calculator. For example, a cash flow of $-250.00 and a cash flow of $750.00 occurring at the same place on the cash flow diagram would be keyed in as a $500.00 cash flow (750 − 250 = 500).
4. To have a valid financial transaction, you must have at least one positive cash-flow and one negative cash-flow.

Simple and Compound Interest

Financial calculations are based on the fact that money earns interest over time. There are two types of interest: simple interest and compound interest. Compound interest is more common and is the basis for TVM and Cash-Flow calculations, but compound interest is actually just an extension of simple interest.

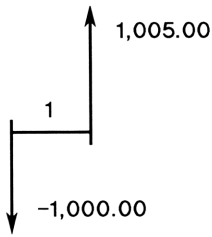
Simple Interest

In simple-interest contracts, the amount of interest is a percent of the original principal, and it is usually due at the end of the contract (along with the principal). As an example of a simple interest contract, say you loan $500 to a friend for a year, and you want to be repaid with 10% simple interest. At the end of the year, your friend owes you $550.00 (50 is 10% of 500). Simple interest calculations can be done in your head or using the [%] key on your HP-14B. An example of a simple interest calculation is shown in the section on the [%] key in chapter 2.

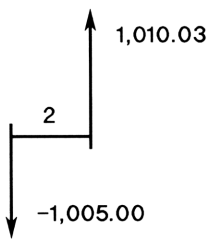
Compound Interest

A compound-interest contract is like a series of simple-interest contracts connected together. The length of each simple-interest contract is equal to one compounding period, and the interest earned on each simple-interest contract is added to the principal at the end of each period.

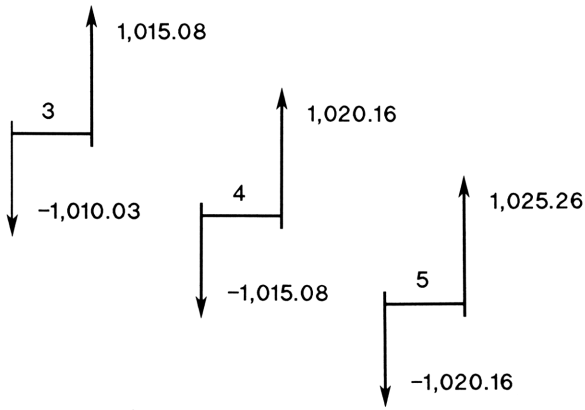
For example, if you deposit $1,000.00 into a savings account that pays 6% annual interest compounded monthly, your earnings for the first month look exactly like a simple-interest contract written for 1 month at 1/2% (6% ÷ 12) simple interest. The balance of the account at the end of the first month is $1,005.00 because 5 is ½% of 1,000:



At the end of the period (1 month), the interest is added to the principal. The second month, the same process takes place on this new balance of $1005.00. The amount of interest paid at the end of the second month is ½% of $1,005.00 or $5.03.



This compounding process continues for the third, fourth, and fifth months as shown in the following cash-flow diagrams:



The word *compound* in compound interest comes from the fact that interest previously earned is added to the principal so it can earn more interest. The financial calculation capabilities on the HP-14B are based on compound interest.

Interest Rates

When you are approaching a financial problem, it is important to recognize that the interest rate or rate of return can be described in at least three different ways:

1. As a periodic rate. This is the rate that is applied to your money from period to period.
2. As a nominal annual rate. This is the periodic rate multiplied by the number of periods in a year.
3. As an effective annual rate. This is an annual rate that considers compounding.

In the previous example of the $1,000.00 savings account, the periodic rate is ½% (per month), but this periodic rate would usually be quoted as a nominal annual rate, which is 6% (½ × 12). This same periodic rate could be quoted as an effective annual rate, which considers compounding. The balance after 12 months of compounding would be $1,061.68, which means the effective annual interest rate is 6.168%.

Examples of converting between nominal and effective annual rates are on pages 81 through 84.

Two Types of Financial Problems

The financial problems in this manual use compound interest unless specifically stated as simple interest calculations. Financial problems can be divided into two groups:

TVM Problems

The cash-flow diagrams of TVM problems have a steady stream of regular, constant cash flows between the first and last periods. Every cash flow in that stream is of the same amount and that amount is referred to as the *PMT* (payment) by the HP-14B. Financial problems of this type are solved using the time value of money (TVM) keys [N], [I/YR], [PV], [PMT], and [FV].

Cash-Flow Problems

The cash-flow diagrams of cash-flow problems generally do not have a steady stream of constant cash flows between the first and last periods. Cash-flow problems are more general than TVM problems. Any financial problem can fit into this group, even TVM problems.

As long as a cash-flow diagram conforms to the rules stated in the section "Periods and Cash Flows," earlier in this chapter, it can be solved as a cash-flow problem. Cash-flow problems are solved using a cash-flow list and the [NPV] and [IRR%] keys.

Recognizing a TVM Problem

If a steady stream of constant cash flows occurs between the first and last periods on the cash-flow diagram, the financial problem is a "TVM" (time value of money) problem. The main keys on the HP-14B that are used to solve a TVM problem are:

[N] Number of periods.

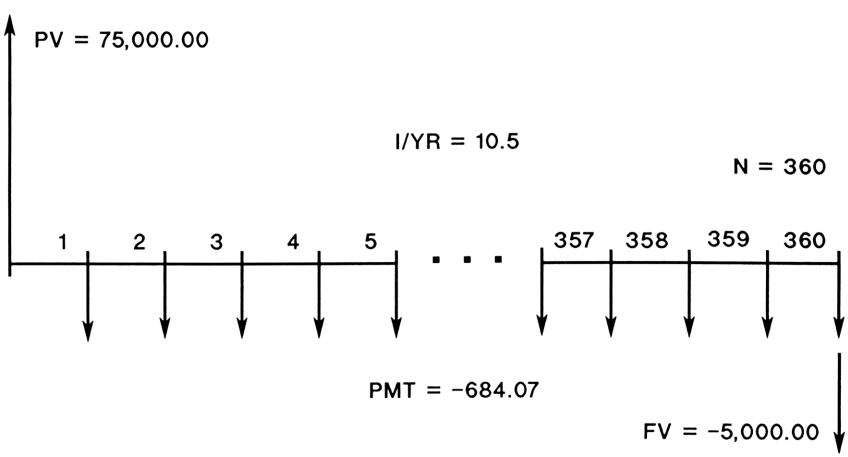
[I/YR] Annual percentage interest rate.

[PV] Present value. This is the cash flow at the beginning of the time-line.

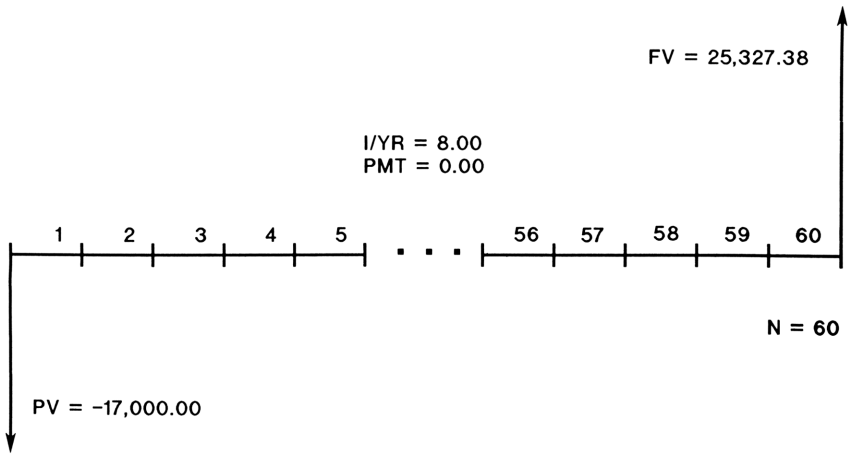
[PMT] Payment.

[FV] Future value. This is the cash flow at the end of the cash-flow diagram, above and beyond any regular payment that occurs there.

Any of the above values can be calculated once you key in the other four. The cash-flow diagrams of loans, mortgages, leases, savings accounts, or any contract with regular cash flows of the same amount normally are treated as TVM problems. An example of a cash-flow diagram of a TVM problem would be the following diagram of a 30-year, $75,000.00 mortgage, at 10.5% annual interest, with a $5,000 balloon payment.



One of the values *PV*, *PMT*, or *FV* can be zero in the solution. An example cash-flow diagram of a savings account with a single deposit and a single withdrawal five years later is shown below. Interest is compounded monthly. This is an example of a TVM problem where *PMT* is zero.

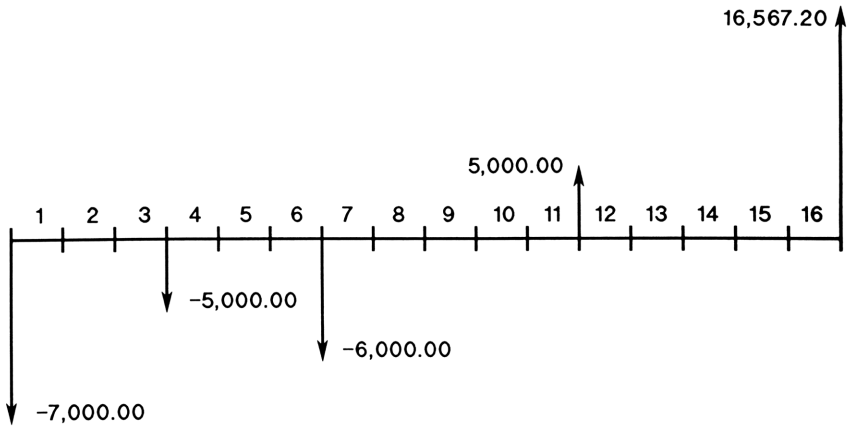


Time value of money calculations are described in the next chapter.

Recognizing a Cash-Flow Problem

If the cash-flow diagram you draw for a financial problem does not have a series of regular, constant payments between the first and last periods, it is a cash-flow problem rather than a TVM problem. TVM problems are a subset of cash-flow problems.

The previous cash-flow diagram of the investment in a mutual fund is shown below.



This is an example of a problem that you would solve using either the NPV (Net Present Value) or IRR% (Internal Rate of Return) keys. Most likely, you would be interested in the *IRR%*, which would tell you the periodic (monthly) yield on the fund. Cash-flow calculations are described in chapter 6.

An example of calculating yield on an investment like that shown above is on page 87.

5

Time Value of Money Calculations

How to Use the TVM Application

The time value of money (TVM) application is used for compound interest calculations that involve a series of regular, constant cash flows (called payments) between the first and last periods. To use the TVM application for a financial calculation, the following requirements need to be met:

- The amount of each payment must be the same. If the payment amounts vary, use the [NPV] or [IRR%] keys described on page 86.
- All cash flows in the problem must occur at regular intervals.
- The payment period must coincide with the interest compounding period. (If it does not, the interest rate will have to be converted to match the payment period using the [NOM%], [EFF%], and [P] keys as described on page 81.)

The TVM application is made up of the five keys [N], [I/YR], [PV], [PMT], and [FV] in the top-row of keys on your HP-14B. The TVM application keys (and three other keys used for TVM calculations) are described in the table on the following page:

TVM Keys

Key	Description
[N]	Stores or calculates the total number of payments or compounding periods. (For a 30 year loan with monthly payments, $N = 12 \times 30 = 360$.)
[I/YR]	Stores or calculates the *nominal annual* interest rate as a percentage.
[PV]	Stores or calculates the present value of the series of future cash flows (stored as *PMT* and *FV*). *PV* is usually a loan amount or an initial investment. *PV* always occurs at the beginning of the first period.
[PMT]	Stores or calculates the amount of each periodic payment. All payments are equal, and no payments are skipped. Payments can occur at the beginning or end of each period, see [BEG/END].
[FV]	Stores or calculates the future value, which is either a final cash flow or the compounded value of a series of previous cash flows (stored as *PV* and *PMT*). *FV* always occurs at the end of the last period.
[P/YR]	Stores the number of periods per year. (*P/YR* = 12 for monthly periods. This is the default value.)
[xP/YR]	Optional shortcut for [N]: multiplies the number (or expression) in the display by the value stored in *P/YR* and stores the result in *N*.
[BEG/END]	Sets the HP-14B to Begin mode or End mode. In Begin mode, the BEGIN annunciator comes on in the display.
[AMORT]	Used for calculating an amortization table for a loan or mortgage.

Clearing the TVM Application

To clear all the values in the TVM application, press [CLEAR] {TVM}. This sets the five values [N], [I/YR], [PV], [PMT], and [FV] to zero and displays the current setting for *P/YR*.

Begin and End Modes (BEG/END)

Before you start a TVM calculation, you should identify whether the first payment (*PMT*) occurs at the beginning or end of the first period. If the first payment occurs at the end of the first period, your HP-14B should be set to End mode, and if it occurs at the beginning of the first period, your HP-14B should be set to Begin mode.

To change modes, press BEG/END and select the desired mode from the displayed menu. The **BEGIN** mode annunciator will be displayed when your calculator is in Begin mode.

Mortgages and loans typically require End mode, while leases and savings plans typically require Begin mode. Mortgage payments are typically due at the beginning of the month. However, you usually wait one month before making the first payment so End mode is used. The examples that follow require End mode. For an example of a Begin mode calculation, turn to page 71.

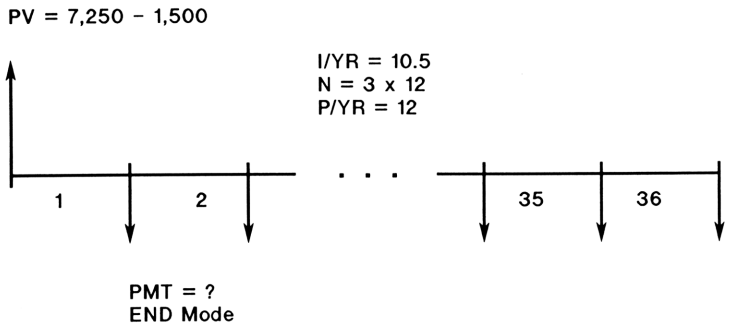
Loan Calculations

The following three examples illustrate common loan calculations. Amortization of loan payments is covered on page 76.

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.

Part 1. What will your monthly payments be at the 10.5% interest rate? (Assume your payments start one month after the purchase or at the *end* of the first period.)

The cash-flow diagram for part 1 looks like this:



Keys:	**Display:**	**Description:**
[BEG/END] {END} 12 [P/YR]	P/YR=12.00	Sets End mode and 12 periods per year.
3 [x] 12 [N]	N=36.00	Stores the number of periods in the loan.
10.5 [I/YR]	I/YR=10.50	Stores the annual interest rate.
7250 [-] 1500 [PV]	PV=5,750.00	Stores the amount borrowed to purchase the car.
0 [FV]	FV=0.00	Stores the amount left to pay after 3 years.
[PMT]	PMT=-186.89	Calculates the monthly payment. The negative sign is explained on page 51.

Notice that the keystrokes 3 [x] 12 [N] in the previous solution can be replaced with 3 [xP/YR]. The longer set of keystrokes was used in this solution to emphasize the fact that the term of the loan in years needs to be multiplied by the periods per year before it is stored as *N*.

Also notice that the keystrokes [BEG/END] {END} are necessary only if the **BEGIN** annunciator is showing in the display, and 12 [P/YR] are necessary only if you have set *P/YR* to equal something other than 12.

Part 2. At the price of $7,250 what interest rate would you have to find to lower your payment by $10.00?

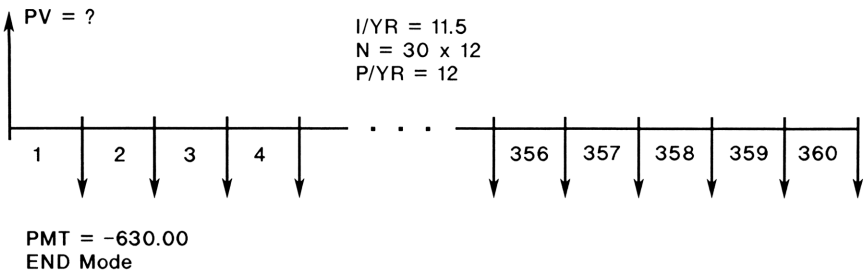
Keys:	**Display:**	**Description:**
[+] 10 [PMT]	PMT=-176.89	Stores the desired payment.
[I/YR]	I/YR=6.75	Calculates the annual interest rate that will give you the reduced payment.

Part 3. At the 10.5% interest rate, what price would you have to get on the car to lower your payment to $175.00?

Keys:	**Display:**	**Description:**
10.5 [I/YR]	I/YR=10.50	Stores the original interest rate.
175 [+/-] [PMT]	PMT=-175.00	Stores your desired payment.
[PV]	PV=5,384.21	Calculates the amount of money you will finance.
[+] 1500 [=]	6,884.21	Adds the down-payment to the amount financed for a total price on the car.

Example: A Home Mortgage. After careful consideration of your personal finances, you've decided that the maximum monthly mortgage payment you can afford is $630.00. You can make a $12,000 down payment, and annual interest rates are currently around 11.5%. If you obtain a 30-year mortgage, what is the maximum purchase price you can afford?

The cash-flow diagram looks like this:

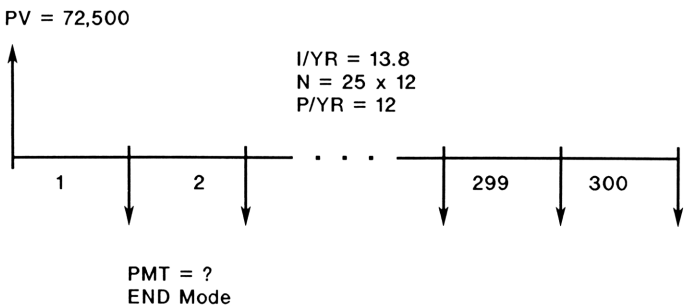


Keys:	**Display:**	**Description:**
[BEG/END] {END} 12 [P/YR]	P/YR=12.00	Sets End mode and 12 periods per year.
30 [xP/YR]	N=360.00	Stores the length of the mortgage (30 × 12).
0 [FV]	FV=0.00	You will completely pay off the mortgage in 30 years.
11.5 [I/YR]	I/YR=11.50	The current annual interest rate is 11.5%.
630 [+/-] [PMT]	PMT=-630.00	Stores your desired payment as a negative value (money paid out is negative).
[PV]	PV=63,617.64	Calculates the loan you can afford with a $630 payment.
[+] 12000 [=]	75,617.64	Adds in the $12,000 down payment to give a total purchase price.

Example: A Mortgage With a Balloon Payment. You've obtained a 25-year, $72,500 mortgage at 13.8% annual interest. You anticipate that you will own the house for four years and then sell it, repaying the loan with a balloon payment. What will be the amount of your balloon payment?

Solve this problem using two steps:

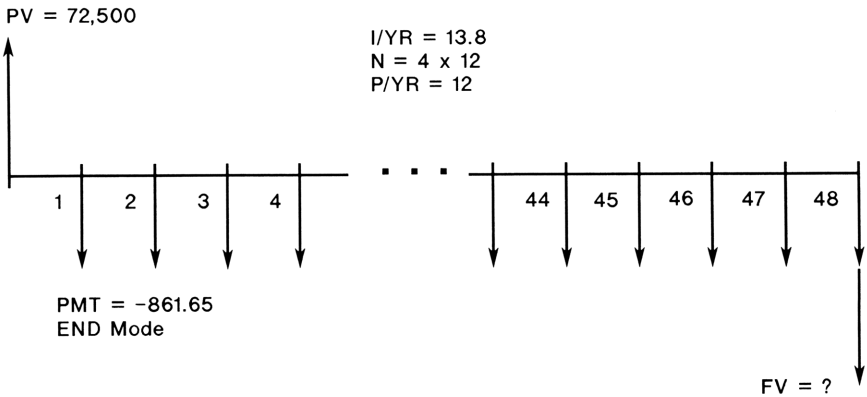
1. Calculate the loan payment using the 25-year term.
2. Calculate the balance left to pay after 4 years.



