Introduction

About This Handbook

This hp 12c user's guide is intended to help you get the most out of your investment in your hp 12c Programmable Financial Calculator. Although the excitement of acquiring this powerful financial tool may prompt you to set this handbook aside and immediately begin “pressing buttons,” in the long run you’ll profit by reading through this handbook and working through the examples it contains.

Following this introduction is a brief section called Making Financial Calculations Easy—which shows you that your hp 12c does just that! The remainder of this handbook is organized basically into three parts:

- Part I (sections 1 through 7) describes how to use the various financial, mathematics, statistics, and other functions (except for programming) provided in the calculator:
  - Section 1 is about Getting Started. It tells you how to use the keyboard, how to do simple arithmetic calculations and chain calculations, and how to use the storage registers (“memories”).
  - Section 2 tells you how to use the percentage and calendar functions.
  - Section 3 tells you how to use the simple interest, compound interest, and amortization functions.
  - Section 4 tells you how to do discounted cash flow analysis, bond, and depreciation calculations.
  - Section 5 tells you about miscellaneous operating features such as Continuous Memory, the display, and special function keys.
  - Sections 6 and 7 tell you how to use the statistics, mathematics, and number-alteration functions.
- Part II (sections 8 through 11) describe how to use the powerful programming capabilities of the hp 12c.
- Part III (sections 12 through 16) give you step-by-step solutions to specialized problems in real estate, lending, savings, investment analysis, and bonds. Some of these solutions can be done manually, while others involve running a program. Since the programmed solutions are both self-contained and step-by-step, you can easily employ them even if you don’t care to learn how to create your own programs. But if you do start to create your own programs, look over the programs used in the solutions: they contain examples of good programming techniques and practices.

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- The various appendices describe additional details of calculator operation as well as warranty and service information.
- The Function Key Index and Programming Key Index at the back of the handbook can be used as a handy page reference to the comprehensive information inside the manual

Financial Calculations in the United Kingdom

The calculations for most financial problems in the United Kingdom are identical to the calculations for those problems in the United States — which are described in this handbook. Certain problems, however, require different calculation methods in the United Kingdom than in the United States. Refer to Appendix F for more information.

For More Solutions to Financial Problems

In addition to the specialized solutions found in Sections 12 through 16 of this handbook, many more are available in the optional hp 12c Solutions Handbook. Included are solutions to problems in lending, forecasting, pricing, statistics, savings, investment analysis, personal finance, securities, Canadian mortgages, learning curves in manufacturing, and queuing theory. A Solutions Handbook is available online (www.hp.com/calculators).

Contents

Making Financial Calculations Easy

Before you begin to read through this handbook, let's take a look at how easy financial calculations can be with your hp 12c. While working through the examples below, don't be concerned about learning how to use the calculator; we'll cover that thoroughly beginning with Section 1.

Example 1: Suppose you want to ensure that you can finance your daughter's college education 14 years from today. You expect that the cost will be about $6,000 a year ($500 a month) for 4 years. Assume she will withdraw $500 at the beginning of each month from a savings account. How much would you have to deposit into the account when she enters college if the account pays 6% annual interest compounded monthly?

This is an example of a compound interest calculation. All such problems involve at least three of the following quantities:

- n: the number of compounding periods.
- i: the interest rate per compounding period.
- PV: the present value of a compounded amount.
- PMT: the periodic payment amount.
- FV: the future value of a compounded amount.

In this particular example:

- n is 4 years × 12 periods per year = 48 periods.
- i is 6% per year ÷ 12 periods per year = 0.5% per period.
- PV is the quantity to be calculated — the present value when the financial transaction begins.
- PMT is $500.
- FV is zero, since by the time your daughter graduates she (hopefully!) will not need any more money.

To begin, turn the calculator on by pressing the key. Then, press the keys shown in the Keystrokes column below.*

* If you are not familiar with the use of an hp calculator keyboard, refer to the description on pages 16 and 17.

Note: A battery symbol (¼) shown in the lower-left corner of the display when the calculator is on signifies that the available battery power is nearly exhausted. To install new batteries, refer to Appendix E.

The calendar functions and nearly all of the financial functions take some time to produce an answer. (This is typically just a few seconds, but theY ,
, & , and -

Example 3: The preceding example showed that the insurance policy will provide about half the required amount. An additional amount must be set aside to provide the balance (21,396.61 – 10, 470.85 = 10,925.76). Suppose you make monthly payments, beginning at the end of next month, into an account that pays 6% annually, compounded monthly. What payment amount would be required in order to accumulate $10,925.75 in the 14 years remaining

Part I

Problem Solving

Section 1

Getting Started

Power On and Off

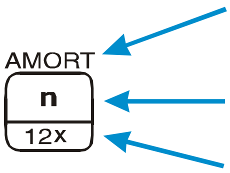
To begin using your hp 12c, press the key*. Pressing again turns the calculator off. If not manually turned off, the calculator will turn off automatically 8 to 17 minutes after it was last used.