First calculate the loan payment using the 25-year term.

Keys:	Display:	Description:
[BEG/END] {END} 12 [P/YR]	P/YR=12.00	Sets End mode and 12 periods per year.
25 [xP/YR]	N=300.00	Stores the term of the mortgage (300 months).

0 [FV]	FV=0.00	Stores the balance of the loan after 25 years of payments.
72500 [PV]	PV=72,500.00	Stores the original loan balance.
13.8 [I/YR]	I/YR=13.80	Stores the annual interest rate.
[PMT]	PMT=-861.65	Calculates the mortgage payment.



Notice that with the payments at the end of the month, the final payment and the balloon payment occur at the same time. The total final payment is the sum of *PMT* and *FV*.

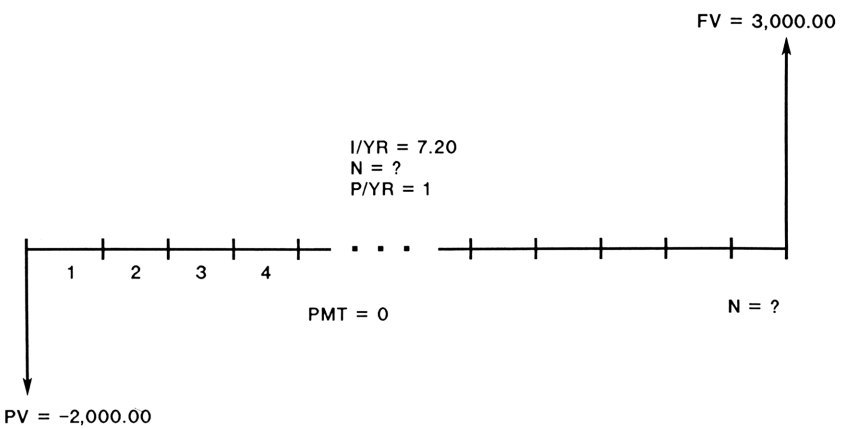
Also, the first keystrokes in the following solution round the payment to dollars and cents. The value in *PMT* should always be rounded to two decimal places when calculating *FV* or *PV* to avoid small, accumulative errors.

RND PMT	PMT=-861.65	Rounds the payment to two decimal places.
48 N	N=48.00	Stores the 4-year term that you expect to own the house.
FV	FV=-70,725.90	Calculates the balance of the loan after 4 years of payments.
+ RCL PMT =	-71,587.55	Calculates the total 48th payment required to pay off 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?

The cash-flow diagram looks like this:



Since this account has no regular payments (*PMT* = 0), the payment mode (End or Begin) is irrelevant. The display in the first line of this solution assumes your *P/YR* is set to 12.

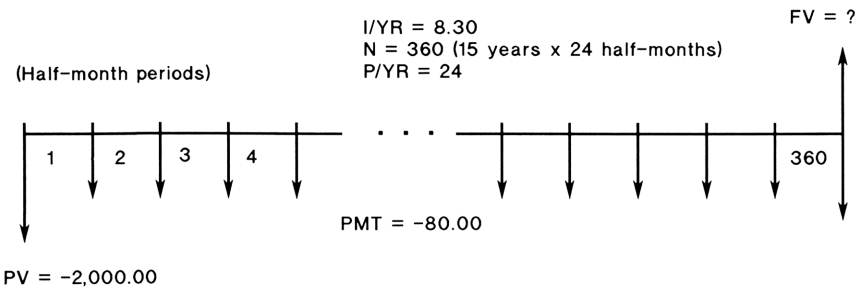
Keys:	**Display:**	**Description:**
[shift] CLEAR {TVM}	12 P/YR	Clears the TVM registers (sets them to zero) and displays *P/YR*.
1 [shift] P/YR	P/YR=1.00	Sets *P/YR* to 1.
2000 +/- PV	PV=-2,000.00	Stores the amount of your first deposit.
3000 FV	FV=3,000.00	Stores the amount you wish the account to grow to.
7.2 I/YR	I/YR=7.20	Stores the annual interest rate on the account.
N	N=5.83	Calculates number of years it will take to reach $3,000.

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 six years can be calculated as follows.

Keys:	**Display:**	**Description:**
6 N	N=6.00	Sets *N* to 6 years.
FV	FV=3,035.28	Calculates the amount you will be able to withdraw after 6 years.

Example: An Individual Retirement Account. You opened an individual retirement account on April 15, 1985, with a deposit of $2,000. Thereafter, you have deposited $80.00 into the account at the end of each half-month. The account pays 8.3% annual interest compounded semimonthly. How much will be in the account on April 15, 2000?

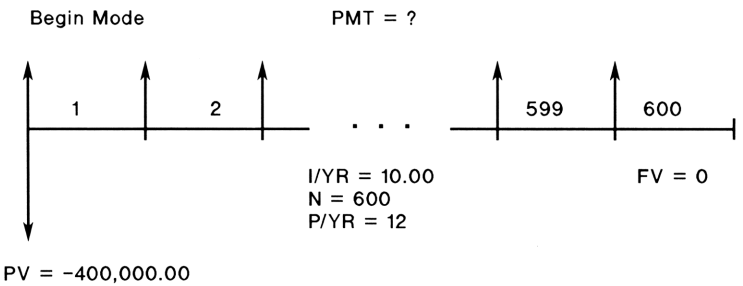
The cash-flow diagram looks like this:



Keys:	Display:	Description:
[BEG/END] {END} 24 [P/YR]	P/YR=24.00	Sets End mode and stores the number of half-months in a year.
2000 [+/-] [PV]	PV=-2,000.00	Stores the amount of your initial deposit.
80 [+/-] [PMT]	PMT=-80.00	Stores the amount of your regular semimonthly deposits.
8.3 [I/YR]	I/YR=8.30	Stores the annual interest rate.
15 [xP/YR]	N=360.00	Stores the number of deposits.
[FV]	FV=63,963.84	Calculates the balance.

Example: An Annuity Account. After a long and prosperous career, you have accumulated a savings of $400,000 that earns an average of 10% annual interest (after taxes), compounded monthly. What annuity can you draw at the first of each month if you wish that savings account to support you for the next 50 years?

The cash-flow diagram looks like this:



Keys:	Display:	Description:
12 [P/YR] [BEG/END] {BEGIN}	P/YR=12.00	Sets 12 payments per year and Begin mode.
400000 [+/-] [PV]	PV=-400,000.00	Stores your nest egg as an outgoing deposit.
10 [I/YR]	I/YR=10.00	Stores the annual interest rate you expect to earn.
50 [xP/YR]	N=600.00	Stores the number of withdrawals.
0 [FV]	FV=0.00	Stores the balance of the account after 50 years of monthly withdrawals.
[PMT]	PMT=3,328.68	Calculates the amount that you can withdraw at the beginning of each month.

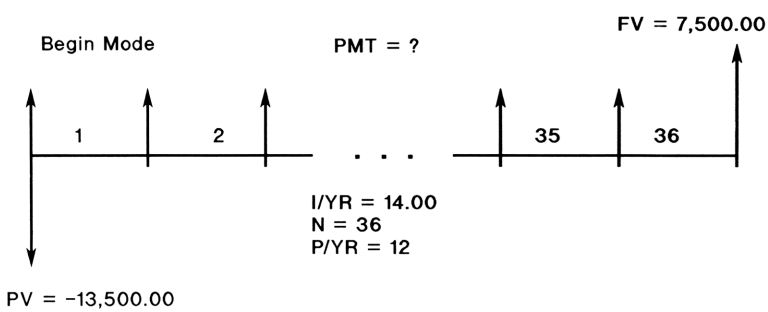
Lease Calculations

A lease is simply a loan of valuable property (real estate, automobiles, or equipment) for a specified amount of time, in exchange for regular payments. Some leases are written as purchase agreements (a form of financing) where the person leasing the property has an option to buy the property at the end of the lease (often for as little as $1.00). The defined future value (*FV*) of the property at the end of a lease is sometimes called the "residual value" or "buy-out value."

All five values available on the TVM application are of interest in lease calculations. However, the two most common lease calculations are finding the lease payment necessary to achieve a specified yield and finding the present value (capitalized value) of a lease.

The first payment in a lease usually occurs at the beginning of the first period. Thus, most lease calculations use Begin mode.

Example: Calculating a Lease Payment. A customer at your car dealership wishes to lease a new car valued at $13,500 for 3 years. The lease includes an option to buy the car for $7,500 at the end of the the lease. The first monthly payment is due the day the customer drives the car off the lot. What will the payments be to yield your leasing company 14% annually (compounded monthly)? Calculate the payments from your (the lessor's) point of view.



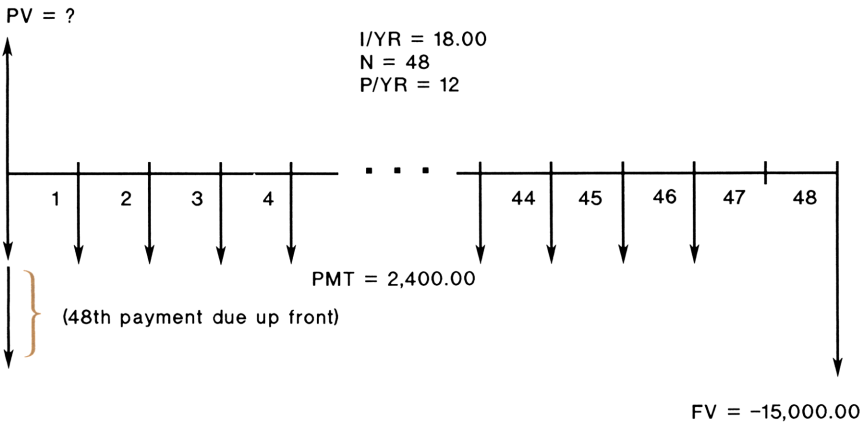
Keys:	Display:	Description:
12 [P/YR] [BEG/END] {BEGIN}	P/YR=12.00	Sets 12 payments per year and Begin mode.
14 [I/YR]	I/YR=14.00	Stores the desired annual yield.
13500 [+/-] [PV]	PV=-13,500.00	Stores the lease price of the car.
7500 [FV]	FV=7,500.00	Stores the residual (buy-out value).
36 [N]	N=36.00	Stores the length of the lease, in months.
[PMT]	PMT=289.19	Calculates the monthly lease payment.

Notice that even if the customer chooses not to buy the car, the lessor still includes a cash-flow coming in at the end of the lease equal to the residual value of the car. Whether the customer buys the car or it is sold on the open market, the lessor expects to recover at least $7,500.

Leases also frequently have more than one payment in advance (some of the payments occurring at the end of the lease may be moved to the front of the lease). The following example demonstrates this type of calculation. Also refer to the example in chapter 8 "Advance Payments (Leasing)."

Example: Capitalized Value: Lease With Advance Payments. Your food processing company is leasing a corn cob stripper. The lease is written for a term of 4 years with monthly payments of $2,400. Payments are due at the beginning of the month, and the first and last payments are due at the onset of the lease. You have an option to buy the machine for $15,000 at the end of the leasing period.

If the annual interest rate you pay to borrow funds is 18%, what is the capitalized value of the lease?



This solution is done in four steps:

1. Calculate the present value of the 47 monthly payments.
2. Add to this the value of the additional advance payment.
3. Find the present value of the buy option.
4. Sum the values calculated in steps 2 and 3.

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

Keys:	**Display:**	**Description:**
12 [P/YR] [BEG/END] {BEGIN}	P/YR=12.00	Sets 12 payments per year and Begin mode.
47 [N]	N=47.00	Stores the number of payments.
2400 [+/−] [PMT]	PMT=-2,400.00	Stores the monthly payment amount.
0 [FV]	FV=0.00	Stores an *FV* of 0 for part 1.
18 [I/YR]	I/YR=18.00	Stores the interest rate.
[PV]	PV=81,735.58	Calculates the present value of the 47 monthly payments.

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

Keys:	Display:	Description:
[+] [RCL] [PMT] [+/-] [=]	84,135.58	Adds in the additional advance payment.
[STO] 0	84,135.58	Stores the result in register 0.

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

Keys:	Display:	Description:
48 [N]	N=48.00	The buy option occurs at the end of the 48th month.
0 [PMT]	PMT=0.00	There is no payment in this part of the solution.
15000 [+/-] [FV]	FV=-15,000.00	You are discounting the last cash flow.
[PV]	PV=7,340.43	Calculates the present value of the last cash flow.

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

Keys:	Display:	Description:
[+] [RCL] 0 [=]	91,476.00	Calculates the present (capitalized) value of the lease.

Amortization (AMORT)

Amortization is the process of dividing a payment into the amount that applies to interest and the amount that applies to principal. The AMORT key on the HP-14B allows you to calculate the following values:

- The loan balance after a certain number of payments are made (*BAL*).
- The amount of a payment or series of payments applied toward interest, including the total interest paid on a loan (*INT*).
- The amount of a payment or series of payments applied toward principal (*PRN*).

The AMORT function assumes you have just calculated a payment or you have stored the appropriate amortization values in *N*, *I/YR*, *PV*, *PMT*, and *P/YR*. Amortization uses these values as follows:

N Once you start an amortization, *N* contains the number of periods amortized so far. It is updated each time you amortize a payment or group of payments.

I/YR Contains the annualized interest rate used in the amortization.

PV Used to keep track of the changing balance (*BAL*) of the loan or investment that is being amortized. It is updated with every amortization. Before amortizing and each time it is updated, *PV* is rounded to the number of decimal places in the current display format (usually two).

PMT Contains the payment amount used in the amortization. The value stored in *PMT* is rounded to the number of decimal places in the current display format.

P/YR Contains the number of payments per year.

The numbers displayed for *INT*, *PRN*, and *BAL* are rounded to the current display setting (see the DISP function).

N must be set to 0 before starting amortization calculations that use Begin mode.

When you first press [AMORT], the HP-14B will display the following:

```
PERIODS?12.00
```

If you have previously changed the number of periods to a number other than 12, that number is displayed. You can choose to amortize the displayed number of payment periods by pressing [INPUT], or you can key in the number of payment periods you wish to amortize and press [INPUT]. [AMORT] remembers the number you input, and it will display that number the next time it prompts you for periods.

Example: An Amortization Schedule. Calculate the first two years of the annual amortization schedule for a 30-year, $80,000 mortgage, at 9.75% annual interest (monthly payments and compounding).

Keys:	**Display:**	**Description:**
[BEG/END] {END} 12 [P/YR]	P/YR=12.00	Sets End mode and 12 payments per year.
30 [xP/YR] 9.75 [I/YR] 80000 [PV] 0 [FV]	FV=0.00	Stores the four known values for the mortgage payment calculation.
[PMT]	PMT=-687.32	Calculates the monthly payment.

Mortgage payment calculations are covered in more detail on page 64. If you already know the mortgage payment, you can key it in and store it just like you store the other four values. Next, amortize the first year as follows.

Keys:	Display:	Description:
[AMORT]	PERIODS?12.00	Displays the current setting for number of periods.
[INPUT]	INT=-7,779.42	Enters the number of periods to be amortized. Displays the amount of interest paid in the first year.
[▼]	PRN=-468.42	Displays the amount of principal paid in the first year.
[▼]	BAL=79,531.58	Displays the loan balance after one year of payments.

Next amortize the second year as follows:

Keys:	Display:	Description:
[AMORT]	PERIODS?12.00	Do you wish to amortize 12 more periods?
[INPUT]	INT=-7,731.67	Displays the amount of interest paid in the second year.
[▼]	PRN=-516.17	Displays the amount of principal paid in the second year.
[▼]	BAL=79,015.41	Displays the loan balance after 24 payments.

The succeeding years would follow in the same fashion.

With each amortization, the TVM registers *N* and *PV* are updated. Press [RCL] [N] to see N=24, indicating the number of months that have been amortized. [RCL] [PV] displays the current balance of the loan.

Example: Amortizing a Single Payment. Amortize the 1st, 25th, and 54th payments of a 5-year car loan. The loan amount is $14,250 and the interest rate is 11.5%. Payments are monthly at the beginning of the month, starting immediately.

Keys:	**Display:**	**Description:**
[BEG/END] {BEGIN} 12 [P/YR]	P/YR=12.00	Sets Begin mode and 12 payments per year.
5 [xP/YR] 11.5 [I/YR] 14250 [PV] 0 [FV]	FV=0.00	Stores the four known values in the loan calculation.
[PMT]	PMT=-310.42	Calculates the monthly (beginning of the month) payment.

Now the TVM application contains the values that describe the above car loan. Press [RCL] [N], [RCL] [I/YR], [RCL] [PV], [RCL] [PMT], and [RCL] [FV], if you wish to verify those values. Also, pressing [RCL] [xP/YR] will recall *N* in years and [RCL] [P/YR] shows you the number of payments per year that the calculator is set to. Recalling these numbers does not change what's in the registers. (Recalling from registers is also described on page 29.)

To amortize the 1st, 25th, and 54th payments in the loan, use the following keystrokes.

Keys:	Display:	Description:
0 [N]		Stores 0 in *N*.
[AMORT] 1 [INPUT]	INT=0.00	In Begin mode, no interest is owed on the first payment, since the loan just started.
[▼]	PRN=-310.42	The entire first payment is principal.
[▼]	BAL=13,939.58	Displays the loan balance after one payment.
[AMORT]	PERIODS?1.00	Prompts for periods.
23 [INPUT]	INT=-2,613.57	Amortizes up through the 24th payment (23 more payments).
[AMORT] 1 [INPUT]	INT=-90.21	Amortizes just one payment period. Displays the interest paid on the 25th payment.
[▼] [▼]	PRN=-220.21 BAL=9,193.28	Displays the principal paid on the 25th payment and the balance after that payment.
[AMORT]	PERIODS?1.00	Prompts for periods.
53 [−] 25 [INPUT]	INT=-1,590.42	Amortizes from the 25th payment up through the 53rd payment.
[AMORT] 1 [INPUT]	INT=-20.05	Amortize one payment (the 54th). Displays the interest paid.

▼	PRN=-290.37	Displays the principal
▼	BAL=1,801.57	and balance.

If you make a mistake and need to start over on an amortization schedule, all you have to do is key in the beginning balance of the loan as *PV* and 0 as *N*. To start over at the first payment in the above problem, press 14250 PV 0 N AMORT 1 INPUT.

Interest Rate Conversions

The Interest Conversion application (NOM%, EFF%, P) converts between nominal and effective annual interest rates. Nominal and effective interest rates are described on page 55.

If you know a *nominal* annual interest rate and you wish to solve for the corresponding *effective* annual rate, use the following steps.

1. Key in the nominal rate and press NOM%.
2. Key in the number of compounding periods and press P.
3. Calculate the effective rate by pressing EFF%.

To calculate a nominal rate from a known effective rate, use the following steps.

1. Key in the effective rate and press EFF%.
2. Key in the number of compounding periods and press P.
3. Calculate the nominal rate by pressing NOM%.

The Interest Conversion application works in the same way as all the other applications on the HP-14B (the TVM application and the percentage applications), except you can't solve for the number of periods (P). If you attempt to solve for *P* by pressing P, the HP-14B will display the message CANNOT SOLVE.

The interest conversion application shares registers with the other three-value applications (*%CHG*, *MAR*, and *%TOTAL*). This sharing of registers is described on page 42.

Interest conversions are used primarily for two types of problems:

- Comparing investments with different compounding periods.
- Solving TVM problems in which the payment period and the interest period differ.

Investments With Different Compounding Periods

Example: Comparing Investments. You are considering opening a savings account in one of three banks. Which bank has the most favorable interest rate?

Bank #1 6.70% annual interest, compounded quarterly.

Bank #2 6.65% annual interest, compounded monthly.

Bank #3 6.63% annual interest, compounded 360 times per year.

Keys:	Display:	Description:
6.7 [NOM%] 4 [P]	P=4.00	Stores the known nominal percentage rate and the compounding periods (Bank 1).
[EFF%]	EFF%=6.87	Calculates Bank 1's effective annual rate.
6.65 [NOM%] 12 [P]	P=12.00	Stores the known nominal percentage rate and the compounding periods (Bank 2).
[EFF%]	EFF%=6.86	Calculates Bank 2's effective annual percentage rate.

6.63 [f] [NOM%] 360 [f] [P]	P=360.00	Stores the known nominal percentage rate and the compounding periods (Bank 3).
[f] [EFF%]	EFF%=6.85	Calculates Bank 3's effective annual rate.

Bank 1 has the best deal (by a slight margin)!

Compounding and Payment Periods Differ

The TVM application assumes that the compounding periods and the payment periods are the same. However, some regularly occurring loan installments or savings-account deposits and withdrawals do not necessarily coincide with the bank's compounding periods. If the payment period differs from the compounding period, you need to adjust the interest rate to match the payment period before solving the problem using the TVM application.

To adjust an interest rate when the compounding period differs from the payment period:

1. Key in the nominal rate and press [f] [NOM%]. Key in the number of compounding periods in a year and press [f] [P]. Solve for the effective rate by pressing [f] [EFF%].
2. Key in number of payment periods in a year and press [f] [P]. Solve for the adjusted nominal rate [f] [NOM%].

Example: Monthly Payments, Daily Compounding. Starting today, you make monthly deposits of $25 into an account paying 5% interest compounded daily (using a 365-day year). What will be the balance of the account in 7 years?

Keys:	Display:	Description:
5 [NOM%] 365 [P]	P=365.00	Stores the known nominal percentage rate and the bank's compounding periods per year.
[EFF%]	EFF%=5.13	Calculates the effective annual rate earned on the account.
12 [P]	P=12.00	Stores monthly periods.
[NOM%]	NOM%=5.01	Calculates the equivalent nominal percentage rate for monthly compounding.
[I/YR]	I/YR=5.01	Stores this newly converted rate as the annual interest rate.
12 [P/YR] [BEG/END] {BEGIN}	P/YR=12.00	Sets 12 payments per year and Begin mode.
0 [PV] 25 [+/-] [PMT] 7 [xP/YR]	N=84.00	Stores the other known values in the savings account.
[FV]	FV=2,519.61	Computes the balance of the account after 7 years.

Example: Monthly Compounding, Quarterly Payments. You are taking out a student loan for $3,000. The loan will be amortized over the first 8 years after graduation. The annual interest rate will be 6% compounded monthly, but you will make quarterly payments (at the end of each quarter). What will your payments be?

Keys:	Display:	Description:
6 [shift] [NOM%] 12 [shift] [P]	P=12.00	Stores the known nominal percentage rate and the compounding periods.
[shift] [EFF%]	EFF%=6.17	Calculates the effective annual rate on the loan.
4 [shift] [P]	P=4.00	You wish to know the interest rate that will yield the same effective rate with quarterly compounding.
[shift] [NOM%]	NOM%=6.03	Calculates the equivalent rate for quarterly compounding.
[I/YR]	I/YR=6.03	Stores this newly converted rate as the annual interest rate.
[shift] [BEG/END] {END}	I/YR=6.03	Sets End mode.
4 [shift] [P/YR]	P/YR=4.00	Sets four payments per year.
3000 [PV] 0 [FV] 8 [×] 4 [N]	N=32.00	Stores the other three known values for the student loan.
[PMT]	PMT=-118.87	Calculates your quarterly payment.

When you have calculated a new converted interest rate, it is best to store that interest rate directly into *I/YR* or a storage register. If you wish to write down a calculated interest rate to use later in a calculation, write down all the available decimal places (not just the two that may be displayed) to maintain accuracy. To see all the available decimal places press [shift] [SHOW] and hold down the [SHOW] key.

6

Cash-Flow Calculations

Introduction

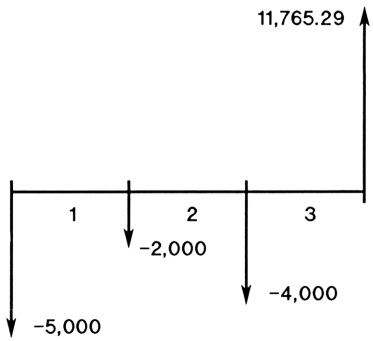
Cash-flow calculations on the HP-14B are used to solve financial problems where cash flows occur at regular intervals but are of varying amounts. You can also use cash-flow calculations to solve problems with regular, equal, periodic cash flows, but these situations are handled more easily using the TVM application.

In general, there are four steps to cash-flow calculations on the HP-14B:

1. Organize your cash flows (a cash-flow diagram is useful here). If consecutive equal cash flows occur beyond the initial cash flow, group them.
2. Decide whether you need to compute a net present value or an internal rate of return. Press either [shift] [NPV] or [shift] [IRR%] (depending on what you wish to compute). If you press [shift] [NPV], the HP-14B asks you to input a periodic interest rate.
3. Input the new cash-flow list (or edit the one that's stored as needed).
4. Press [shift] [COMPUTE] to compute the function you chose in step 2.

Try the following short example as an introduction to solving a cash-flow problem.

Example: A Short Term Investment. The following cash-flow diagram represents an investment in stock over three months. Purchases were made at the beginning of each month, and the stock was sold at the end of the third month. Compute the internal rate of return.



Keys:	Display:	Description:
IRR%	CL CFLO? Y N	

If a cash-flow list is currently stored, the calculator displays this clear prompt. Press {Y} to clear the list.

	C0?	Prompts for the initial cash flow.
5000 +/- INPUT	C0=-5,000.00	Enters the initial cash flow. Displays the cash flow for as long as you hold down the INPUT key.
	C1?	Prompts for the next cash flow.
2000 +/- INPUT	C1=-2,000.00	Enters the next cash flow.
	N1?1.00	Prompts for the number of repetitions of this cash flow.

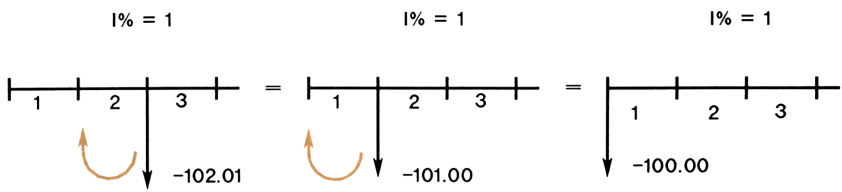
INPUT	N1=1.00	Enters the number of repetitions (it occurs only once).
	C2?	Prompts for the next cash flow.
4000 +/- INPUT	C2=-4,000.00	Enters the next cash flow.
	N2?1.00	Prompts for the number of repetitions of this cash flow.
INPUT	N2=1.00	Enters the number of repetitions.
	C3?	Prompts for the next cash flow.
11765.29 INPUT	C3=11,765.29	Enters the final cash flow.
	N3?1.00	Prompts for the number of repetitions of the final cash flow.
INPUT	C4?	Enters the number of repetitions.
COMPUTE	IRR%=3.25	Calculates the monthly yield on this short term investment.

NPV, *IRR*%, and "Discounting" Cash Flows

The first step to solving a cash-flow problem on the HP-14B requires you to choose to calculate either the net present value (NPV) or the internal rate of return (IRR%). If you already understand these two functions, you may skip ahead to the section "Organization of the Cash-Flow List."

Chapter 4 demonstrates the use of the cash-flow diagram to clarify the solution to a financial problem. However, the process of *discounting* cash flows has not yet been addressed. The *NPV* and *IRR%* functions are frequently referred to as *discounted cash-flow functions,* because they depend on a process known as "discounting."

When a cash flow is discounted, it is slid toward the beginning of the time-line and adjusted to compensate for the periodic interest rate. In fact, for calculation purposes, any cash flow can be moved to any period on the cash-flow diagram as long as it is correctly adjusted to compensate one way or the other for accumulated interest. The following figure shows a $102.01 payment being discounted one period at a time using an interest rate of 1% per period.



The numbers in the above figure were chosen specifically to simplify the explanation of discounting cash flows (1% of 100 equals 1, and 1% of 101 equals 1.01). If you discount a cash flow to the beginning of the time-line, you are essentially calculating its present value. The discounting process is always similar to that shown above, but the numbers usually don't work out as nicely. However, two powerful functions on the HP-14B make discounting cash flows easy.

The net present value (*NPV*) function finds the present value of each cash flow and then sums or nets them. The periodic interest rate has to be a known value to calculate *NPV*.

The internal rate of return (*IRR%*) function calculates the interest rate that is required to give a net present value of zero.

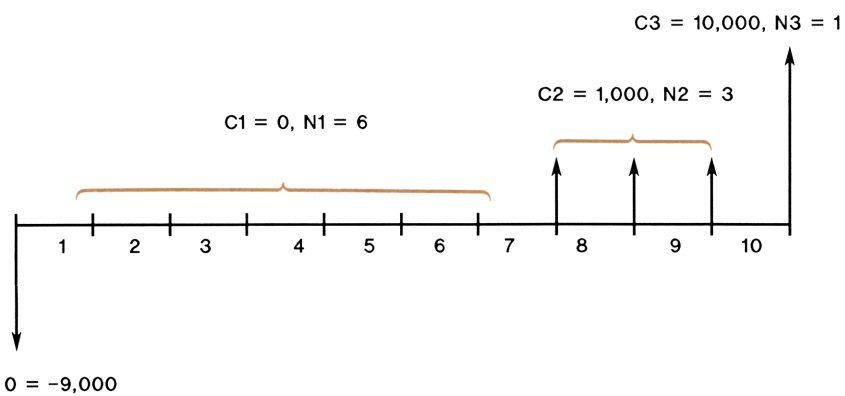
The true utility of these two financial tools will become clear after working a few examples. The next two sections describe organizing your cash-flows and entering them into the list. Examples of *NPV* and *IRR%* calculations follow.

Organization of the Cash-Flow List

You can store one cash-flow list at a time in the HP-14B. The cash-flow list is organized into an initial cash flow (`C0`) and succeeding *cash-flow groups* (up to 21 groups). `C0` occurs at the beginning of the first period. A cash-flow group consists of a cash-flow amount and a number of repetitions. To key in the cash flows of any financial problem:

1. Key in the amount of the initial cash flow.
2. Key in the amount and number of repetitions in each succeeding group of cash flows until you have reached the end of the problem.

For example, in the following cash-flow diagram, the initial cash flow is −$9,000. The next group of cash flows consists of six flows of zero each followed by a group of three $1,000 cash flows. The final group consists of one $10,000 cash flow.



Whenever you create a cash-flow list, it is important to account for every period on the cash-flow diagram, even periods with cash flows of zero.

Entering and Editing a Cash-Flow List

To enter or edit a cash-flow list:

1. Press either [shift] [NPV] or [shift] [IRR%].
2. If you press [shift] [NPV], the calculator displays `I%?0.00`. The *periodic* interest rate must be known to compute a net present value. Key in the interest rate and press [INPUT].
3. If values are already stored in the cash-flow list, the HP-14B displays:

```
CL CFLO? Y N
```

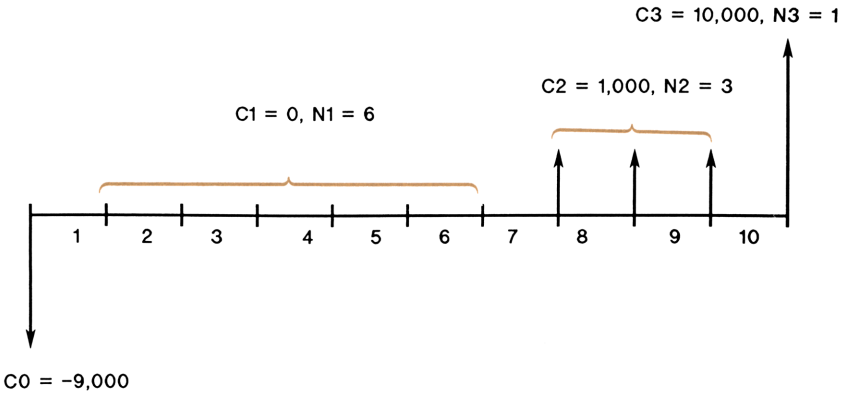
Press {N} if you wish to use the currently stored list, or press {Y} if you wish to start anew. If no cash-flow list is stored, the HP-14B immediately starts a new list by displaying `C0?`, asking you to input the initial cash flow of the new list.

Entering the Cash-Flow List

The initial cash flow in the list is called `C0`. When `C0?` is in the display, key in the initial cash flow (be careful to get the sign correct) and press [INPUT]. The calculator will display this entry for as long as you hold down the [INPUT] key. When you release [INPUT], the HP-14B displays `C1?`

For the succeeding cash-flow groups, you need to input a cash-flow amount and a number of repetitions. When `C1?` is in the display, key in the amount of cash-flow group 1 and press [INPUT]. `N1?1.00` will then be displayed. You can either accept the default value of `1.00` by pressing [INPUT], or you can key in a different number of repetitions for group 1 and press [INPUT]. `C2?` is then displayed. Continue keying in cash-flow groups until you've entered all the cash flows.

Example: Keying in a Cash-Flow List. Enter the cash flows on the following cash-flow diagram in order to calculate *IRR%*.



Keys:	Display:	Description:
[IRR%]	CL CFLO? Y N	Chooses the internal rate of return function.

If a cash-flow list is currently stored, the calculator displays this clear prompt. Press {Y} to clear the list.

	C0?	Prompts for the initial cash flow.
9000 [+/-] [INPUT]	C0=-9,000.00	Enters the initial cash flow. Displays the cash flow for as long as you hold down the [INPUT] key.
	C1?	Prompts for the first cash-flow group amount.
0 [INPUT]	C1=0.00	Enters the first cash-flow group amount.
	N1?1.00	Prompts for the number of repetitions of this amount.
6 [INPUT]	N1=6.00	Enters the number of repetitions.

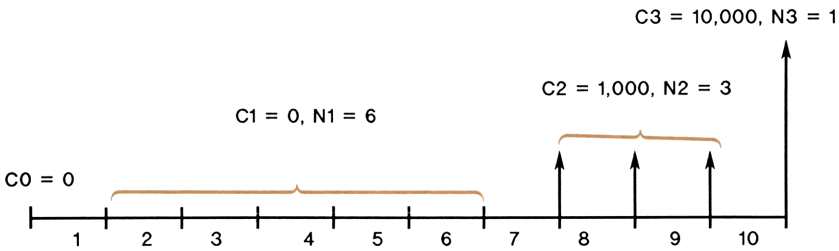
	C2?	Prompts for the second cash-flow group amount.
1000 [INPUT]	C2=1,000.00	Enters the second cash-flow group amount.
	N2?1.00	Prompts for the number of repetitions in cash-flow group 2.
3 [INPUT]	N2=3.00	Enters the number of repetitions.
	C3?	Prompts for the third cash-flow group amount.
10000 [INPUT]	C3=10,000.00	Enters the third and final cash-flow amount.
	N3?1.00	Prompts for the number of repetitions of the final cash flow.
[INPUT]	C4?	Prompts for the next cash-flow amount.
[COMPUTE]	IRR%=3.94	Calculates the periodic yield in the above cash-flow problem.

Viewing and Correcting the List

As you are keying in or editing a list of cash flows, you can use the [▼] or [▲] keys to move forward and backward in the list. If you press [▼] when you are at the end of the list, you will move to the top of the list (C0). Likewise, if you press [▲] when C0 is in the display, you will move to the bottom of the list.

To change any value in the list, use [shift] [▲] or [▼] to move that value into the display, key in the new number and press [INPUT]. Be sure to press [INPUT] after keying in the new number if you wish to save the new value in the list. If you inadvertently key in a new number and wish to recover the original value, press [▼] [shift] [▲]. The new entry isn't saved until you press [INPUT].

Example: Net Present Value. After completing the previous example, what would the initial cash flow have to be to give a periodic return of 4.2%?



This solution requires just a slight modification to the cash-flow list that is currently stored in the calculator. Change the initial cash flow to zero then calculate *NPV* using an *I*% of 4.2. The result is the initial investment that, if added to the above picture, makes the periodic return equal 4.2% .

Keys:	**Display:**	**Description:**
[shift] [NPV]	`I%?0.00`	Prompts for the periodic interest rate.
4.2 [INPUT]	`CL CFLO? Y N`	Enters the periodic interest rate.
{N}	`C0?-9,000.00`	Chooses to preserve the current list rather than clear it.
0 [INPUT]	`C0=0.00`	Changes the initial cash flow to zero.

	C1?0.00	Displays the first cash-flow group amount. You do not need to change anything else in the list.
COMPUTE	NPV=8,786.94	Calculates the net present value.

Using a Number From the Cash-Flow List

Whenever a number stored in the cash-flow list is in the display, you can use that number in calculations. This is consistent with the way the HP-14B does arithmetic as described in the first section of chapter 2.

When you've completed the calculation, press INPUT to save the result in the cash-flow list and move to the next number in the list. If you don't wish to save the result of your calculations, simply press the ▼ or ▲ keys to move on in the list.

Sharing Cash-Flow Memory With Statistics

The memory used to store the cash-flow groups at the end of the cash-flow list (groups 10 to 21) is also used to store information for statistics calculations. You will only notice this when you have statistical information stored and you are keying in a cash-flow problem with more than 10 cash-flow groups. When you input C10, you will see the message CL STAT? Y N. This tells you that you need to clear away the statistical information before you can proceed with entering cash-flow groups. Pressing {Y} clears the statistics memory and saves C10 in the list.

Clearing the Cash-Flow List

If a cash-flow list is stored in the calculator, you are given the option to clear that list in the following two instances:

1. When you enter the cash-flow list by pressing [NPV] and inputting *I*%, or by pressing [IRR%].
2. When you press the [Σ+] or [Σ−] keys to enter statistical values (but only if your stored cash-flow list extends beyond cash-flow group 9).

Computing Net Present Value (*NPV*)

The net present value function is used to discount the cash flows in the list to the front of the time line using a periodic interest rate that you supply.

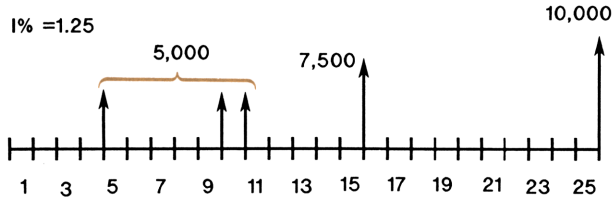
Computing *NPV* requires 4 steps:

1. Press [NPV] and input the periodic interest rate.
2. Either save or clear the current cash-flow list.
3. Input the cash-flow list or edit the one that is already stored.
4. Press [COMPUTE] to calculate a result.

Example: A Discounted Contract, Uneven Cash Flows. You have been offered a chance at purchasing a contract with the following cash flows.

End Of Month	Amount
4	$ 5,000.00
9	$ 5,000.00
10	$ 5,000.00
15	$ 7,500.00
25	$10,000.00

How much should you pay for the contract if you wish to yield a monthly rate of 1.25% on your investment?



Keys:	Display:	Description:
[NPV]	I%?0.00	Prompts for the periodic interest rate.
1.25 [INPUT]	CL CFLO? Y N	

If this clear message is displayed, press {Y} to clear the list.

	C0?	Prompts for the initial cash flow.
0 [INPUT]	C0=0.00	Enters the initial cash flow of zero. This display will stay there as long as you hold down the [INPUT] key.
	C1?	Prompts for the amount in group 1.
0 [INPUT]	C1=0.00	Displays the input.
	N1?1.00	Prompts for the number of cash flows in group 1 (if there is only one, you can press [INPUT]).