Low-Power Indication

A battery symbol (½) shown in the upper-left corner of the display when the calculator is on signifies that the available battery power is nearly exhausted. To replace the batteries, refer to Appendix E.

The Keyboard

Many keys on the hp 12c perform two or even three functions. The primary function of a key is indicated by the characters printed in white on the upper face of the key. The alternate function(s) of a key are indicated by the characters printed in gold above the key and the characters printed in blue on the lower face of the key. These alternate functions are specified by pressing the appropriate prefix key before the function key:



z To specify the alternate function printed in gold above a key, press the gold prefix key (=), then press the function key.

z To specify the primary function printed on the upper face of a key, press the key alone.

z To specify the alternate function printed in blue on the lower face of a key, press the blue prefix key (>), then press the function key.

---

* Note that the key is lower than the other keys to help prevent its being pressed inadvertently.

Throughout this handbook, references to the operation of an alternate function appear as only the function name in a box (for example, “The & function …”). References to the selection of an alternate function appear preceded by the appropriate prefix key (for example, “Pressing = & …”). References to the functions shown on the keyboard in gold under the bracket labeled “CLEAR” appear throughout this handbook preceded by the word “CLEAR” (for example, “The CLEAR' function …” or “Pressing = CLEAR' …”).

If you press the = or > prefix key mistakenly, you can cancel it by pressing = CLEAR0 . This can also be pressed to cancel the , , and @ keys. (These keys are “prefix” keys in the sense that other keys must be pressed after them in order to execute the corresponding function.) Since the 0 key is also used to display the mantissa (all 10 digits) of a displayed number, the mantissa of the number in the display will appear for a moment after the 0 key is released.

Pressing the = or > prefix key turns on the corresponding status indicator — f or g — in the display. Each indicator turns off when you press a function key (executing an alternate function of that key), another prefix key, or = CLEAR0 .

Keying in Numbers

To key a number into the calculator, press the digit keys in sequence, just as if you were writing the number on paper. A decimal point must be keyed in (using the decimal point key) if it is part of the number unless it appears to the right of the last digit.

Digit Separators

As a number is keyed in, each group of three digits to the left of the decimal point is automatically separated in the display. When the calculator is first turned on after coming from the factory — or after Continuous Memory is reset — the decimal point in displayed numbers is a dot, and the separator between each group of three digits is a comma. If you wish, you can set the calculator to display a comma for the decimal point and a dot for the three-digit separator. To do so, turn the calculator off, then press and hold down the key while you press . Doing so again sets the calculator to use the original digit separators in the display.

Negative Numbers

To make a displayed number negative — either one that has just been keyed in or one that has resulted from a calculation — simply press o (change sign) . When the display shows a negative number — that is, the number is preceded by a minus sign — pressing o removes the minus sign from the display, making the number positive.

Keying in Large Numbers

Since the display cannot show more than 10 digits of a number, numbers greater than 9,999,999,999 cannot be entered into th e display by keying in all the digits in the number. However, such numbers can be easily entered into the display if the number is expressed in a mathematical shorthand called “scientific notation.” To convert a number into scientific notation,move the decimal point until there is only one digit (a nonzero digit) to its left. The resulting number is called the “mantissa” of the original number, and the number of decimal places you moved the decimal point is called the “exponent” of the original number. If you moved the decimal point to the left, the exponent is positive; if you moved the decimal point to the right (this would occur for numbers less than one), the exponent is negative. To key the number into the display, simply key in the mantissa, press\ (enter exponent), then key in the exponent. If the exponent is negative, presso after pressing \ .

For example, to key in $1,781,400,000,000, we move the decimal point 12 places to the left, giving a mantissa of 1.7814 and an exponent of 12:

Keystrokes	Display	
1.7814 \ 12	1.7814 12	1,781,400,000,000 entered in scientific notation.

Numbers entered in scientific notation can be used in calculations just like any other number.

The CLEAR Keys

Clearing a register or the display replaces the number in it with zero. Clearing program memory replaces the instructions there with> @ 00. There are several clearing operations on the hp 12c, as shown in the table below:

Key(s)	Clears:
)	Display and X-register.
= CLEARU	Statistics registers (R_1 through R_6), stack registers, and display.
= CLEARa	Program memory (only when pressed in Program mode).
= CLEAR!	Financial registers.
= CLEAR'	Data storage registers, financial registers, stack and LAST X registers, and display.