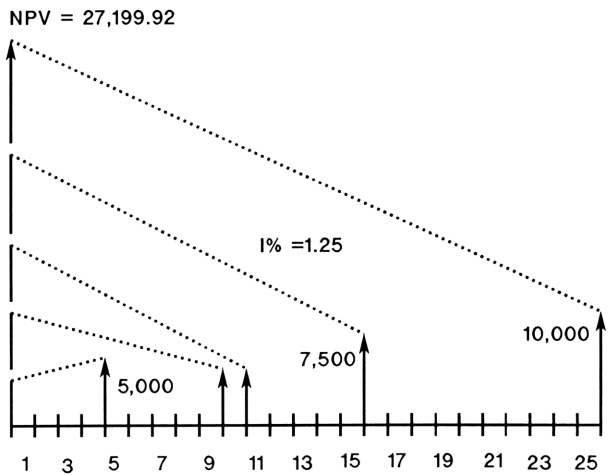
3 [INPUT]	N1=3.00	Displays the input.
	C2?	Prompts for the cash-flow amount for group 2.
5000 [INPUT]	C2=5,000.00	Displays the input.
	N2?1.00	Prompts for the number of cash flows in group 2 (for 1, just press [INPUT]).
[INPUT]	C3?	Enters 1 for N2.
0 [INPUT] 4 [INPUT]	C4?	Enters the cash-flow amount and repetitions for group 3.
5000 [INPUT] 2 [INPUT]	C5?	Enters cash-flow group 4.
0 [INPUT] 4 [INPUT]	C6?	Enters cash-flow group 5.
7500 [INPUT] [INPUT]	C7?	Enters cash-flow group 6.
0 [INPUT] 9 [INPUT]	C8?	Enters cash-flow group 7.
10000 [INPUT] [INPUT]	C9?	Enters cash-flow group 8.

The cash-flow list that describes your prospective investment is now in the calculator. You can use the up-arrow [▲] and down-arrow [▼] keys to review the list. If any value is incorrect, you can change it by keying in a new value and pressing [INPUT].

Now that you have the cash-flow list keyed in, compute the net present value.

Keys:	Display:	Description:
COMPUTE	NPV=27,199.92	Calculates the net present value of the stored cash-flow list.

This result says that if you wish to yield 1.25% per month by buying the contract, you should pay $27,199.92. Notice that this amount is positive. As shown in the following figure, the net present value is simply the summed (or netted) value of a series of cash flows when they are discounted to the front of the time-line.



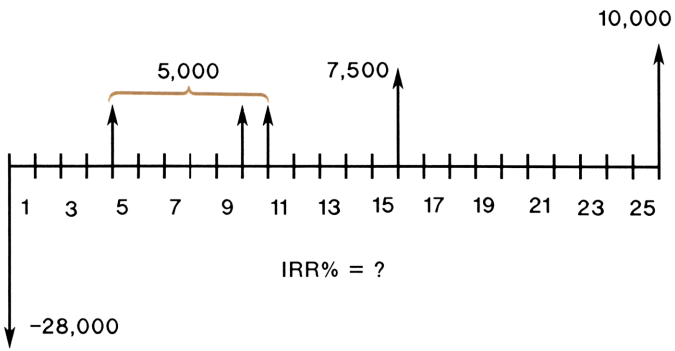
Computing Internal Rate of Return (*IRR%*)

Computing *IRR%* requires 3 steps:

1. Press IRR% and choose to save or clear the current cash-flow list.
2. Enter the cash-flow list or edit the one that is already stored.
3. Press COMPUTE.

The following example uses the cash-flow list that was keyed in when you worked the previous *NPV* example.

Example: An *IRR%* Calculation. If the seller of the contract in the previous example (the cash-flow diagram is shown on page 97) wants $28,000 and you accept that price, what is your yield? This is an *IRR%* calculation that requires a slight modification to the currently stored cash-flow list.



Keys:	Display:	Description:
12 P/YR	P/YR=12.00	Sets monthly periods (the following section explains the need for this step).
IRR%	CL CFLO? Y N	Chooses the internal rate of return function.
{N}	C0?0.00	Chooses to preserve the current list.
28000 +/- INPUT	C1?0.00	Changes the initial cash flow and displays C1.
COMPUTE	IRR%=1.04	Calculates your monthly yield.

By calculating *IRR%*, you are asking the calculator to give you the periodic rate that will make the *NPV* of the above cash-flow diagram equal to zero.

More examples that use *NPV* and *IRR%* calculations are given in chapter 8, "Additional Examples".

Automatic Storage of *IRR%* and *NPV*

When you compute *NPV*, the result is stored in *PV* for your convenience. To recall that result, press [RCL] [PV]. If you haven't changed any of the TVM values since you worked the last example using *NPV* on page 97, pressing [RCL] [PV] should display `PV = 27,199.92`.

When you compute *IRR%*, the result is multiplied by the number of periods per year (*P/YR*) and stored in *I/YR*. In the previous example that calculated *IRR%*, the first step in the keystroke solution set *P/YR* to 12. Pressing [RCL] [I/YR] after working this example will display `12.49`. This is the annualized yield (1.04 × 12).

"What if..." *IRR%* and *NPV* Calculations

The [COMPUTE] key becomes active immediately after you press either [NPV] or [IRR%]. This makes it easy to do "what if..." calculations using these cash-flow functions. Once you have a valid cash-flow list and periodic interest rate keyed in, you can quickly go from computing an *IRR%* to computing an *NPV* and vice versa.

7

Statistical Calculations

The statistical functions on the HP-14B can do calculations as simple as totaling a list of numbers or as involved as forecasting using a curve generated by a set of number pairs. Menus and understandable labels on the HP-14B make all of these statistical calculations easy to use.

Once you've entered a list of single numbers, you can calculate:

- The sum (Σx) and the sum of the squares (Σx^2).
- The mean ($\bar{x}$).
- The standard deviation (s).

Once you've entered a set of x,y number pairs, you can:

- Calculate the sum, sum of squares, mean, or standard deviation of the x's or the y's.
- Use the [FRCST] key to predict new values using the calculator's choice for the best-fitting curve.
- Fit the data to any of four available curve models and predict new values using that curve.
- Calculate the weighted mean of the x's weighted according to the y's.

Entering Statistical Data

The [Σ+] and [Σ−] keys are used to enter and correct statistical data. The [INPUT] key is used to separate two values in an x,y data pair. To clear statistics memory, press [CLEAR] {Σ}.

You can enter as many statistical values as you wish. As you key in each number, the HP-14B does a series of intermediate calculations and stores only the results necessary for statistical calculations.

Sharing Statistics Memory With Cash-Flows

The statistics functions use some of the same memory that is used by the cash-flow list. If you have numbers stored in the cash-flow list beyond cash-flow group 9, the first time you press [Σ+], the calculator displays:

```
CL CFLO? Y N
```

Press {Y} to clear the cash-flow list. The calculator displays n=1.00 to indicate that one statistical value or pair has been stored. If you press {N}, the calculator ignores the [Σ+] key.

Entering Data For One-Variable Statistics

To enter data for one-variable statistics:

1. Clear any previously stored statistical data by pressing [CLEAR] {Σ}.
2. Key in the first value and press [Σ+]. The HP-14B displays n=1.00.
3. Continue entering values by keying in the numbers and pressing [Σ+]. The *n*-value in the display is updated with each entry.

Example: Totaling a List. Total the following list of values: 25.7, 99.3, 78.2, 22.9, and 17.6.

Keys:	Display:	Description:
[CLEAR] {Σ}		Clears the statistics registers.
25.7 [Σ+]	CL CFLO? Y N	

If data is stored in the cash-flow list beyond C9, you will see the above prompt in the display. Press {Y} to clear the cash-flow list.

	n=1.00	Displays the number of values you have entered so far.
99.3 Σ+	n=2.00	Enters the second value.
78.2 Σ+	n=3.00	Enters the third value.
22.9 Σ+	n=4.00	Enters the fourth value.
17.6 Σ+	n=5.00	Enters the fifth value.
STAT {Σ} {x}	Σx=243.70	Calculates the total.

Entering Data For Two-Variable Statistics

To enter x,y pairs of statistical data:

1. Clear any previously stored statistical data by pressing CLEAR {Σ}.
2. Key in the first x-value and press INPUT. The HP-14B will display the x-value followed by a colon (:).
3. Key in the corresponding y-value and press Σ+. The HP-14B displays n=1.00.
4. Continue entering x,y pairs by keying in the x-value, pressing INPUT, keying in the y-value, and pressing Σ+. The n-value in the display is updated with the entry of each pair.

Before pressing Σ+, you can swap the x-and y-values in the display, if necessary, by pressing SWAP.

Example: Forecasting. The sales at your company have been increasing steadily over the past 5 months according to the following table.

Month	Sales
1	$21,400
2	$22,920
3	$24,100
4	$28,265
5	$33,890

If this trend continues, what will be your sales for month 8?

Keys:	Display:	Description:
[CLEAR] {Σ}		Clears the statistics registers.
1 [INPUT]	1.00:	Enters the x-value.
21400 [Σ+]	CL CFLO? Y N	

If data is stored in the cash-flow list beyond C9, you will see the above prompt in the display. Press {Y} to clear the cash-flow list.

	n=1.00	Displays the number of pairs you have entered so far.
2 [INPUT] 22920 [Σ+]	n=2.00	Enters the second pair.
3 [INPUT] 24100 [Σ+]	n=3.00	Enters the third pair.
4 [INPUT] 28265 [Σ+]	n=4.00	Enters the fourth pair.
5 [INPUT] 33890 [Σ+]	n=5.00	Enters the fifth pair.
[FRCST]	MODEL = EXP	Chooses the forecasting function. Displays the best fitting model (exponential).

	x̂	ŷ	Prompts for you to choose prediction of x's or y's.
{ŷ}	x?		Chooses prediction of y's, prompts for x.
8 INPUT	ŷ=45,286.44		Predicts sales for month 8 using exponential model.

Correcting Statistical Data

If incorrect data has been entered by pressing Σ+, it can be deleted by using the ■ Σ− key. Then, the correct values can be added using Σ+. If one value of an x,y pair is incorrect, you *must* delete and then re-enter both values.

To correct statistical data:

1. Key in the x-value to be deleted. If the data consists of x,y-pairs, press INPUT and then key in the y-value.
2. Press ■ Σ− to delete the values. The n shown in the display decreases by one.
3. Enter the correct value or x,y-pair using Σ+.

Refer to "Using the ■ Σ− Key to Correct Data," in appendix B for additional information.

Clearing Statistical Data

To clear statistics memory, press ■ CLEAR {Σ}. This clears all of the statistical values to zero.

Doing Statistical Calculations

When you press the [STAT] key, the four main headings of the STAT menu are displayed:

$$\Sigma \quad \bar{x},\bar{y} \quad s \quad \text{FIT}$$

Each of these choices leads to another menu of statistical functions as shown in the following table:

The STAT Menu

Menu Key	Description
{Σ}	Displays menu of summation statistics:
{n}	The number of data points entered.
{x}	Sum of the *x*-values.
{y}	Sum of the *y*-values.
{x^2}	Sum of the squares of the *x*-values.
{y^2}	Sum of the squares of the *y*-values.
{xy}	Sum of the products of the *x*- and *y*-values.
{$\bar{x},\bar{y}$}	Displays menu for means:
{$\bar{x}$}	Arithmetic mean (average) of the *x*-values.
{$\bar{y}$}	Arithmetic mean (average) of the *y*-values.
{$\bar{x}$w}	Weighted mean of the *x*-values weighted according to the *y*-values.
{s}	Displays menu for sample standard deviation:*
{sx}	Standard deviation of the *x*-values.
{sy}	Standard deviation of the *y*-values.
{FIT}	Curve fitting (two variables required):
{B}	Best fit.
{L}	Linear model.
{EX}	Exponential model.
{LOG}	Logarithmic model.
{P}	Power model.

* The standard deviation is a measure of how dispersed the numbers are about the mean. The HP-14B calculates the *sample standard deviation*, which assumes the data is a sampling of a larger, complete set of data. If the data constitutes the entire population of data, the *true population*, see page 109, "Sample-Versus-Population Standard Deviation."

The curve fitting sub-menu below is displayed for each of the above five selections for curve fitting model.

Menu Key	Description
{x̂}	Predict *x*-values.
{ŷ}	Predict *y*-values.
{r}	Correlation coefficient.
{m}	M in the curve equation. For the linear model, this is slope.
{b}	B in the curve equation. For the linear model, this is the y-intercept.

One-Variable Statistical Calculations

If you enter just one value and press [Σ+], the HP-14B takes that value to be an *x*-value. In fact, single *x*-values are treated just like *x,y* pairs, with $y=0$.

Mean and Standard Deviation

Example: One-Variable Mean and Standard Deviation. Production supervisor May Kitt wants to determine how long it takes to assemble the double bladed widgits produced by her company. She randomly picks six people, observes each one as they assemble one widgit, and records the number of minutes required:

15.50	9.25	10.00
12.50	12.00	8.50

Calculate the mean and standard deviation of the times.

Keys:	Display:	Description:
[CLEAR] {Σ}		Clears the statistics registers.
15.5 [Σ+]	CL CFLO? Y N	

If you have cash flows stored beyond C9, the above message is displayed. Press {Y} to clear the cash-flow list.

	n=1.00	Enters the first time.
9.25 [Σ+]	n=2.00	Enters the second time.
10 [Σ+]	n=3.00	Enters the third time.
12.5 [Σ+]	n=4.00	Enters the fourth time.
12 [Σ+]	n=5.00	Enters the fifth time.
8.5 [Σ+]	n=6.00	Enters the sixth time.
[STAT] {$\bar{x}$,$\bar{y}$} {$\bar{x}$}	x=11.29	Calculates the mean.
[STAT] {s} {sx}	sx=2.58	Calculates the sample standard deviation.

Sample-Versus-Population Standard Deviation

The standard deviation is a measure of how dispersed numbers are about the mean. Two types of standard deviation are *sample standard deviation* and *true population standard deviation.*

The HP-14B calculates the *sample standard deviation,* which assumes the data is a sampling of a larger, complete set of data. If the data constitutes the entire population of data, the *true population standard deviation* can be computed by calculating the mean of the original data, adding the mean to the statistical data using [Σ+], and then calculating the standard deviation.

Example: Population Standard Deviation. You have a fleet of eight taxis and you wish to calculate the average mileage (miles traveled per gallon of gasoline) of your fleet and the standard deviation of the mileages. You have already calculated the mileage for each taxi over the last year. The mileages are a follows:

28.6	24.4	29.0	27.9
31.2	32.0	26.7	25.3

What is the average mileage of your fleet and the standard deviation of the mileages. Because this is the complete population of the data, you should calculate the *true population standard deviation.*

Keys:	Display:	Description:
[CLEAR] {Σ}		Clears statistics memory.
28.6 [Σ+]	CL CFLO? Y N	

If you have cash flows stored beyond C9, the above message is displayed. Press {Y} to clear the cash-flow list.

	n=1.00	Enters the first mileage.
24.4 [Σ+]	n=2.00	Enters the second mileage.
29 [Σ+]	n=3.00	Enters the third mileage.
27.9 [Σ+]	n=4.00	Continues entering data.
31.2 [Σ+]	n=5.00	
32 [Σ+]	n=6.00	
26.7 [Σ+]	n=7.00	
25.3 [Σ+]	n=8.00	
[STAT] {x̄,ȳ} {x̄}	x=28.14	Calculates the mean.
[Σ+]	n=9.00	Adds the mean to the data.
[STAT] {s} {sx}	sx=2.48	Calculates the *true population standard deviation.*

Two-Variable Summation Statistics

Summation values are of interest if you want to perform other statistical calculations besides those provided by the HP-14B. You can calculate n (the number of data sets you keyed in), Σx, Σy, Σx^2, Σy^2, and Σxy.

Example: Totaling Numbers. What are the totals of the following two rows of numbers:

x: 7.13	0.62	9.93	22.0	4.62	2.54	9.67
y: 0.23	1.64	33.2	82.3	1.65	32.3	5.45

Keys:	**Display:**	**Description:**
CLEAR {Σ}		Clears the statistics registers.
7.13 INPUT .23 Σ+	CL CFLO? Y N	

If you have cash flows stored beyond C9, the above message is displayed. Press {Y} to clear the cash-flow list.

	n=1.00	Enters the first pair.
.62 INPUT 1.64 Σ+	n=2.00	Enters the second pair.
9.93 INPUT 33.2 Σ+	n=3.00	Enters the third pair.
22 INPUT 82.3 Σ+	n=4.00	Enters the fourth pair.
4.62 INPUT 1.65 Σ+	n=5.00	Enters the fifth pair.
2.54 INPUT 32.3 Σ+	n=6.00	Enters the sixth pair.
9.67 INPUT 5.45 Σ+	n=7.00	Enters the seventh pair.
STAT {Σ} {x}	Σx=56.51	Calculates the total of the x's.
STAT {Σ} {y}	Σy=156.77	Calculates the total of the y's.

Two-Variable Mean and Standard Deviation

Example: Calculate the mean and standard deviation of the x-and y-values from the previous example.

Keys:	Display:	Description:
STAT {x̄,ȳ} {x̄}	x̄=8.07	Calculates the mean of the x's.
STAT {s} {sx}	sx=7.06	Calculates the sample standard deviation of the x's.
STAT {x̄,ȳ} {ȳ}	ȳ=22.40	Calculates the mean of the y's.
STAT {s} {sy}	sy=30.12	Calculates the sample standard deviation of the y's.

Weighted Mean

To calculate a weighted mean, the x-values are weighted by the y-values. The steps for a weighted mean calculation are:

1. Clear statistics memory by pressing ■ CLEAR {Σ}.
2. Enter the paired data. Key in x, press INPUT, then key in its weight or frequency and press Σ+.
3. Press STAT {x̄, ȳ} {x̄w}.

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?

Keys:	Display:	Description:
[CLEAR] {Σ}		Clears statistics memory.
200 [INPUT] 54 [Σ+]	CL CFLO? Y N	

If you have cash flows stored beyond C9, the above message is displayed. Press {Y} to clear the cash-flow list.

	n=1.00	Enters the first rent and its weight.
205 [INPUT] 32 [Σ+]	n=2.00	Enters the second rent and its weight.
210 [INPUT] 88 [Σ+]	n=3.00	Enters the third rent and its weight.
216 [INPUT] 92 [Σ+]	n=4.00	Enters the fourth rent and its weight.
[STAT] {x̄,ȳ}	x̄ ȳ x̄w	Displays the mean calculation menu.
{x̄w}	x̄w=209.44	Calculates the weighted mean.

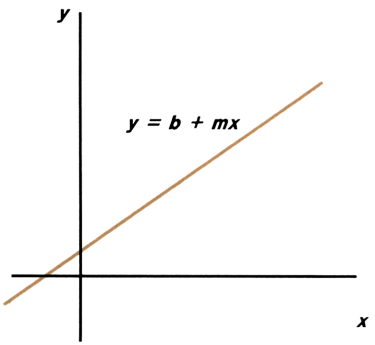
Forecasting and Curve Fitting

Forecasting and curve fitting are statistical methods for finding a relationship between two variables, x and y. Using this relationship, you can *estimate* new values of y based on a given x-value, and vice-versa. The x,y data pairs are input as described under "Entering Data For Two Variable Statistics" on page 104, and a short example of forecasting is in that same section. Four popular curve-fitting *models** are available on the HP-14B.

* The exponential, logarithmic, and power models are calculated using transformations that allow the data to be fit 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.

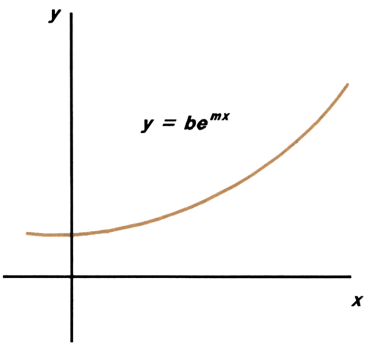
Linear Curve Fit

{L}



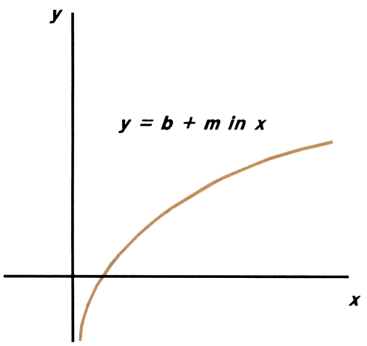
Exponential Curve Fit

{EX}



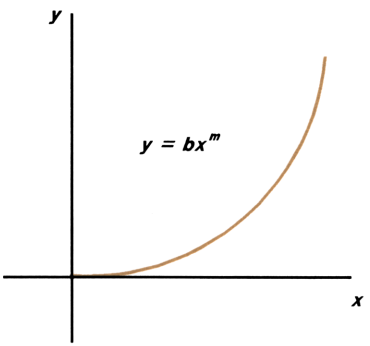
Logarithmic Curve Fit

{LOG}



Power Curve Fit

{P}



Forecasting

To do forecasting:

1. Enter your *x,y* pairs as described under "Entering Data For Two-Variable Statistics" on page 104.
2. Press [shift] [FRCST]. The calculator displays the model that best fits the data.
3. The HP-14B displays the following menu:

   {x̂} {ŷ}

4. Choose either {x̂} or {ŷ}, depending on which value you wish to forecast.
5. Key in the point to be forecasted and press [INPUT]. The forecasted value will be displayed with its appropriate label.
6. If you wish to forecast another value, press the [▼] or [shift] [▲] keys, and then key in the next point to be forecasted.

Curve Fitting

To do curve fitting:

1. Enter your *x,y* pairs as described under "Entering Data For Two-Variable Statistics" on page 104.
2. Press [STAT] {FIT} and choose the model that you wish to fit your data to.
3. The HP-14B displays the following menu:

   x̂ ŷ r m b

The keys {x̂} and {ŷ} allow you to forecast *x*-or *y*-values using the curve model you chose. The {r} (correlation coefficient), {m}, and {b} keys show you the curve fitting results.

Pressing {FIT} displays a menu in which the previously selected model is highlighted with periods. For example, once you have fit data to the exponential curve, [STAT] {FIT} will result in the following display:

B L .EX. LOG P

In the previous FIT menu, the labels stand for best, linear, exponential, logarithmic, and power, respectively. The periods around EX show you that the exponential model was the last model selected (either by [FRCST] or using {FIT}).

To estimate a value from the FIT menu:

1. Choose the curve model that you wish to fit your data to.
2. Choose either {x̂} or {ŷ} depending on which value you wish to estimate.
3. Key in the point at which to estimate and press [INPUT]. The estimated value will be displayed with its appropriate label.
4. If you wish to estimate another value using the same curve, press the [▼] or [▲] keys and then key in the next point at which to estimate.

[FRCST] Versus {FIT}

The {FIT} function under the STAT menu allows *you to choose* the curve model, while the [FRCST] key uses the *calculator's choice* of best curve model to fit your data. (It chooses the model whose correlation coefficient, *r*, has an absolute value that is closest to 1, and it temporarily displays the abbreviation of this best fitting model.)

Forecasting and Curve Fitting Examples

Example: Forecasting. 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)	Dollar Sales (y-values)
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

What would the forecasted sales be if 7 minutes of advertising are purchased using the best fit model? Repeat the calculation for 8 minutes?

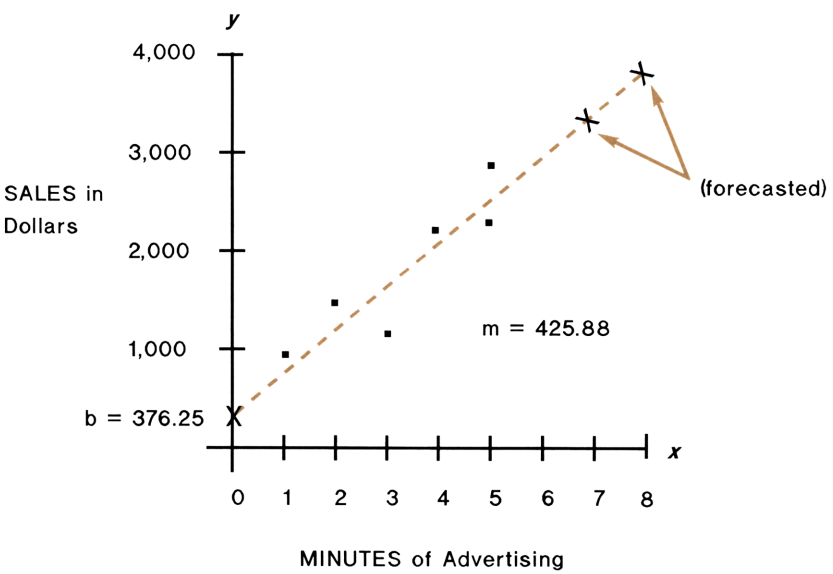
Keys:	Display:	Description:
[CLEAR] {Σ}		Clears the statistics registers.
2 [INPUT] 1400 [Σ+]	CL CFLO? Y N	

If you have cash flows stored beyond C9, the above message is displayed. Press {Y} to clear the cash-flow list.

	n=1.00	Enters minutes and sales for week 1.
1 [INPUT] 920 [Σ+]	n=2.00	
3 [INPUT] 1100 [Σ+]	n=3.00	
5 [INPUT] 2265 [Σ+]	n=4.00	
5 [INPUT] 2890 [Σ+]	n=5.00	
4 [INPUT] 2200 [Σ+]	n=6.00	
[FRCST]	MODEL=EXP	Displays the best fitting model.

	x̂	ŷ
{ŷ}	x?	Chooses estimation of y-values.
7 INPUT	ŷ=4,177.40	Estimates sales if 7 minutes of advertising are purchased.
▼	x?	Continues estimating y-values.
8 INPUT	ŷ=5,379.14	Estimates sales if 8 minutes of advertising are purchased.

Example: Curve Fitting. Rather than use the exponential model, BJ's wants to determine if there is a strong linear relationship between the amount of radio advertising and the weekly sales. If a strong relationship exists, BJ's wants to use the linear relationship to forecast sales. A graph of the data with the linear model sketched in looks like this:



Keys:	Display:	Description:
[STAT] {FIT} {L}	x̂ ŷ r m b	Selects the linear model for the curve fit.
{r}	r=0.90	Computes 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 or 8 minutes of advertising time per week.

[STAT] {FIT} {L}	x̂ ŷ r m b	Selects the linear model for the curve fit.
{ŷ}	x?	Chooses estimation of y-values.
7 [INPUT]	ŷ=3,357.38	Estimates sales if 7 minutes of advertising are purchased.
[▼] 8 [INPUT]	ŷ=3,783.25	Estimates sales if 8 minutes are purchased.

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

[STAT] {FIT} {L}	x̂ ŷ r m b	Selects the linear model for the curve fit.
{x̂}	y?	Chooses estimation of x-values.
3000 [INPUT]	x̂=6.16	Estimates minutes of advertising required for $3,000 in sales.

8

Additional Examples

Business Applications

Setting a Sales Price

One method for setting a unit sales price is to determine the unit cost of production, and then multiply by the desired rate of return. For this method to be accurate, you must identify all costs associated with the product.

The following equation calculates price based on unit cost and rate of return:

$$\text{PRICE} = \text{COST} \div \text{UNITS} \times (1 + (\%\text{RTN} \div 100))$$

Example: Setting a Sales Price. To produce 2,000 units, your cost is $40,000. You want a 20% rate of return. What price should you charge?

Keys:	Display:	Description:
40000 [÷]	40,000.00÷	Starts with the cost.
2000 [×]	2,000×	Divides by the units.
[(] 1 [+] [(] 20 [÷] 100 [=]	24.00	Calculates the price.

Notice that the [=] sign closes all parentheses. The same would be true if you pressed [INPUT].

Forecasting Based on History

One method of forecasting sales, manufacturing rates, or expenses is to look at historical trends. Once you have historical data, the data are fit to a curve with time on the x-axis and the quantity you are forecasting on the y-axis. Linear curve fit is appropriate if you have a fairly constant growth rate; exponential curve fit is appropriate with compound growth, such as the growth in sales that might occur with a new product.

Example: Forecasting Using the Best Curve Model. You want to determine the sales forecasts for the next two years using the best fitting curve model for the data. The following data represents your sales for the past five years.

Year	Sales
1	10,000
2	11,210
3	13,060
4	16,075
5	20,590

Keys:	Display:	Description:
[CLEAR] {Σ}		Clears statistics memory.
1 [INPUT] 10000 [Σ+]	n=1.00	Enters the first year and the sales for that year.
2 [INPUT] 11210 [Σ+]	n=2.00	Enters the second year's data.
3 [INPUT] 13060 [Σ+]	n=3.00	Continue data entry.
4 [INPUT] 16075 [Σ+]	n=4.00	
5 [INPUT] 20590 [Σ+]	n=5.00	
[FRCST]	MODEL=EXP	Temporarily displays the best fitting model.

	x̂ ŷ	Displays the choices for estimating.
{ŷ}	x?	Chooses estimation of y-values (year).
6 INPUT	ŷ=23,562.89	Estimates the sales for year 6.
▼	x?	Prompts for another x-value.
7 INPUT	ŷ=28,223.73	Estimates the sales for year 7 based on exponential growth.

Example: Forecasting Using the Linear Model. What would the sales estimates be for years 6 and 7 based on the linear curve model?

STAT {FIT}	B L EX LOG P	Displays the available curve models.
{L}	x̂ ŷ r m b	Selects the linear model. Displays curve fitting and estimating options.
{ŷ}	x?	Selects estimation of y-values. The calculator requests an x-value (year).
6 INPUT	ŷ=22,000.50	Estimates the sales for year 6.
▼	x?	Continues forecasting.
7 INPUT	ŷ=24,605.00	Estimates the sales for year 7.

Planning Advertising Expenditures

The advertising-sales ratio helps determine how much money to spend for advertising, based on projected sales. This calculation is based on the equation:

Ad$ = #Units × unit price × portion of sales for advertising

To calculate the amount dedicated to advertising (Ad$), you need to know the forecast number of units to be sold (#Units), unit price, and the portion of sales to be spent on advertising. The calculation becomes a simple arithmetic and percentage calculation.

Example: You expect to sell 2,000 units next month. The unit revenue is $15. The normal advertising budget is 5% of projected sales. How much can you spend on advertising next month?

Keys:	**Display:**	**Description:**
2000 [×] 15	× 15	Calculates the number of units times the unit price.
[×] 5 [%] [=]	1,500.00	Calculates the advertising dollars for the month.

Cost of Failing to Take a Cash Discount

A cash discount gives a buyer a reduction in price if the payment is made within a specified time period. For example, "2/10, NET/30" means that the buyer can deduct 2 percent if payment is made within 10 days. If payment is not made within 10 days, the full amount must be paid by the 30th day.

You can use the equation shown below to calculate the cost of failing to take the cash discount. The cost is calculated as an annual interest rate charged for delaying payment.

$$\text{COST\%} = \frac{\text{DISC\%} \times 360 \times 100}{((100 - \text{DISC\%}) \times (\text{TOTALDAYS} - \text{DISCDAYS}))}$$

DISC% is the discount percent if the payment is made early.
TOTALDAYS is the total number of days until the bill must be paid.
DISCDAYS is the number of days for which the discount is available.

Example: You receive a bill with the credit terms 2/10, NET/30. What is the cost of not taking the cash discount?

Keys:	**Display:**	**Description:**
2 [x] 360 [x] 100 [÷]	72,000.00÷	Calculate the numerator in the equation.
[(] [(] 100 [−] 2 [)]	(98.00	Parentheses force the order of calculation.
[x] [(] 30 [−] 10 [=]	36.73	Calculates, as an annual percentage rate, the cost of not taking the discount.

Example: Another bill has the terms 2/30, NET/90. What is the cost of not taking the cash discount?

Keys:	**Display:**	**Description:**
2 [x] 360 [x] 100 [÷]	72,000.00÷	Calculates the numerator in the COST% equation.
[(] [(] 100 [−] 2 [)] [x] [(] 90 [−] 30 [=]	12.24	Calculates, as an annual percentage rate, the cost of not taking the discount.

Loans and Mortgages

Simple Annual Interest

Example: Simple Interest at an Annual Rate. Your good friend needs a loan to start her latest enterprise and has requested that you lend her $450 for 60 days. You lend her the money at 10% simple annual interest, to be calculated on a 365-day basis. How much interest will she owe you in 60 days, and what is the total amount owed?

The equation for simple annual interest using a 365 day year is:

$$\frac{\text{loan amount} \times \text{interest\%} \times \text{term of loan (in days)}}{365}$$

Keys:	Display:	Description:
450 [STO] 0 [×] 7 [%]		Computes the amount of
[×] 60 [÷] 365 [=]	5.18	interest your friend will owe.
[+] [RCL] 0 [=]	455.18	Calculates the total amount she will owe.

Continuous Compounding

The equation for calculating an effective rate for continuous compounding is:

$$\text{EFF\%} = (e^{(\text{NOM\%} \div 100)} - 1) \times 100$$

To solve a continuous compounding problem:

1. Compute the effective annual rate using the above equation.
2. Either use this effective rate in your calculations with an annual period ($P/YR = 1$) or convert this rate so that it applies to your payment period. In the following example, $P/YR = 12$ so you have to calculate a new *NOM%* using the interest rate conversion application with P equal to 12.

Example: Continuous Compounding. You currently have $4,572.80 in an account at Dream World Investments that earns 18% annual interest compounded continuously. At the end of each month, you make a deposit of $250.00 to that account. What will be the balance after 15 years?

Keys:	**Display:**	**Description:**
18 [%]	0.18	Divides the nominal rate by 100.
[MATH]	e^x LN n!	Displays the math menu.
{e^x}	1.20	Raises e to the 0.18 power.
[−] 1 [×] 100 [=]	19.72	Calculates the effective annual rate for an 18% nominal rate compounded continuously.
[EFF%]	EFF%=19.72	Stores the effective rate.
12 [P]	P=12.00	Sets number of payment periods to 12.
[NOM%]	NOM%=18.14	Calculates the nominal annual rate for a monthly payment period.
[I/YR]	I/YR=18.14	Stores this rate as the interest rate.

12 [gold] [P/YR] [gold] [BEG/END] {END}	P/YR=12.00	Sets payments per year to 12 and End mode.
15 [gold] [xP/YR]	N=180.00	Stores the number of months.
250 [+/-] [PMT]	PMT=-250.00	Stores the regular payment.
4572.8 [+/-] [PV]	PV=-4,572.80	Stores the current balance as a negative value (like an initial investment).
[FV]	FV=297,640.27	Calculates the account balance after 15 years of payments with 18% interest compounded continuously.

Yield of a Discounted (or Premium) Mortgage

The annual yield of a mortgage bought at a discount or premium can be calculated given the original mortgage amount (*PV*), interest rate (*I/YR*), periodic payment (*PMT*), balloon payment amount (if any) (*FV*), and the price paid for the mortgage (new *PV*).

Remember the cash-flow sign convention: money paid out is negative; money received is positive.

Example: Discounted Mortgage. An investor wishes to purchase a $100,000 mortgage taken out at 9% for 20 years. Since the mortgage was issued, 42 monthly payments have been made. The loan is to be paid in full (a *balloon payment*) at the end of its fifth year. What is the yield to the purchaser if the price of the mortgage is $79,000?

1. Since the payment amount (*PMT*) is not given, calculate it first. To do this, first assume 20 years' amortization on the original mortgage with no balloon payment (so $N = 20 \times 12$, $I/YR = 9$, $PV = -100{,}000$, and $FV = 0$).

2. Since the balloon amount is not given, calculate it (*FV*) next. Use *PMT* from step 1, but change *N* to 60 months ($N = 5 \times 12$), which is when the balloon is due.
3. Finally, enter current values for *N* (less number of payment periods already passed, or $5 \times 12 - 42$) and *PV*(proposed purchase price, −79,000), then calculate *I/YR* for the annual yield.

Step 1: Calculate *PMT*. Make sure $FV = 0$.

Keys:	**Display:**	**Description:**
12 [shift] [P/YR] [shift] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode.
9 [I/YR]	I/YR=9.00	Stores the interest rate.
20 [shift] [xP/YR]	N=240.00	Stores the number of months.
100000 [+/−] [PV]	PV= -100,000.00	Stores the original amount of the mortgage.
0 [FV]	FV=0.00	The loan will be completely paid off in 20 years.
[PMT]	PMT=899.73	Calculates the regular payment.

Step 2: Enter the new value for *N* given a balloon in 5 years, then find FV, the amount of the balloon.

[shift] [RND] [PMT]	PMT=899.73	Rounds the payment to two decimal places for accuracy.
5 [shift] [xP/YR]	N=60.00	Stores the number of months to the balloon.
[FV]	FV=88,706.74	Calculates the balloon payment (this would be added to the final payment).

Step 3: Enter actual, current values for *N* and *PV*; then find new *I/YR* for discounted mortgage with balloon.

RCL N − 42 N	N=18.00	Stores remaining number of payments.
79000 +/− PV	PV=-79,000.00	Stores the price of the mortgage.
I/YR	I/YR=20.72	Calculates the return on this discounted mortgage.

In solving a problem like the above one, it helps to clarify each step if you draw a cash-flow diagram. See chapter 4 for more information on cash-flow diagrams.

Annual Percentage Rate for a Loan With Fees

The annual percentage rate, APR, incorporates fees usually charged when a mortgage is issued, which effectively raises the interest rate. The actual amount received (the *PV*) by the borrower is reduced, while the periodic payments remain the same. The APR can be calculated given the term of the mortgage (*N* periods), the annual interest rate (*I/YR*), the mortgage amount (new *PV*), and the method by which the fee is calculated.

Remember the cash-flow sign convention: money paid out is negative; money received is positive.

Example: APR for a Loan With Fees. A borrower is charged two points for the issuance of a mortgage. (One point is equal to 1% of the mortgage amount.) If the mortgage amount is $60,000 for 30 years and the interest rate is 11.5% annually with monthly payments, what APR is the borrower paying?

1. Since the payment amount (*PMT*) is not given, calculate it first. Use the given mortgage amount (PV = 60,000), interest rate (*I/YR* = 11.5%), and total number of payments (*N* = 30 × 12).
2. To find the APR (the new *I/YR*), use the *PMT* calculated in step 1 and adjust the mortgage amount to reflect the points paid (*PV* = 60,000 − 2%). All other values remain the same. (Term is 30 years; *FV* is 0.)

Keys:	Display:	Description:
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode.
11.5 [I/YR]	I/YR=11.50	Stores the interest rate.
30 [xP/YR]	N=360.00	Stores the length of the mortgage.
60000 [PV]	PV=60,000.00	Stores the original amount of the mortgage.
0 [FV]	FV=0.00	The loan will be completely paid off in 30 years.
[PMT]	PMT=-594.17	Calculates the payment.
[RCL] [PV]	PV=60,000.00	Recalls the loan amount.
[−] 2 [%] [PV]	PV=58,800.00	Subtracts the points.
[I/YR]	I/YR=11.76	Calculates the APR considering the fees.

Example: Interest Only Loan With Fee. A $1,000,000, 10-year, 12% (annual interest) *interest-only* loan has an origination fee of 3 points. What is the yield to the lender? Assume that monthly payments of interest are made.