Simple Arithmetic Calculations

Any simple arithmetic calculation involves two numbers and an operation — addition, subtraction, multiplication, or division. To do such a calculation on your hp 12c, you first tell the calculator the two numbers, then tell the calculator the operation to be performed. The answer is calculated when the operation key (, , R , or M) is pressed.

The two numbers should be keyed into the calculator in the order they would appear if the calculation were written down on paper left-to-right. After keying in the first number, press the 3 key to tell the calculator that you have completed entering the number. Pressing 3 separates the second number to be entered from the first number already entered.

In summary, to perform an arithmetic operation:

1. Key in the first number.
2. Press 3 to separate the second number from the first.
3. Key in the second number.
4. Press , , R , or M to perform the desired operation.

For example to calculate 13 ÷ 2, proceed as follows:

Keystrokes	Display	
13	13.	Keys the first number into the calculator.
3	13.00	Pressing 3 separates the second number from the first.
2	2.	Keys the second number into the calculator.
M	6.50	Pressing the operation key calculates the answer.

Notice that after you pressed 3 , two zeroes appeared following the decimal point. This is nothing magical: the calculator's display is currently set to show two decimal places of every number that has been entered or calculated. Before you pressed 3 , the calculator had no way of knowing that you had completed entering the number, and so displayed only the digits you had keyed in. Pressing 3 tells the calcc y76-6.4s(d iis)-9.727.3((a)9(p)(TD7 -0.0r078033> 26.8(Tj /TT16 1 Tf 9 0 0 9 264.66 4f2(4(c). (e

Chain Calculations

Whenever the answer has just been calculated and is therefore in the display, you can perform another operation with this number by simply keying in the second number and then pressing the operation key: you need not press 3 to separate the second number from the first. This is because when a number is keyed in after a function key (such as , , R , M , etc.) is pressed, the result of that prior calculation is stored inside the calculator — just as when the 3 key is pressed. The only time you must press the 3 key to separate two numbers is when you are keying them both in, one immediately following the other.

The hp 12c is designed so that each time you press a function key in RPN mode, the calculator performs the operation then — not later — so that you see the results of all intermediate calculations, as well as the "bottom line."

Example: Suppose you've written three checks without updating your checkbook, and you've just deposited your paycheck for $1,053.00 into your checking account. If your latest balance was $58.33 and the checks were written for $22.95, $13.70, and $10.14, what is the new balance ?

Solution: When written down on paper, this problem would read

58.33 – 22.95 – 13.70 – 10.14 + 1053

Keystrokes	Display	
58.33	58.33	Keys the first number.
3	58.33	Pressing 3 separates the second number from the first.
22.95	22.95	Keys in the second number.
	35.38	Pressing subtracts the second number from the first. The calculator displays the result of this calculation, which is the balance after subtracting the first check.
13.70	13.70	Keys in the next number. Since a calculation has just been performed, do not press 3 ; the next number entered (13.70) is automatically separated from the one previously in the display (35.38).

Keystrokes	Display	
	21.68	Pressing subtracts the number just entered from the number previously in the display. The calculator displays the result of this calculation, which is the balance after subtracting the second check.
10.14	11.54	Keys in the next number and subtracts it from the previous balance. The new balance appears in the display. (It's getting rather low!)
1053	1,064.54	Keys in the next number — the paycheck deposited — and adds it to the previous balance. The new, current balance appears in the display.

The preceding example demonstrates how the hp 12c calculates just as you would using pencil and paper (except a lot faster!):

```
 58.33
−22.95
 35.38
```

Your hp 12c calculates the answer in just the same way:

Keystrokes	Display	
3 3 4 R	12.00	Step 1: Multiply the numbers in the first parentheses.
5 3 6 R	30.00	Step 2: Multiply the numbers in the second parentheses.
	42.00	Step 3: Add the results of the two multiplications.

Notice that before doing step 2, you did not need to store or write down the result of step 1: it was stored inside the calculator automatically. And after you keyed in the 5 and the 6 in step 2, the calculator was holding two numbers (12 and 5) inside for you, in addition to the 6 in the display. (The hp 12c can hold a total of three numbers inside, in addition to the number in the display.) After step 2, the calculator was still holding the 12 inside for you, in addition to the 30 in the display. You can see that the calculator holds the number for you, just as you would have them written on paper, and then calculates with them at the proper time, just as you would yourself.* But with the hp 12c, you don't need to write down the results of an intermediate calculation, and you don't even need to manually store it and recall it later.