Keys:	Display:	Description:
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode.
12 [I/YR]	I/YR=12.00	Stores the interest rate.
10 [xP/YR]	N=120.00	Stores the length of the mortgage.

1000000 PV	PV=1,000,000.00	Stores the original amount of the mortgage.
+/- FV	FV=	Displays the label. The label and number are too long to fit in the display.
	-1,000,000.00	The payments are interest only, so the entire loan amount is due. (To redisplay the label, press SHOW).
PMT	PMT=-10,000.00	The interest-only payments are $10,000 per month.
RCL PV	PV=1,000,000.00	Recalls the loan amount.
- 3 % PV	PV=970,000.00	Subtracts the points.
I/YR	I/YR=12.53	Calculates the APR considering the fees.

Loan With a Partial (Odd) First Period

The TVM application deals with financial transactions in which each payment period is the same length. However, situations exist in which the first payment period is not the same length as the remaining periods. This first period is sometimes called an *odd* or *partial first period.*

If interest is applied to an odd first period, it is usually calculated as simple interest. So using the HP-14B to do a payment calculation with an odd first period is a two step process:

1. Calculate the amount of simple interest that accrues during the fractional first period and add it to the loan amount. This is your new *PV*. You must be able to calculate the length of the odd first period as a fraction of the whole period. (For example, a 15-day odd first period would be 0.5 periods assuming a whole period to be a 30-day month.)
2. Calculate the payment using the new *PV*, with *N* equal to the number of full periods. Use Begin mode if the number of days until the first payment is less than 30; otherwise use End mode.

Example: Loan With an Odd First Period. A 36-month loan for $4,500 has an annual rate of 15%. If the first monthly payment is made in 46 days, what is the monthly payment amount assuming 30-day months?

The odd first period in this example is 16 days.

Keys:	Display:	Description:
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets payments per year to 12 and End mode.
15 [I/YR]	I/YR=15.00	Stores the interest rate.
[÷] 12 [×]	1.25×	Calculates the periodic interest rate.
16 [÷] 30 [×]	0.67×	Multiplies by the fraction of a period.
4500 [SWAP] [%] [=]	30.00	Calculates the amount of simple interest owed for the odd period.
[+] 4500 [PV]	PV=4,530.00	Adds this simple interest to the present value.

36 [N]	N=36.00	Stores the term of the loan.
0 [FV]	FV=0.00	The 36 payments will completely pay off the loan.
[PMT]	PMT=-157.03	Calculates the payment amount.

Automobile Loan

Example: You are buying a new $14,000.00 sedan. Your down payment is $1,500 and you are going to finance the remaining $12,500. The car dealer is offering two choices for financing:

1. A 3-year loan with an annual interest rate of 3.5%.
2. A 3-year loan with an annual interest rate of 9.5% and a $1,000.00 rebate.

With which of the above two choices do you pay less for the car?

Keys:	**Display:**	**Description:**
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode.
36 [N] 12500 [PV] 0 [FV]	FV=0.00	Stores the known values.
3.5 [I/YR]	I/YR=3.50	Stores the first interest rate.
[PMT]	PMT= -366.28	Calculates the payment for the first financing option.

[x] [RCL] [N] [=]	-13,185.94	Calculates the total amount you will pay in interest and principal.
11500 [PV]	PV=11,500.00	Calculates the loan amount with the rebate.
9.5 [I/YR]	I/YR=9.50	Stores the second interest rate.
[PMT]	PMT=-368.38	Calculates the payment for the second financing option.
[x] [RCL] [N] [=]	-13,261.64	Calculates the total amount you will pay in interest and principal.

The first option costs less.

Canadian Mortgages

In Canadian mortgages, the compounding and payment periods are not the same. Interest is compounded semi-annually while payments are made monthly. To use the TVM application in the HP-14B, you need to calculate a *Canadian mortgage factor* (which is an adjusted interest rate) to store as *I/YR*.

For additional information on interest rate conversions, see the section "Interest Rate Conversions" in chapter 5.

Example: What is the monthly payment required to fully amortize a 30-year, $30,000 Canadian mortgage if the annual interest rate is 12%?

Keys:	Display:	Description:
12 [NOM%] 2 [P]	P=2.00	Stores the known nominal percentage and the number of compounding periods.
[EFF%]	EFF%=12.36	Calculates the effective annual rate.
12 [P]	P=12.00	Stores 12 periods per year.
[NOM%]	NOM%=11.71	Calculates the *Canadian mortgage factor* (adjusted interest rate).
[I/YR]	I/YR=11.71	Stores this newly converted rate as the annual interest rate.
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode.
30000 [PV] 0 [FV] 30 [xP/YR]	N=360.00	Stores the other known values for the mortgage.
[PMT]	PMT=-301.92	Calculates the monthly payment for the Canadian mortgage.

Advance Payments (Leasing)

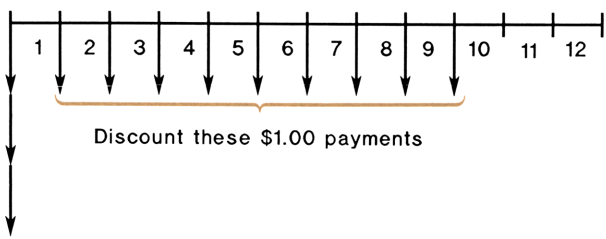
The following example calculates the monthly payment required to meet a specific yield when one or more payments are made in advance.

Remember the cash-flow sign convention: money paid out is negative; money received is positive.

Example: A Lease With Advance Payments. Equipment worth $7,500 is leased to you for 12 months. The equipment is assumed to have no salvage value at the end of the lease. To reduce your payment, you agree to make three payments in advance. What is the monthly payment if the annual interest rate is 10%.

Because the number of payments made in advance affects the amount of the payment, use "factors" to arrive at a solution:

1. Assume the payment is $1.00 and calculate the *PV* of the following cash-flow diagram. (Calculate the *PV* of the $1.00 payments then add the three $1.00 payments made in advance.)



2. Divide the lease amount by the resulting *PV* factor to arrive at the correct monthly payment.

Keys:	Display:	Description:
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode.
10 [I/YR]	I/YR=10.00	Stores the annual interest rate.
1 [PMT] 0 [FV]		
9 [N]	N=9.00	Stores the other three known values.
[PV]	PV=-8.64	Calculates the *PV* of the $1.00 payments.
[−] 3 [=]	-11.64	Calculates the *PV* including the advance payments.
[STO] 0	-11.64	Stores the factor for use in potential future calculations.
[÷] 7500 [SWAP] [=]	-644.54	Divides the lease amount by the resulting PV to get the actual payment.

"What If...?" TVM Calculations

One of the most valuable aspects of the TVM application on the HP-14B is the ease with which it handles the question "what if . . .?" in financial calculations. For example, one of the most popular "what if . . .?" questions is: "What if the interest rate changes to . . .? How will that affect my payment?" To answer this question, once you have calculated a payment based on one interest rate, all you need to do is key in the new interest rate and recalculate *PMT*.

Some of the examples earlier in this manual have included some brief encounters with "what if . . .?" questions, but a more complete example follows.

Example: A "What If...?" Loan Calculation. You are about to sign the dotted line on a 30-year $735,000 mortgage on a vacation home in a nice wooded neighborhood thirty miles from downtown San Francisco. The annual interest rate is 11.2%.

Part 1: What will be your end-of-the-month payments?

Keys:	Display:	Description:
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode.
735000 [PV] 11.2 [I/YR] 30 [xP/YR] 0 [FV]	FV=0.00	Stores the known values
[PMT]	PMT=-7,110.88	Calculates the payment.

Part 2: Your company's regular payroll happens every other Friday. What if the bank agrees to automatically draw payments of $3,555.00 out of each paycheck (approximately half of what a monthly payment would be) and adjust the payment period accordingly (26 compounding periods per year). What would be the new term of the loan?

Keys:	Display:	Description:
3555 [+/-] [PMT]	PMT=-3,555.00	Enters the new payment.
26 [P/YR]	P/YR=26.00	Sets the number of payments per year (one payment every two weeks).

N	N=514.82	Calculates the number of biweekly payments required to pay off the loan.
RCL xP/YR	YR=19.80	Displays the number of years (round up to 20) required to pay off the loan.

Part 3: What if you had monthly payments as in part 1, but chose a 15-year term? What would your new payment be? What would be the total interest paid on the contract?

Keys:	**Display:**	**Description:**
12 P/YR	P/YR=12.00	Back to monthly payments.
15 xP/YR	N=180.00	Stores the new term.
PMT	PMT=-8,446.53	Calculates the payment for the shorter term.
× RCL N	×180.00	Multiplies the payment amount by the number of payments?
+ RCL PV =	-785,374.70	Displays the total interest paid on the contract.

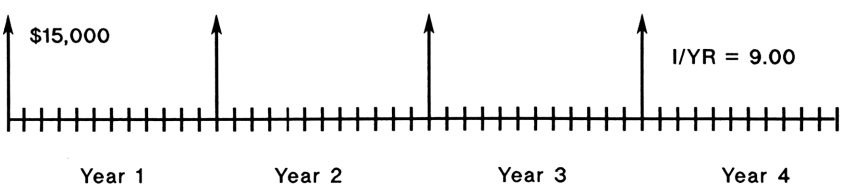
Savings

Saving for College Costs

Suppose you want to start saving now to accommodate a future series of cash outflows. An example of this is saving money for college. To determine how much you need to save each period, you must know when you'll need the money, how much you'll need, and at what interest rate you can invest your deposits.

Example: Savings for College. Your daughter will be going to college in 12 years and you are starting a fund for her education. She will need $15,000 at the beginning of each year for four years. The fund earns 9% annual interest, compounded monthly, and you plan to make monthly deposits, starting at the end of the current month. The deposits cease when she begins college. How much do you need to deposit each month?

This problem needs to be solved in two steps. First calculate the *PV* of this cash-flow diagram starting with an interest rate conversion because of the monthly compounding:

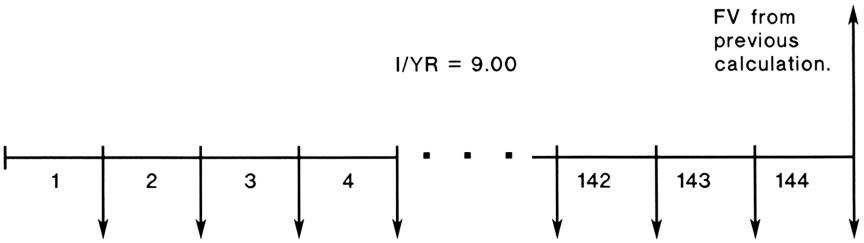


Keys:	Display:	Description:
9 [NOM%]	NOM%=9.00	Stores the nominal annual rate.
12 [P]	P=12.00	Stores the number of compounding periods used with this nominal rate.
[EFF%]	EFF%=9.38	Calculates the effective annual rate.

When compounding occurs only once per year, the effective rate and the nominal rate are the same.

[I/YR]	I/YR=9.38	Stores the effective rate as the annual rate.
1 [P/YR] [BEG/END] {BEGIN}	P/YR=1.00	Sets 1 payment per year and Begin mode.
15000 [PMT]	PMT=15,000.00	Stores the annual withdrawal.
4 [N]	N=4.00	Stores number of withdrawals.
0 [FV]	FV=0.00	Stores the balance at the end of four years.
[PV]	PV=-52,713.28	Calculates the amount required when your daughter starts college.

Then use that *PV* as the *FV* on the following cash-flow diagram, and calculate the *PMT*.



PMT = ?

Keys:	Display:	Description:
[+/-] [FV]	FV=52,713.28	Stores the amount you will need.
0 [PV]	PV=0.00	Stores the amount you are starting with.
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode.
144 [N] 9 [I/YR]	I/YR=9.00	Stores the number of deposits and the interest rate.
[PMT]	PMT=-204.54	Calculates the monthly payment required now to meet the future demands of college.

Gains That Go Untaxed Until Withdrawal

You can use the TVM application to calculate the future value of a tax-free or tax-deferred account. (Current tax law and your current income will determine whether just interest or also principal are tax-free, and for how long. You can solve for either case.)

N	=	the number of payments until retirement.
I/YR	=	the annual dividend rate.
PV	=	the current amount of your deposit (it must be constant for the duration of the account).
PMT	=	the amount of the annual payment.
FV	=	the future value of the retirement account.

The purchasing power of that future value depends on the inflation rate and the duration of the account.

Example: Tax-Free Account. Consider opening a tax-deferred account with a dividend rate of 8.175%. If you invest $2,000 at the beginning of each year for 35 years, how much will you have in the account at retirement? How much will you have paid into the account? How much interest will you have earned? If your post-retirement tax rate is 15%, what is the after-tax future value of the account? Assume that only the interest will be taxed. (Assume the principal was taxed before deposit.) What is the purchasing power of that amount, in today's dollars, assuming an 8% inflation rate?

Keys:	Display:	Description:
1 [P/YR] [BEG/END] {BEGIN}	P/YR=1.00	Sets 1 payment per year and Begin mode.
35 [N] 8.175 [I/YR]	I/YR=8.18	Stores the number of payment periods until retirement and the interest rate.
0 [PV]	PV=0.00	Stores the amount you are starting with.

2000 [+/-] [PMT]	PMT=-2,000.00	Stores the amount of the annual payment.
[FV]	FV=387,640.45	Calculates the amount in the account at retirement.
[RCL] [PMT] [×] [RCL] [N] [=]	-70,000.00	Calculates the amount you have paid into the account by retirement.
[+] [RCL] [FV] [=]	317,640.45	Calculates the interest the account has earned by retirement.
[×] 15 [%] [=]	47,646.07	Taxes at 15% of interest.
[+/-] [+] [RCL] [FV] [=]	339,994.39	Calculates the after-tax *FV*.
[FV]	FV=339,994.39	Stores the after-tax future value in *FV*.
8 [I/YR] 0 [PMT] [PV]	PV=-22,995.36	Calculates present-value purchasing power of the above after-tax *FV* assuming an 8% inflation rate.

Value of a Taxable Retirement Account

This problem uses the TVM application to calculate the future value of a *taxable* retirement account that receives regular, annual payments beginning today (Begin mode). The annual tax on the interest is paid out of the account. (Assume the deposits have been taxed already.)

N =	the number of years until retirement.
I/YR =	the annual interest rate diminished by the tax rate: *interest rate* × (1 − *tax rate*).
PV =	the current amount in the retirement account.
PMT =	the amount of the annual payment.
FV =	the future value of the retirement account.

Example: Taxable Retirement Account. If you invest $3,000 each year for 35 years, with dividends taxed as ordinary income, how much will you have in the account at retirement? Assume an annual dividend rate of 8.175% and a tax rate of 28%, and that payments begin today. What will be the purchasing power of that amount in today's dollars, assuming 8% inflation?

Keys:	**Display:**	**Description:**
1 [P/YR] [BEG/END] {BEGIN}	P/YR=1.00	Sets 1 payment per year and Begin mode.
35 [N]	N=35.00	Stores the number of payment periods until retirement.
8.175 [×] [(] 1 [−] 28 [%] [)] [=]	5.89	Calculates the interest rate diminished by the tax rate.
[I/YR]	I/YR=5.89	Stores the interest rate.
0 [PV]	PV=0.00	Stores the amount you are starting with.
3000 [+/−] [PMT]	PMT=-3,000.00	Stores the amount of the annual payment.

FV	FV=345,505.61	Calculates the amount in the account at retirement.
8 I/YR 0 PMT PV	PV=-23,368.11	Calculates present-value purchasing power of the above *FV* assuming an 8% inflation rate.

Cash-Flow Examples

Wrap-Around Mortgages

A wrap-around mortgage is a combination of refinancing a mortgage and borrowing against real estate equity. Usually the two unknown quantities in the wrapped mortgage are the new payment and the rate of return to the lender. To arrive at a solution, you need to use both the TVM application and the cash-flow function *IRR%*.

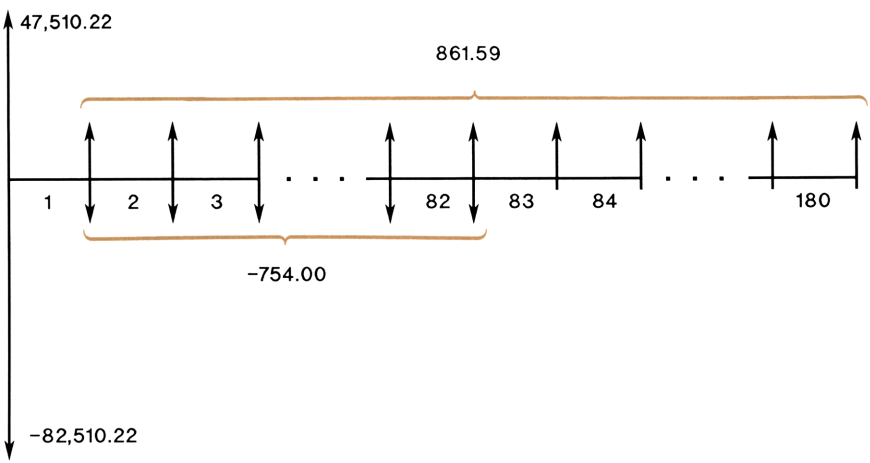
Example: You have 82 monthly payments of $754 left on your 8% mortgage, leaving a remaining balance of $47,510.22. You would like to wrap that mortgage and borrow an additional $35,000 for another investment. You find a lender who is willing to "wrap" an $82,510.22 mortgage at 9.5% for 15 years. What are your new payments and what return is the lender getting on this wrap-around mortgage?

The payment calculation is a straightforward TVM payment calculation using the new amount as the *PV*.

Keys:	Display:	Description:
12 P/YR BEG/END {END}	P/YR=12.00	Sets 12 payments per year and End mode.

47510.22 [+] 35000 [PV]	PV=82,510.22	Stores the loan amount on which your new payment is calculated.
9.5 [I/YR]	I/YR=9.50	Stores the interest rate.
0 [FV]	FV=0.00	Stores the final balance.
15 [gold] [xP/YR]	N=180.00	Stores the number of monthly payments you will make.
[PMT]	PMT=-861.59	Calculates your new payment.

Then, to calculate the lender's return, you need to input a cash-flow list that represents the *complete* picture of the wrap-around mortgage from the lenders point of view:



When you group the above cash flows, you'll find that:

```
C0 = 47,510.22 − 82,510.22 = −35,000.00
C1 = 861.59 − 754.00 = 107.59
N1 = 82
C2 = 861.59
N2 = 180 − 82 = 98
```

Keys:	Display:	Description:
12 [gold] [P/YR]	P/YR=12.00	Sets 12 payments per year.
[gold] [IRR%]	CL CFLO? Y N	

If this display comes up, press {Y} to clear the list.

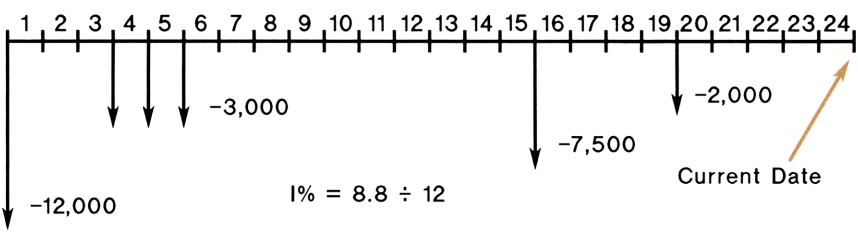
	C0?	Now the HP-14B is waiting for you to input the lender's cash flow.
35000 [+/−] [INPUT]	C0=-35,000.00	Enters $35,000 for the loan amount.
	C1?	Prompts for the amount in group 1.
[RCL] [PMT] [+/−]		
[−] 754 [INPUT]	C1=107.59	Enters the net payment for the first 82 months.
	N1?1.00	Prompts for the number of payments in this group.
82 [INPUT]	N1=82.00	Briefly displayed.
	C2?	Prompts for the amount for group 2.