By the way, notice that in step 2 you needed to press 3 again. This is simply because you were again keying in two numbers immediately following each other, without performing a calculation in between.

To check your understanding of how to calculate with your hp 12c, try the following problems yourself. Although these problems are relatively simple, more complicated problems can be solved using the same basic steps. If you have difficulty obtaining the answers shown, review the last few pages.

$$(3 \quad 4)\,\iota\,(5 \quad 6) \quad 77.00$$

$$\frac{(27 \quad 14)}{(14 \quad 38)} \quad 0.25$$

$$\frac{5}{3 \quad 16 \quad 21} \quad 0.13$$

* Although you don't need to know just how these numbers are stored and brought back at just the right time, if you're interested you can read all about it in Appendix A. By gaining a more complete understanding of the calculator's operation, you'll use it more efficiently and confidently, yielding a better return on the investment in your hp 12c.

Storage Registers

Numbers (data) in the hp 12c are stored in memories called “storage registers” or simply “registers.” (The singular term “ memory” is sometimes used in this handbook to refer to the entire collection of storage registers.) Four special registers are used for storing numbers during calculations (these “stack registers” are described in Appendix A), and another (called the “LAST X” register) is used for storing the number last in the display before an operation is performed. In addition to these registers into which numbers are stored automatically, up to 20 “data storage” registers are available for manual storage of numbers. These data storage registers are designated R_0 through R_9 and $R_{.0}$ through $R_{.9}$. Fewer registers are available for data storage if a program ha s been stored in the calculator (since the program is stored in some of those 20 registers), but a minimum of 7 registers

Later that same day …

Keystrokes	Display	
	2,500.00	Turns the calculator back on.
1	3,250.00	Recalls the cost of the computer to the display.
6 R	19,500.00	Multiplies the quantity ordered to get the cost of the computers.
2	2,500.00	Recalls the cost of the printer to the display.
	22,000.00	Total invoice.

Clearing Storage Registers

To clear a single storage register — that is, to replace the number in it with zero — merely store zero into it. You need not clear a storage register before storing data into it; the storing operation automatically clears the register before the data is stored.

To clear all storage registers at once — including the financial registers, the stack registers, and the LAST X register — press= CLEAR' .* This also clears the display.

All storage registers are also cleared when Continuous Memory is reset (as described on page 70).

Storage Register Arithmetic

Suppose you wanted to perform an arithmetic operation with the number in the display and the number in a storage register, then store the result back into the same register without altering the number in the display. The hp 12c enables you to do all this in a single operation:

1. Press .
2. Press , , R , or M to specify the desired operation.
3. Key in the register number.

When storage register arithmetic is performed, the new number in the register is determined according to the following rule:

$$\text{number now in register} = \text{number formerly in register} \left\{ \begin{matrix} + \\ - \\ \times \\ \div \end{matrix} \right\} \text{number in display}$$

* CLEAR' is not programmable.

Storage register arithmetic is possible with only registers R_0 through R_4.

Example: In the example on page 20, we updated the balance in your checkbook. Let's suppose that because data is stored indefinitely in your calculator's Continuous Memory, you keep track of your checking account balance in the calculator. You could use storage register arithmetic to quickly update the balance after depositing or writing checks.

Keystrokes	Display	
58.33 0	58.33	Stores the current balance in register R_0.
22.95 0	22.95	Subtracts the first check from the balance in R_0. Note that the display continues to show the amount subtracted; the answer is placed only in R_0.
13.70 0	13.70	Subtracts the second check.
10.14 0	10.14	Subtracts the third check.
1053 0	1,053.00	Adds the deposit.
0	1,064.54	Recalls the number in R_0 to check the new balance.

Section 2

Percentage and Calendar Functions

Percentage Functions

The hp 12c includes three keys for solving percentage problems:9 , q , and 1 . You don't need to convert percentages totheir decimal equivalents; this is done automatically when you press any of these keys. Thus, 4% need not be changed to 0.04; you key it in the way you see and say it: 4 9 .

Percentages

To find the amount corresponding to a percentage of a number:

1. Key in the base number.
2. Press 3 .
3. Key in the percentage.
4. Press 9 .

For example, to find 14% of $300:

Keystrokes	Display	
300	300.	Keys in the base number.
3	300.00	Pressing 3 separates the next number entered from the first number, just as when an ordinary arithmetic calculation is performed.
14	14.	Keys in the percentage.
9	42.00	Calculates the amount.

If the base number is already in the display as a result of a previous calculation, you should not press 3 before keying in the percentage — just as in a chain arithmetic calculation.