RCL PMT +/- INPUT	C2=861.59	Enters the net payment for the next 98 months.
	N2?1.00	Prompts for the number of cash flows in group 2.
180 − 82 INPUT	N2=98.00	Briefly displayed.
	C3?	Prompts for group 3, but you have finished entering the list.
COMPUTE	IRR%=0.85	Calculates the periodic return.
RCL I/YR	10.16	Recalls the annual return (automatically stored in *I/YR*).

Net Future Value

The net future value can be calculated by using the TVM keys to *slide* the net present value (*NPV*) forward on the cash-flow diagram.

Example: Value of a Fund. You have made the following investments over the past two years into a money market fund earning 8.8%. What is the current balance of the account?



Keys:	Display:	Description:
12 [P/YR] [BEG/END] {END}	P/YR=12.00	Sets 12 payments per year and End mode for use with the TVM application at the end of this solution.
[NPV]	I%?0.00	To calculate *NPV,* you need to input a periodic interest rate

The I% displayed above may not be zero. The rate displayed is whatever was previously input.

8.8 [÷] 12 [INPUT]	CL CFLO? Y N	

If this clear message is displayed, press {Y} to clear the list.

	C0?	Prompts for the initial cash flow.
12000 [+/-] [INPUT]	C0=-12,000.00	Enters the initial cash flow.
	C1?	Prompts for the amount in group 1.
0 [INPUT]	C1=0.00	Enters the amount in group 1.
	N1?1.00	Prompts for the number of cash flows in group 1 (if there is only one, press [INPUT]).
2 [INPUT]	N1=2.00	Briefly displayed.
	C2?	Prompts for the amount in group 2.
3000 [+/-] [INPUT]	C2=-3,000.00	Enters the amount in group 2.

	N2?1.00	Prompts for the number of cash flows in group 2.
3 [INPUT]	C3?	Enters the number of cash flows in group 2.
0 [INPUT] 9 [INPUT]	C4?	Enters cash-flow group 3.
7500 [+/-] [INPUT] [INPUT]	C5?	Enters cash-flow group 4.
0 [INPUT] 3 [INPUT]	C6?	Enters cash-flow group 5.
2000 [+/-] [INPUT] [INPUT]	C7?	Enters cash-flow group 6.
[COMPUTE]	NPV=-29,203.14	Calculates the net present value (*NPV*). This amount is automatically stored as *PV*.
24 [N] 0 [PMT] 8.8 [I/YR]	I/YR=8.80	Stores the known values.
[FV]	FV=34,800.58	Calculates the net future value.

A

Assistance, Batteries, Warranty, and Service

Obtaining Help in Operating the Calculator

Hewlett-Packard is committed to providing owners of HP calculators with ongoing support. You can obtain answers to your questions about using the calculator from our Calculator Support Department. (The address and phone number are on the inside of the back cover).

We suggest reading "Answers to Common Questions," below, before contacting us. Past experience has shown that many of our customers have similar questions.

Answers to Common Questions

Q: I'm not sure if the calculator is malfunctioning or if I'm doing something incorrectly. How can I determine if the calculator is operating properly?

A: Refer to page 158, which describes the diagnostic self-test.

Q: My numbers contain commas as decimal points. How do I restore the periods?

A: Press [DISP] {.} .

Q: How do I change the number of decimal places the HP-14B displays?

A: The procedure is described in "Decimal Places" on page 25.

Q: How do I clear all or portions of memory?

A: Use the [C] key to clear the display to zero. Sometimes you need to press [C] more than once if you are using an application. Using the CLEAR menu to clear parts of memory is described on page 19. Erasing everything in memory is described in "Clearing Memory," on page 157.

Q: Why am I getting the wrong answer or the message `NO SOLUTION` using the TVM menu?

A: Be sure to enter a value for four of the five TVM values before you solve for the fifth, even if one of the values is zero. (Don't forget to store a zero for FV if you completely pay off a loan.) Clearing the TVM registers ([CLEAR] {TVM}) before entering your known values accomplishes the same thing. Check to see that the calculator is in the appropriate payment mode (Begin mode or End mode).

Be careful about the cash-flow sign convention (money paid out needs to be entered as a negative number). *PV*, *PMT*, and *FV* cannot all be positive in the same problem.

Q: Why is there a colon (:) in the display?

A: The colon is displayed when you key in a number and press [INPUT]. This operation is used when entering statistics data. Refer to page 105.

Q: What does "E" in a number mean (for example, 2.51E-13)?

A: Exponent of ten (for example, 2.51 x 10^{-13}). Refer to "Scientific Notation" on page 27.

Q: How can I change the sign of a number in the cash-flow list without keying the number in again?

A: Move the number into the display using the appropriate arrow key, then press [+/-] [INPUT].

Power and Batteries

The HP-14B is shipped with alkaline batteries. A fresh set of three alkaline batteries typically provides approximately 7 to 24 months of use. (Mercury and silver oxide batteries last about twice as long.) However, expected battery life depends on how the calculator is used. The calculator consumes the most power when it is trying to solve a long calculation (like computing an [IRR%]).

Use only fresh button-cell batteries. Do not use rechargeable batteries. The following batteries are recommended for use. Not all batteries are available in all countries.

Alkaline	**Mercury**	**Silver Oxide**
Panasonic LR44	Panasonic NP675	Panasonic SR44 or SP357
Eveready A76	Eveready EP675E	Eveready 357
Varta V13GA	Duracell MP675H	Ray-O-Vac 357
Duracell LR44	Toshiba NR44 or MR44	Varta V357
	Radio Shack NR44 or MR44	

Low Power Indications

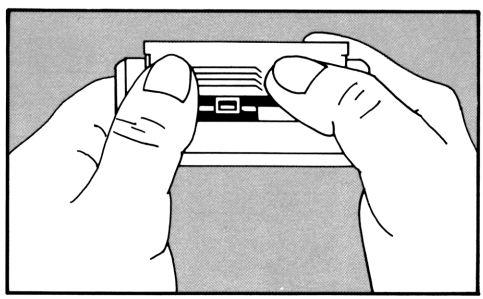
When the low-battery annunciator () comes on, you should replace the batteries as soon as possible.

If you continue to use the calculator after the battery annunciator comes on, power can eventually drop to a level at which the display becomes dim and stored data may be affected. If this happens, the calculator requires fresh batteries before it will operate properly. If stored data has not been preserved due to extremely low power, the HP-14B displays `MEMORY CLEAR`.

Installing Batteries

Once the batteries are removed, replace the batteries within one minute to prevent loss of Continuous Memory. Have the new batteries readily at hand before removing the batteries. Also, you must make sure the calculator is off during the entire process of changing batteries.

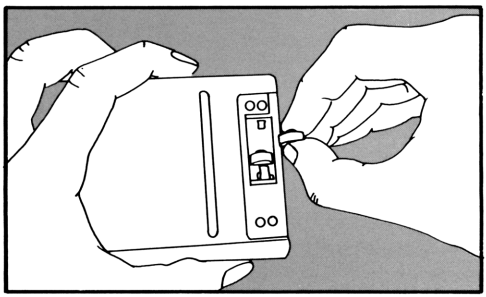
1. Have three fresh button-cell batteries at hand.
2. Make sure the calculator is off. **Do not press [C] again until the entire procedure for changing the batteries is completed. Changing batteries with the calculator on can erase the contents of Continuous Memory.**
3. Hold the calculator as shown. To remove the battery-compartment door, press down and outward on it until it slides off (away from the center).



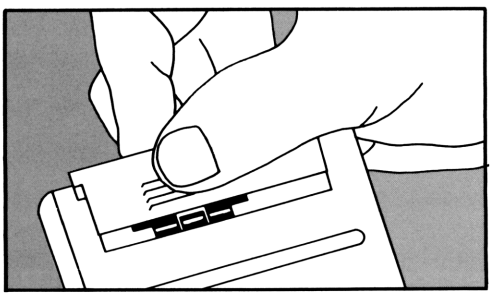
4. Turn the calculator over and shake out the batteries.

Warning **Do not mutilate, puncture, or dispose of batteries in fire. The batteries can burst or explode, releasing hazardous chemicals.**

5. Hold the calculator as shown and stack the batteries, one at a time, in the battery compartment. Orient the batteries according to the diagram inside the battery compartment. Be sure the raised and flat ends match the diagram.



6. Insert the tab of the battery-compartment door into the slot in the calculator case, as shown:



Now turn the calculator on. If it does not function, you might have taken too long to change the batteries or you might have inadvertently turned the calculator on while the batteries were out. *Remove the batteries* again and lightly press a coin against both battery contacts in the calculator *for a few seconds.* Put the batteries back in and turn the calculator on. It should display MEMORY CLEAR.

Resetting the Calculator

If the calculator doesn't respond to keystrokes or if it is otherwise behaving unusually, attempt to reset it. Resetting the calculator halts the current calculation or application and clears the display.

To reset the calculator, hold down the [C] key while you press the [PV] key. Release both keys. If you are unable to reset the calculator, try installing fresh batteries. If the calculator cannot be reset, or if it still fails to operate properly, you should attempt to clear memory using the procedure described in the next section.

Clearing Memory

If the calculator fails to respond to keystrokes, and you are unable to restore operation by resetting it or changing the batteries, do the following procedure. These keystrokes clear memory (like [CLEAR] {ALL}), and may be possible whent he keyboard is not functioning properly:

1. Press and hold down the [C] key.
2. Press and hold down the [N] key.
3. Press [Σ+]. (You will be pressing three keys simultaneously.)

When you release the keys, the HP-14B displays MEMORY CLEAR if the operation is successful, and these start-up conditions are set: FIX 2, P/YR=12, End mode, and period (.) decimal point.

Memory may inadvertently be cleared if the calculator is dropped or if power is interrupted.

Environmental Limits

In order to maintain product reliability, observe the following temperature and humidity limits of the HP-14B:

- Operating temperature: 0° to 45°C (32° to 113°F).
- Storage temperature: −20° to 65°C (−4° to 149°F).
- Operating and storage humidity: 90% relative humidity at 40°C (104°F) maximum.

Determining If the Calculator Requires Service

Use these guidelines to determine if the calculator requires service. If it does, read "If the Calculator Requires Service" on page 161.

- **If the calculator won't turn on (nothing is visible in the display):**
  1. Attempt to reset the calculator (see page 157).
  2. If the calculator fails to respond after step 1, replace the batteries.

  If steps 1 and 2 fail to restore calculator function, it requires service.
- **If the calculator doesn't respond to keystrokes (nothing happens when you press any of the keys):**
  1. Attempt to reset the calculator (see page 157).
  2. If the calculator fails to respond after step 1, attempt to clear memory (see page 157). This will erase all the information you have stored.
  3. If the calculator fails to respond after steps 1 and 2, remove the batteries (see page 154) and lightly press a coin against both calculator battery contacts. Put the batteries back in and turn on the calculator. It should display MEMORY CLEAR.

  If steps 1 through 3 do not restore calculator function, the calculator requires service.

■ **If the calculator responds to keystrokes but you suspect it is malfunctioning:**

1. Do the self-test (described below). If the calculator fails the self test, it requires service.
2. If the calculator passes the self-test, it is likely you've made a mistake in operating the calculator. Try rereading portions of the manual, and check "Answers to Common Questions" on page 152.
3. Contact the Calculator Support Department. The address and phone number are listed on the inside back cover.

Confirming Calculator Operation: Self-Test

If the display can be turned on, but it appears that the calculator is not operating properly, you can do a diagnostic self-test.

To run the self test:

1. To start the self-test, hold down the [C] key while you press the [PMT] key*.
2. Press any key eight times, and watch the display as various patterns are displayed. After you've pressed the key eight times, the calculator displays the copyright message `COPR. HP 1987`, and then the message `KBD 01`.
3. Starting at the upper left corner ([N]) and moving from left to right, press each key in the top row. Then, moving left to right, press each key in the second row, third row, etc., until you've pressed every key.
   - If you press the keys in the proper order, and they are functioning properly, the calculator displays `KBD` followed by two-digit numbers (the calculator is counting the keys using hexadecimal numbers).

* Holding down the [C] key as you press the [FV] key starts a continuous self-test that is used at the factory. If you accidently start this self-test, you can stop it by pressing any key.

- If you press a key out of order, or if a key isn't functioning properly, the next keystroke displays a fail message (see step 4).

4. The self-test produces one of these two results:
   - The calculator displays `14B -OK`, if it passed the self-test. Go to step 5.
   - The calculator displays `14B -FAIL`, followed by a one-digit number, if it failed the self-test. If you received the message because you pressed a key out of order, you should reset the calculator (hold down [C] and press [PV]), and do the self-test again. If you pressed the keys in order, but got the fail message, repeat the above self-test to verify the results. If the calculator fails again, it requires service (see page 161). Include a copy of the fail message with the calculator when you ship it for service.
5. To exit the self-test, reset the calculator (hold down [C] and press [PV]).

Limited One-Year Warranty

What Is Covered

The calculator except for the batteries, or damage caused by the batteries *is warranted by Hewlett-Packard against defects in materials and workmanship for one year from the date of original purchase.* If you sell your unit or give it as a gift, the warranty is automatically transferred to the new owner and remains in effect for the original one-year period. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you return the product, shipping prepaid, to a Hewlett-Packard service center. Replacement may be with a newer model of equivalent or greater functionality.

This warranty gives you specific legal rights, and you may also have other rights that vary from state to state, province to province, or country to country.

What Is Not Covered

Batteries, and damage caused by the batteries, are not covered by the Hewlett-Packard warranty. Check with the battery manufacturer about battery and battery leakage warranties.

This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by other than an authorized Hewlett-Packard service center.

No other express warranty is given. The repair or replacement of a product is your exclusive remedy. **ANY OTHER IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS IS LIMITED TO THE ONE-YEAR DURATION OF THIS WRITTEN WARRANTY.** Some states, provinces, or countries do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. **IN NO EVENT SHALL HEWLETT-PACKARD COMPANY BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Some states, provinces, or countries do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Products are sold on the basis of specifications applicable at the time of manufacture. Hewlett-Packard shall have no obligation to modify or update products once sold.

Consumer Transactions in the United Kingdom

This warranty shall not apply to consumer transactions and shall not affect the statutory rights of a consumer in the United Kingdom. In relation to such transaction, the rights and obligations of Seller and Buyer shall be determined by statute.

If the Calculator Requires Service

Hewlett-Packard maintains service centers in many countries. These centers will repair a calculator or replace it (with an equivalent or newer model) whether it is under warranty or not. There is a charge for service after the warranty period. Calculators normally are serviced and re-shipped within 5 working days of receipt.

Obtaining Service

- **In the United States:** Send the calculator to the Calculator Service Center listed on the inside of the back cover.
- **In Europe:** Contact your HP sales office or dealer or HP's European headquarters for the location of the nearest service center. Do not ship the calculator for service without first contacting a Hewlett-Packard office.

  Hewlett-Packard S.A.
  150 Route du Nant-d'Avril
  P.O. Box CH 1217 Meyrin 2
  Geneva, Switzerland
  Telephone: (022) 82 81 11
- **In other countries:** Contact your HP sales office or dealer or write to the U.S. Calculator Service Center (listed on the inside of the back cover) for location of other service centers. If local service is unavailable, you can ship the calculator to the U.S. Calculator Service Center for repair.

All shipping, re-importation arrangements, and customs costs are your responsibility.

Service Charge

There is a standard repair charge for out-of-warranty service. The Calculator Service Center (listed on the inside of the back cover) can tell you how much this charge is. The full charge is subject to the customer's local sales or value-added tax wherever applicable.

Calculator products damaged by accident or misuse are not covered by the fixed service charges. In these cases, charges are individually determined based on time and material.

Shipping Instructions

If your calculator requires service, ship it to the nearest authorized service center or collection point. (You must pay the shipping charges for delivery to the service center, whether or not the calculator is under warranty.) Be sure to:

- Include your return address and description of the problem.
- Include proof of purchase if the warranty has not expired.
- Include a purchase order, check, or credit card number plus expiration date (Visa or MasterCard) to cover the standard repair charge. In the United States and some other countries, the serviced calculator will be returned C.O.D. if you do not pay in advance.
- Ship the calculator in adequate protective packaging to prevent damage. Such damage is not covered by warranty, so we recommend that you insure the shipment.

Warranty on Service

Service is warranted against defects in materials and workmanship for 90 days from the date of service.

Service Agreements

In the U.S., a support agreement is available for repair and service. Refer to the form in the front of the manual. For additional information, contact the Calculator Service Center (see the inside of the back cover).

Regulatory Information

Radio Frequency Interference

U.S.A. The HP-14B generates and uses radio frequency energy and may interfere with radio and television reception. The calculator complies with the limits for a Class B computing device as specified in Subpart J of Part 15 of FCC Rules, which provide reasonable protection against such interference in a residential installation. In the unlikely event that there is interference to radio or television reception (which can be determined by turning the HP-14B off and on or by removing the batteries, try:

- Reorienting the receiving antenna.
- Relocating the calculator with respect to the receiver.

For more information, consult your dealer, an experienced radio/television technician, or the following booklet, prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-TV Interference Problems.* This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock Number 004-000-00345-4. At the first printing of this manual, the telephone number was (202) 783-3238.

West Germany. The HP-14B complies with VFG 1046/84, VDE 0871B, and similar non-interference standards.

If you use equipment that is not authorized by Hewlett-Packard, that system configuration has to comply with the requirements of Paragraph 2 of the German Federal Gazette, Order (VFG) 1046/84, dated December 14, 1984.

B

More About Calculations

IRR% Calculations

The calculator determines *IRR%* for a set of cash flows using mathematical formulas that "search" for the answer. The process finds a solution by estimating an answer and then using that estimate to do another calculation. In mathematical terms, this is called an iterative process.

In most cases, the calculator finds the desired answer, since there is usually only one solution to the calculation. However, calculating *IRR%* for certain sets of cash flows is more complex. There may be more than one mathematical solution to the problem, or there may be no solution. In these cases, the calculator displays a message to help you interpret what has happened.

Possible Outcomes of Calculating *IRR%*

These are the possible outcomes of an *IRR%* calculation for which you have not stored a guess.

- **Case 1:** The calculator displays a positive answer. This is the only positive answer. However, one or more negative answers may exist.
- **Case 2:** The calculator finds a negative answer but a single positive answer also exists. It displays: `IRR%>0 EXIST`. To see the negative answer, press [←] to clear the message. To search for the positive answer, you must input a guess. (Refer to "Storing a Guess for *IRR%*," below). There might also be additional negative answers.
- **Case 3:** The calculator displays a negative answer and no message. This is the only answer.

- **Case 4:** The calculator displays the message: MANY/NO SOL (Many or No Solution). This indicates that the calculation is very complex. It might involve more than one positive or negative answer, or there may be no solution. To continue the calculation, you must store a guess (see below).
- **Case 5:** The calculator displays: NO SOLUTION. There is no answer. This situation might be the result of an error, such as a mistake in keying in the cash flows. A common mistake that results in this message is putting the wrong sign on a cash flow. A valid cash-flow series for an *IRR%* calculation must have at least one positive and one negative cash flow.

Halting and Restarting *IRR%*

The search for *IRR%* may take a relatively long time. You can halt the calculation at any time by pressing the [C] key. The calculator displays the message: INTERRUPTED. Pressing [◀] now displays the current estimate for *IRR%*. You can resume the calculation by:

- Pressing [STO] [IRR%] while the current estimate is displayed in the calculator line. This continues the calculation from where it left off.
- Storing a guess for *IRR%*, discussed below.