Net Amount

A net amount — that is, the base amount plus or minus the percentage amount — can be calculated easily with your hp 12c, since the calculator holds the base amount inside after you calculate a percentage amount. To calculate a net amount, simply calculate the percentage amount, then press or .

Example: You're buying a new car that lists for $13,250. The dealer offers you a discount of 8%, and the sales tax is 6%. Find the amount the dealer is charging you, then find the total cost to you, including tax.

Keystrokes	Display	
13250 3	13,250.00	Keys in the base amount and separates it from the percentage.
8 9	1,060.00	Amount of discount.
	12,190.00	Base amount less discount.
6 9	731.40	Amount of tax (on $12,190).
	12,921.40	Total cost: base amount less discount plus tax.

Percent Difference

To find the percent difference between two numbers:

1. Key in the base number.
2. Press 3 to separate the other number from the base number.
3. Key in the other number.
4. Press q .

If the other number is greater than the base number, the percent difference will be positive. If the other number is less than the base number, the percent difference will be negative. Therefore, a positive answer indicates an increase, while a negative answer indicates a decrease.

If you are calculating a percent difference over time, the base number is typically the amount occurring first.

Example: Yesterday your stock fell from $58^1/_2$ to $53^1/_4$ per share. What is the percent change?

Keystrokes	Display	
58.5 3	58.50	Keys in the base number and separates it from the other number.
53.25	53.25	Keys in the other number.
q	–8.97	Nearly a 9% decrease.

The q key can be used for calculations of the percent difference between a wholesale cost and a retail cost. If the base number entered is the wholesale cost, the percent difference is called the *markup*; if the base number entered is the retail cost, the percent difference is called the *margin*. Examples of markup and margin calculations are included in the *hp 12c Solutions Handbook*.

Percent of Total

To calculate what percentage one number is of another:

1. Calculate the total amount by adding the individual amounts, just as in a chain arithmetic calculation.
2. Key in the number whose percentage equivalent you wish to find.
3. Press 1 .

Example: Last month, your company posted sales of \$3.92 million in the U.S., \$2.36 million in Europe, and \$1.67 million in the rest of the world. What percentage of the total sales occurred in Europe?

Keystrokes	Display	
3.92 3	3.92	Keys in the first number and separates it from the second.
2.36	6.28	Adds the second number.
1.67	7.95	Adds the third number to get the total.
2.36	2.36	Keys in 2.36 to find what percentage it is of the number in the display.
1	29.69	Europe had nearly 30% of the total sales.

The hp 12c holds the total amount inside after a percent of total is calculated. Therefore, to calculate what percentage another amount is of the total:

1. Clear the display by pressing) .
2. Key in that amount.
3. Press 1 again.

For example, to calculate what percent of the total sales in the preceding example occurred in the U.S. and what percent occurred in the rest of the world:

Keystrokes	Display	
) 3.92 1	49.31	The U.S. had about 49% of the total sales.
) 1.67 1	21.01	The rest of the world had about 21% of the total sales.

To find what percentage a number is of a total, when you already know the total number:

1. Key in the total number.
2. Press 3 to separate the other number from the total number.
3. Key in the number whose percentage equivalent you wish to find.
4. Press 1 .

For example, if you already knew in the preceding example that the total sales were $7.95 million and you wanted to find what percentage of that total occurred in Europe:

Keystrokes	Display	
7.95 3	7.95	Keys in the total amount and separates it from the next number.
2.36	2.36	Keys in 2.36 to find what percentage it is of the number in the display.
1	29.69	Europe had nearly 30% of the total sales.

Calendar Functions

The calendar functions provided by the hp 12c — and d — can handle dates from October 15, 1582 through November 25, 4046.

Date Format

For each of the calendar functions — and also for bond calculations (and -) — the calculator uses one of two date formats. The date format is used to interpret dates when they are keyed into the calculator as well as for displaying dates.

Month-Day-Year. To set the date format to month-day-year, press f . To key in a date with this format in effect:

1. Key in the one or two digits of the month.
2. Press the decimal point key ( ).
3. Key in the two digits of the day.
4. Key in the four digits of the year.

Dates are displayed in the same format.

For example, to key in April 7, 2004:

Keystrokes	Display
4.072004	4.072004

Keystrokes	Display	
14.052004 3	14.05	Keys in date and separates it from number of days to be entered.
120 >	11,09,2004 6	The expiration date is 11 September 2004, a Saturday.

When is executed as an instruction in a running program, the calculator pauses for about 1 second to display the result, then resumes program execution.

Number of Days Between Dates

To calculate the number of days between two given dates:

1. Key in the earlier date and press 3 .
2. Key in the later date and press > d .

The answer shown in the display is the actual number of days between the two dates, including leap days (the extra days occurring in leap years), if any. In

Section 3

Basic Financial Functions

The Financial Registers

In addition to the data storage registers discussed on page 23, the hp 12c has five special registers in which numbers are stored for financial calculations. These registers are designated n, i, PV, PMT, and FV. The first five keys on the top row of the calculator are used to store a number from the display into the corresponding register, to calculate the corresponding financial value and store the result into the corresponding register, or to display the number stored in the corresponding register.*

Storing Numbers Into the Financial Registers

To store a number into a financial register, key the number into the display, then press the corresponding key (C , Y , , * , or ').

Displaying Numbers in the Financial Registers

To display a number stored in a financial register, press followed by the corresponding key.†

* Which operation is performed when one of these keys is pressed depends upon the last preceding operation performed: If a number was just stored into a financial register (using C , Y , , * , ' , , or), pressing one of these five keys calculates the corresponding value and stores it into the corresponding register; otherwise pressing one of these five keys merely stores the number from the display into the corresponding register.

† It's good practice to press the corresponding key twice after , since often you may want to calculate a financial value right after displaying another financial value. As indicated in the preceding footnote, if you wanted to display FV and then calculate PV, for example, you should press ' ' . If you didn't press ' the second time, pressing would store FV in the PV register rather than calculating PV, and to calculate PV you would have to press again.

Clearing the Financial Registers

Every financial function uses numbers stored in several of the financial registers. Before beginning a new financial calculation, it is good practice to clear all of the financial registers by pressing = CLEAR! . Frequently, however, you may want to repeat a calculation after changing a number in only one of the financial registers. To do so, do not press = CLEAR! ; instead, simply store the new number in the register. The numbers in the other financial registers remain unchanged.

The financial registers are also cleared when you press = CLEAR" and when Continuous Memory is reset (as described on page 70).

Simple Interest Calculations

The hp 12c simultaneously calculates simple interest on both a 360-day basis and a 365-day basis. You can display either one, as described below. Furthermore, with the accrued interest in the display, you can calculate the total amount (principal plus accrued interest) by pressing .

1. Key in or calculate the number of days, then press C .
2. Key in the annual interest rate, then press Y .
3. Key in the principal amount, then press o .*
4. Press = b to calculate and display the interest accrued on a 360-day basis.
5. If you want to display the interest accrued on a 365-day basis, press ; O .
6. Press to calculate the total of the principal and the accrued interest now in the display.

The quantities n, i, and PV can be entered in any order.

Example 1: Your good friend needs a loan to start his latest enterprise and has requested that you lend him $450 for 60 days. You lend him the money at 7% simple interest, to be calculated on a 360-day basis. What is the amount of accrued interest he will owe you in 60 days, and what is the total amount owed?

Keystrokes	Display	
60 C	60.00	Stores the number of days.

---

*

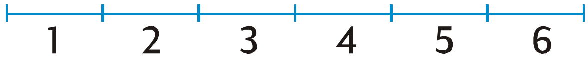
Keystrokes	Display	
7 Y	7.00	Stores the annual interest rate.
450 o	–450.00	Stores the principal.
= b	5.25	Accrued interest, 360-day basis.
	455.25	Total amount: principal plus accrued interest.

Example 2: Your friend agrees to the 7% interest on the loan from the preceding example, but asks that you compute it on a 365-day basis rather than a 360-day basis. What is the amount of accrued interest he will owe you in 60 days, and what is the total amount owed?

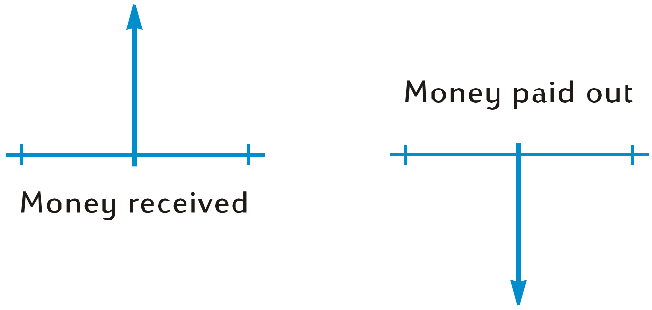
Keystrokes	Display	
60 C 7 Y 450 o	60.00 7.00 –450.00	If you have not altered the numbers in the n, i, and PV registers since the preceding example, you may skip these keystrokes.
= b ; O	5.18	Accrued interest, 365-day basis.
	455.18	Total amount: principal plus accrued interest.