Entering a Guess for IRR%

To enter a guess, key in an estimate of *IRR%* and then press [STO] [IRR%]. You can enter a guess for *IRR%* at these times:

- Before beginning the calculation. A fairly accurate guess can reduce the time required to calculate an answer and reduce the chance of the calculator solving for an undesirable negative solution.
- After you've interrupted the calculation.
- After the calculator has halted the calculation due to any of the aforementioned cases. However, for cases 3 and 5, no (other) solutions will be found.

When calculating *IRR%* using a guess, the calculation halts when it finds an answer. However, there may be additional positive or negative answers, or no true solution at all. You can continue searching for another solution by halting the calculation and entering a different guess.

One way to obtain a good guess for *IRR%* is to calculate the *NPV* for various interest rates. Since *IRR%* is the interest rate at which *NPV* equals zero, the best estimate of *IRR%* is the interest rate that yields the value for *NPV* closest to zero.

To find a good estimate for *IRR%*, compute *NPV* by entering your *IRR%* guess as *I%*. Repeat the calculation of *NPV* for several values of *I%*, and look for trends in the results. Choose as your guess for *IRR%* a value of *I%* that produces an *NPV* close to zero.

Effect of Using [f] [Σ−] to Correct Data

The HP-14B stores the statistical numbers in an "accumulated" fashion. It doesn't store every number that you enter, but rather it performs intermediate calculations when you press the [Σ+] key. The [f] [Σ−] key performs the opposite intermediate calculations to effectively remove a number or pair of numbers from the stored results.

When correcting statistical data, [f] [Σ−] does not delete rounding errors that may occur during the intermediate calculations done by [Σ+]. Thus subsequent results for corrected data may be different than for data that was entered correctly without having to use [f] [Σ−]. However, the difference will not be serious unless the incorrect data has a very large magnitude compared with the correct values; in this case, you may want to clear the statistical registers and re-enter the data.

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 $\pm 1 \times 10^{-499}$. Underflow displays a zero. Refer to the message `OVERFLOW` in "Displayed Messages" following this appendix.

Equations Used

Percentage Calculations

$$\%CHANGE = \left(\frac{NEW - OLD}{OLD}\right) \times 100$$

$$\%TOTAL = \left(\frac{PART}{TOTAL}\right) \times 100$$

$$MAR = \left(\frac{PRC - COST}{PRC}\right) \times 100$$

Business Calculations

$$\text{ROI\%:} = \frac{\text{REV} \times \text{PROF\%}}{\text{INVS}}$$

$$\text{B.EVEN: PROF} = \#\text{SLD} \times (\text{PRC} - \text{VARC}) - \text{FIXC}$$

$$\text{INVEN:} \quad \text{INVEN} = \frac{\text{SOLD}}{(\text{ENDI} + \text{BEGI}) \div 2}$$

Time Value of Money (TVM)

Payment Mode Factor: S = 0 for End mode; 1 for Begin mode.

$$i\% = \frac{I\%YR}{P/YR}$$

$$0 = PV + \left(1 + \frac{i\% \times S}{100}\right) \times PMT \times \left[\frac{1 - \left(1 + \frac{i\%}{100}\right)^{-N}}{\frac{i\%}{100}}\right]$$

$$+ FV \times \left(1 + \frac{i\%}{100}\right)^{-N}$$

Amortization

ΣINT = accumulated interest
ΣPRN = accumulated principal
i = periodic interest rate

BAL is initially *PV* rounded to the current display setting.

PMT is initially *PMT* rounded to the current display setting.

$$i = \frac{I\%YR}{P/YR \times 100}$$

For each payment amortized:

$INT' = BAL \times i$ (*INT'* is rounded to the current display setting; *INT'* = 0 for period 0 in Begin mode.)

$$INT = INT' \text{ (with sign of } PMT)$$

$$PRN = PMT + INT'$$

$$BAL_{new} = BAL_{old} + PRN$$

$$\Sigma INT_{new} = \Sigma INT_{old} + INT$$

$$\Sigma PRN_{new} = \Sigma PRN_{old} + PRN$$

Interest Rate Conversions

$$EFF\% = \left[\left(1 + \frac{NOM\%}{100 \times P}\right)^{P} - 1\right] \times 100$$

Cash-Flow Calculations

j = the group number of the cash flow.
C_j = amount of the cash flow for group j.
n_j = number of times the cash flow occurs for group j.
k = the group number of the last group of cash flows.

$$N_j = \sum_{1 \leq l < j} n_l = \text{total number of cash flows prior to group } j.$$

$$NPV = C_0 + \sum_{j=1}^{k} \left(Cj \times \frac{1 - (1 + i\%/100)^{-n_j}}{i\%/100} \times (1 + i\%/100)^{-N_j} \right)$$

When $NPV = 0$, the solution for I% is $IRR\%$.

Statistics

$$\bar{x} = \frac{\Sigma x_i}{n} \qquad \bar{y} = \frac{\Sigma y_i}{n}$$

$$\bar{x}w = \frac{\Sigma y_i x_i}{\Sigma y_i}$$

$$sx = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n - 1}} \qquad sy = \sqrt{\frac{\Sigma(y_i - \bar{y})}{n - 1}}$$

Forecasting

Model		Transformation	X_i	Y_i
L	$y = b + mx$	$y = b + mx$	x_i	y_i
EX	$y = be^{mx}$	$\ln y = \ln b + mx$	x_i	$\ln y_i$
LOG	$y = b + m \ln x$	$y = b + m \ln x$	$\ln x_i$	y_i
P	$y = bx^m$	$\ln y = \ln b + m \ln x$	$\ln x_i$	$\ln y_i$

Let: $$\overline{X} = \frac{\Sigma X_i}{n} \qquad \overline{Y} = \frac{\Sigma Y_i}{n}$$

$$SX2 = \Sigma(X_i - \overline{X})^2 \qquad SY2 = \Sigma(Y_i - \overline{Y})^2$$

$$SXY = \Sigma(X_i - \overline{X})(Y_i - \overline{Y})$$

Then: $$m = \frac{SXY}{SX2}$$

$b = B$ for L and LOG models, and
$b = e^B$ for EX and P models,

where $B = \overline{Y} - m\overline{X}$.

$$r = \frac{SXY}{\sqrt{SX2 \times SY2}}$$

Displayed Messages

Under certain circumstances, for example, when you attempt an operation that is not allowed, the calculator will display a message. Some messages flash briefly in the display as reminders and others stay in the display until you press any key. The attention annunciator (⚠) will be displayed along with certain messages.

`CALCULATING`
The calculator is busy.

`CANNOT SOLVE`
Attempt to solve for *P* in the interest conversion application or for *P/YR* in the TVM application.

`DIVIDE BY 0`
Attempt to divide by zero.

`I% <= -100%`
One of the following values is less than or equal to −100%:

- *I/YR* ÷ *P/YR* in the TVM application.
- *NOM%* ÷ *P* when calculating *EFF%*.
- *EFF%* when calculating *NOM%*.

`INTERRUPTED`
An *IRR%*, *I/YR*, or amortization calculation was interrupted by pressing [C].

INVALID DATA
A data error. Check the values you are calculating with.

INVALID FIT
Forecasting model is inappropriate for input data.

INVALID LN
Attempt to take the natural logarithm ({LN} in the MATH menu) of zero or a negative number.

INVALID n!
Attempt to calculate the factorial ({n!} in the MATH menu) of a negative or non-integer value.

INVALID N
Attempt to calculate *I/YR* with $N \leq 0.9999$ or $N \geq 10^{10}$.

INVALID PER.
Cash-flow periods must be in the range from 1 to 999 and amortization periods must be in the range from 1 to 1200. This message indicates an attempt to enter values outside those ranges.

INVALID Y^x
Exponentiation error. Attempt to raise a negative to a non-integer power, zero to a negative power, or 0^0.

IRR%>0 EXIST
Calculation of *IRR%* produced a negative answer, but the HP-14B has determined there is also a unique positive answer. Refer to page 165.

LIST IS FULL
The cash-flow list is full. (The maximum number is 21 groups.)

MANY/NO SOL
A solution for *IRR%* or *I/YR* may or may not exist. If you are attempting to solve *I/YR*, you may be able to perform the calculation using *IRR%*. If you are attempting an *IRR%* calculation, refer to page 165.

MEMORY CLEAR
Any data that was stored in the calculator has been cleared (page 157).

MEMORY FULL
The expression in the display has too many levels of parentheses to fit in memory. Memory for the display can hold a maximum of eight levels of parentheses.

NEED NUMBER
An application was requesting an input and no number was entered.

NO BEST FIT
A math or statistics error was encountered while attempting to find the best fitting curve model or not enough data was entered (too few data points or x-data only).

NO CASH FLOW
An *IRR%* or *NPV* calculation has been attempted when the cash-flow list is empty.

NO SOLUTION
No solution exists for the given inputs to the TVM application or for the given cash-flow list with *NPV* or *IRR%*. This most commonly results from an incorrect sign for a cash flow.

NO STAT DATA
No statistics data is currently stored (refer to "Entering Statistical Data" on page 102).

OVERFLOW
Warning (displayed momentarily); the magnitude of a result is too large for the calculator to handle. The HP-14B returns +/- 9.99999999999E499 in the current display format. (Refer to "Range of Numbers" on page 167.) Also, OVERFLOW can be an error message from the TVM calculation indicating a result in a calculation is too large for the HP-14B to handle.

SQRT(NEG)
Attempt to take the square root of a negative number.

STAT ERROR
Statistics error: represents a divide by zero or math error in a statistical calculation, $n = 0$ for a mean calculation, $n \leq 1$ for a standard deviation or curve fit . It can also mean that all x-data or y-data are equal for a curve fit. (Refer to the equations for statistics on page 170 and the footnote on page 113.)

UNDERFLOW
An internal result in a TVM calculation was too small for the HP-14B to handle.

Function Index

Function	Keys and Description	Page
+/−	[+/−] Changes the sign of the displayed number.	19
[■]	Shift key. Activates shifted functions (functions printed in gold).	17
. (period)	[■] [DISP] { . } Sets period as the decimal point.	26
, (comma)	[■] [DISP] { , } Sets comma as the decimal point.	26
() (parentheses)	[(] or [)] Used to specify the order of calculation.	31
←	[←] Backspaces or clears the displayed number, or backs out of menu.	18
▲	[■] [▲] Moves upward through the cash-flow list or the business applications, or continues forecasting. Also moves upward through the three results of an AMORTization calculation.	93
▼	[▼] Moves downward through the cash-flow list or the business applications, or continues forecasting. Also moves downward through the three results of an AMORTization calculation.	93
$1/x$	[■] [1/x] Calculates the reciprocal of the displayed number.	33

Function	Keys and Description	Page
%	[shift] [%] Divides the displayed number q by 100 (q [shift] [%], $q_1 \times q$ [shift] [%], $q_1 \div q$ [shift] [%]), or calculates q% of q_1 ($q_1 + q$ [shift] [%], $q_1 - q$ [shift] [%]).	32
%CHG	[shift] [%CHG] Stores or calculates the percent change in the *OLD-NEW-%CHG* application.	40
%TOTAL	[shift] [%TOTAL] Stores or calculates the percent total in the *PART-TOTAL-%TOTAL* application.	41
×P/YR	[shift] [×P/YR] Multiplies the number in the display by *P/YR* and stores the result in *N* for the TVM application.	61
Σ+	[Σ+] Accumulates *x*- and *y*-values into statistics memory.	102
Σ−	[shift] [Σ−] Removes *x*- and *y*-values from statistics memory.	102
Σx	[STAT] {Σ} {x} Sum of *x* statistical data.	107
Σx^2	[STAT] {Σ} {x²} Sum of the squares of the *x* statistical data.	107
Σxy	[STAT] {Σ} {xy} Sum of the products $x \times y$ for the statistical data.	107
Σy	[STAT] {Σ} {y} Sum of the *y* statistical data.	107
Σy^2	[STAT] {Σ} {y²} Sum of the squares of the *y* statistical data.	107
ALL	[shift] [DISP] {ALL} Displays all non-zero digits.	25
AMORT	[shift] [AMORT] Allows you to calculate an amortization schedule for the current TVM calculation.	76
B	[STAT] {FIT} {B} Fits your statistical data to the best fitting curve model.	113

Function	Keys and Description	Page
b	[STAT] {FIT} *select model* {b} Calculates a value in the curve fitting equation of the statistics function. For a linear curve fit, this value represents the y-intercept.	113
B.EVEN	[B.EVEN] Allows you to do a break-even analysis.	46
BEG/END	[BEG/END] Used to set Begin or End mode for TVM calculations.	62
BEGIN	[BEG/END] {BEGIN} Sets Begin mode for TVM calculations.	62
Clear/cancel	[C] Clears current display contents; cancels current application.	18
CLEAR	[CLEAR] Displays menu for clearing portions of memory.	19
Clear Σ	[CLEAR] {Σ} Clears statistics memory.	102
Clear ALL	[CLEAR] {ALL} Clears all stored data.	19
Clear registers	[CLEAR] {RG} Clears registers.	19
Clear TVM	[CLEAR] {TVM} Clears the TVM application.	61
COMPUTE	[COMPUTE] Computes *IRR%*, *NPV*, or one of the values in the business applications (*ROI, B.EVEN,* or *INVEN*).	43
CST	[CST] Stores or calculates the cost in the *CST-PRC-MAR* application.	40
DISP	[DISP] Displays a menu for changing the display format.	24
E	[E] Begins exponent for exponential notation.	27
e^x	[MATH] {e^x} Natural antilogarithm. Raises *e* to the power of the number in the display.	34

Function	Keys and Description	Page
EFF%	[EFF%] Stores or calculates the effective rate in the NOM%-EFF%-P application.	81
END	[BEG/END] {END} Sets End mode for TVM calculations.	62
EX	[STAT] {FIT} {EX} Fits your statistical data to the exponential model.	113
FIT	[STAT] {FIT} Allows you to select a model for curve fitting statistical data.	113
FIX	[DISP] {FIX} Selects FIX mode; allows you to specify the number of displayed decimal places.	25
FRCST	[FRCST] Forecasts values based on a best curve fit of previously entered statistical pairs.	113
FV	[FV] Stores or calculates the future value in the TVM application.	60
I/YR	[I/YR] Stores or calculates the interest rate in the TVM application.	60
INPUT	[INPUT] Enters values requested by the calculator, separates two statistical values, or completes a pending calculation.	18
INVEN	[INVEN] Allows you to do an inventory analysis.	48
IRR%	[IRR%] Allows you to enter a cash-flow list and compute its internal rate of return.	99
L	[STAT] {FIT} {L} Fits your statistical data to the linear model (performs linear regression).	113
LAST	[LAST] Displays previous result.	35

Function	Keys and Description	Page
LN	[MATH] {LN} Natural logarithm.	34
LOG	[STAT] {FIT} {LOG} Fits your statistical data to the logarithmic model.	113
m	[STAT] {FIT} *select model* {m} Calculates the *m*-value in the curve fitting equation. For linear regression (the linear curve model), *m* is the slope of the line.	113
MAR	[MAR] Stores or calculates the margin in the *CST-PRC-MAR* application.	40
MATH	[MATH] Displays the {e^x}, {LN}, and {n!} functions.	34
N	[N] Stores or calculates the number of periods in the TVM application.	60
n	[STAT] {Σ} {n} Number of *x*- or *x*,*y*-items accumulated in statistics memory.	107
n!	[MATH] {n!} Calculates the factorial of the displayed number.	34
NEW	[NEW] Stores or calculates the new value in the *OLD-NEW-%CHG* application.	40
NOM%	[NOM%] Stores or calculates the nominal rate in the *NOM%-EFF%-P* application.	81
NPV	[NPV] Allows you to enter a cash-flow list and compute its net present value.	96
OLD	[OLD] Stores or calculates the old value in the *OLD-NEW-%CHG* application.	40
OFF	[OFF] Turns the calculator off.	15

Function	Keys and Description	Page
P	[■] [P] Stores the number of periods per year for the *NOM%-EFF%-P* application.	81
P	[STAT] {FIT} {P} Fits your statistical data to a power curve model.	115
P/YR	[■] [P/YR] Stores the number of periods per year for the TVM application.	61
PART	[■] [PART] Stores or calculates the part in the *PART-TOTAL-%TOTAL* application.	41
PMT	[PMT] Stores or calculates the payment in the TVM application.	60
PRC	[PRC] Stores or calculates the price in the *CST-PRC-MAR* application.	40
PV	[PV] Stores or calculates the present value in the TVM application.	60
r	[STAT] {FIT} *select model* {r} Correlation coefficient for *x*,*y* statistics data fit to a curve.	115
RCL	[RCL] *register* Recalls a number from a register.	29
RND	[■] [RND] Rounds the displayed number to the number of decimal places specified by the current display format.	34
ROI%	[■] [ROI%] Allows you to do a return on investment analysis.	44
SHOW	[■] [SHOW] Temporarily shows all 12 digits of number.	25
STAT	[STAT] Displays a menu for accessing statistics functions.	102

Function	Keys and Description	Page
STO	[STO] *register* Stores the displayed number into the designated register.	29
STO +	[STO] [+] *register* Adds the contents of *register* to the displayed number and stores the result in *register.*	37
STO −	[STO] [−] *register* Subtracts the displayed number from the contents of *register* and stores the result in *register.*	37
STO ×	[STO] [×] *register* Multiplies the contents of *register* and the displayed number and stores the result in *register.*	37
STO ÷	[STO] [÷] *register* Divides the contents of *register* by the displayed number and stores the result in *register.*	37
SWAP	[SWAP] Interchanges numbers separated by an operator or colon.	31
sx	[STAT] {Σ} {Σx} Standard deviation of the *x* statistical data.	112
sy	[STAT] {Σ} {Σy}  Standard deviation of the *y* statistical data.	112
TOTAL	[TOTAL] Stores or calculates the total in the *PART-TOTAL-%TOTAL* application.	41
x^2	[x^2] Calculates the square of the displayed value.	33
$\sqrt{x}$	[$\sqrt{x}$] Calculates the square root of the displayed value.	33
$\bar{x}$	[STAT] {$\bar{x}\bar{y}$} {$\bar{x}$} Calculates the mean of the *x* statistical data.	108
$\hat{x}$	[STAT] {FIT} *select model* {$\hat{x}$} *or* [FRCST] {$\hat{x}$} Calculates an estimate of *x* for the displayed *y* using a curve fit of the *x*,*y*-statistical data.	113

Function	Keys and Description	Page
$\bar{x}w$	STAT {$\bar{x}\bar{y}$} {$\bar{x}w$} Calculates weighted mean of the *x* statistical data weighted according to the *y*-values.	112
$\bar{y}$	STAT {$\bar{x}\bar{y}$} {$\bar{y}$} Calculates mean of the *y* statistical data.	112
$\hat{y}$	STAT {FIT} *select model* {$\hat{y}$} *or* FRCST {$\hat{x}$} Calculates an estimate of *y* for the displayed *x* using a curve fit of the *x*,*y*-statistical data.	113
y^x	y^x Exponentiation operator.	34

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Page numbers in **bold** type indicate primary references; page numbers in regular type indicate secondary references.

Special Characters

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Contacting Hewlett-Packard

For Information About Using the Calculator. If you have questions about how to use the calculator, first check the Table of Contents, the Subject Index, and "Answers to Common Questions" in appendix A. If you can't find an answer in the manual, you can contact the Calculator Support Department:

Hewlett-Packard
Calculator Support
1000 N.E. Circle Blvd.
Corvallis, OR 97330, U.S.A.

(503) 757-2004
8:00 a.m. to 3:00 p.m. Pacific time
Monday through Friday

For Service. If your calculator doesn't seem to work properly, see appendix A to determine if the calculator requires service. Appendix A also contains important information about obtaining service. If your calculator does require service, mail it to the Calculator Service Center:

Hewlett-Packard
Calculator Service Center
1030 N.E. Circle Blvd.
Corvallis, OR 97330, U.S.A.

(503) 757-2002

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