Financial Calculations and the Cash Flow Diagram

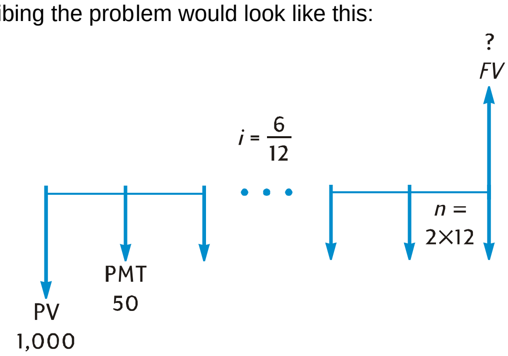
The concepts and examples presented in this section are representative of a wide range of financial calculations. If your specific problem does not appear to be illustrated in the pages that follow, don't assume that the calculator is not capable of solving it. Every financial calculation involves certain basic elements; but the terminology used to refer to these elements typically differs among the various segments of the business and financial communities. All you need to do is identify the basic elements in your problem, and then structure the problem so that it will be readily apparent what quantities you need to tell the calculator and what



The exchange of money in a problem is depicted by vertical arrows. Money you receive is represented by an arrow pointing up from the point in the time line when the transaction occurs; money you pay out is represented by an arrow pointing down.



Suppose you deposited (paid out) $1,000 into an account that pays 6% annual interest and is compounded monthly, and you subsequently deposited an additional $50 at the end of each month for the next 2 years. The cash flow diagram describing the problem would look like this:



The arrow pointing up at the right of the diagram indicates that money is received at the end of the transaction. Every completed cash flow diagram must include at least one cash flow in each direction. Note that cash flows corresponding to the accrual of interest are not represented by arrows in the cash flow diagram.

The quantities in the problem that correspond to the first five keys on the top row of the keyboard are now readily apparent from the cash flow diagram.

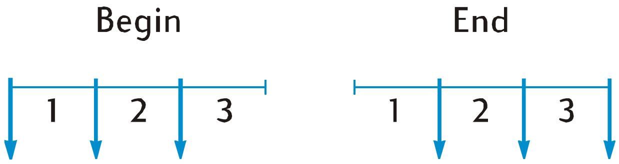
- n is the number of compounding periods. This quantity can be expressed in years, months, days, or any other time unit, as long as the interest rate is expressed in terms of the same basic compounding period. In the problem illustrated in the cash flow diagram above, n = 2 × 12.

The form in which n is entered determines whether or not the calculator performs financial calculations in Odd-Period mode (as described on pages 50 through 53). If n is a noninteger (that is, there is at least one nonzero digit to the right of the decimal point), calculations of i, PV, PMT, and FV are performed in Odd-Period mode.

- i is the interest rate per compounding period. The interest rate shown in the cash flow diagram and entered into the calculator is determined by dividing the annual interest rate by the number of compounding periods. In the problem illustrated above, i = 6% ÷ 12.
- PV — the present value — is the initial cash flow or the present value of a series of future cash flows. In the problem illustrated above, PV is the $1,000 initial deposit.
- PMT is the period payment. In the problem illustrated above PMT is the $50 deposited each month. When all payments are equal, they are referred to as annuities. (Problems involving equal payments are described in this section under Compound Interest Calculations; problems involving unequal payments can be handled as described in under Discounted Cash Flow

The Payment Mode

One more bit of information must be specified before you can solve a problem involving periodic payments. Such payments can be made either at the beginning of a compounding period (payments in advance, or annuities due) or at the end of the period (payments in arrears, or ordinary annuities). Calculations involving payments in advance yield different results than calculations involving payments in arrears. Illustrated below are portions of cash flow diagrams showing payments in advance (Begin) and payments in arrears (End). In the problem illustrated in the cash flow diagram above, payments are made in arrears.



Regardless of whether payments are made in advance or in arrears, the number of payments must be the same as the number of compounding periods.

To specify the payment mode:

- Press > h if payments are made at the beginning of the compounding periods.
- Press > [if payments are made at the end of the compounding periods.

The BEGIN status indicator is lit when the payment mode is set to Begin. If BEGIN is not lit, the payment mode is set to End.

The payment mode remains set to what you last specified until you change it; it is not reset each time the calculator is turned on. However, if Continuous Memory is reset, the payment mode will be set to End.

Generalized Cash Flow Diagrams

Examples of various kinds of financial calculations, together with the applicable cash flow diagrams, appear under Compound Interest Calculations later in this section. If your particular problem does not match any of those shown, you can solve it nevertheless by first drawing a cash flow diagram, then keying the quantities identified in the diagram into the corresponding registers. Remember always to observe the sign convention when keying in PV, PMT, and FV.

The terminology used for describing financial problems varies among the different segments of the business and financial communities. Nevertheless, most problems involving compound interest can be solved by drawing a cash flow diagram in one of the following basic forms. Listed below each form are some of the problems to which that diagram applies.

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Compound Interest Calculations

Specifying the Number of Compounding Periods and the Periodic Interest Rate

Interest rates are usually quoted at the annual rate (also called the nominal rate): that is, the interest rate per year. However, in compound interest problems, the interest rate entered into i must always be expressed in terms of the basic compounding period, which may be years, months, days, or any other time unit. For example, if a problem involves 6% annual interest compounded quarterly for 5 years, n — the number of quarters — would be 5 × 4 = 20 and i — the interest rate per quarter — would be 6% ÷ 4 = 1.5%. If the interest were instead compounded monthly, n would be 5 × 12 = 60 and i would be 6% ÷ 12 = 0.5%.

If you use the calculator to multiply the number of years by the number of compounding periods per year, pressing C then stores the result into n. The same is true for i. Values of n and i are calculated and stored like this in Example 2 on page 47.

If interest is compounded monthly, you can use a shortcut provided on the calculator to calculate and store n and i:

- To calculate and store n, key the number of years into the display, then press > .
- To calculate and store i, key the annual rate into the display, then press > .

Note that these keys not only multiply or divide the displayed number by 12; they also automatically store the result in the corresponding register, so you need not press the C or Y key next. The and keys are used in Example 1 on page 46.

Calculating the Number of Payments or Compounding Periods

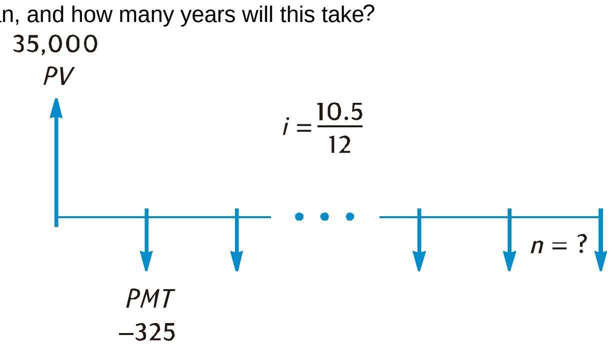
1. Press = CLEAR to clear the financial registers.
2. Enter the periodic interest rate, using Y or .
3. Enter at least two of the following values:
   - Present value, using .
   - Payment amount, using * .
   - Future value, using ' .

   Note: Remember to observe the cash flow sign convention.
4. If a PMT was entered, press > h or > [to set the payment mode.
5. Press C

If the answer calculated is not an integer (that is, there would be nonzero digits to the right of the decimal point), the calculator rounds the answer up to the next higher integer before storing it in the n register and displaying it.* For example, if n were calculated as 318.15, 319.00 would be the displayed answer.

n is rounded up by the calculator to show the total number of payments needed: n–1 equal, full payments, and one final, smaller payment. The calculator does not automatically adjust the values in the other financial registers to reflect n equal payments; rather, it allows you to choose which, if any, of the values to adjust.† Therefore, if you want to know the value of the final payment (with which you can calculate a balloon payment) or desire to know the payment value for n equal payments, you will need to press one of the other financial keys, as shown in the following two examples.

Example 1: You're planning to build a log cabin on your vacation property. Your rich uncle offers you a $35,000 loan at 10.5% interest. If you make $325 payments at the end of each month, how many payments will be required to pay off the loan, and how many years will this take?



Keystrokes	Display	
= CLEAR'		
10.5 >	0.88	Calculates and stores i.
35000	35,000.00	Stores PV.
325 o *	–325.00	Stores PMT (with minus sign for cash paid out).
> [	–325.00	Sets the payment mode to End.
C	328.00	Number of payments required.

* The calculator will round n down to the next lower integer if the fractional portion of n is less than 0.005.

† After calculating n, pressing Y , , * , or ' will recalculate the value in the corresponding financial register.

Keystrokes	Display	
12 M	27.33	Twenty-seven years and four months.

Because the calculator rounds the calculated value of n up to the next higher integer, in the preceding example it is likely that — while 328 payments will be required to pay off the loan — only 327 full payments of $325 will be required, the next and final payment being less than $325. You can calculate the final, fractional, 328th payment as follows:

Keystrokes	Display	
328 C	328.00	Stores total number of payments*.
'	181.89	Calculates FV — which equals the overpayment if 328 full payments were made.
*	–325.00	Recalls payment amount.
	–143.11	Final, fractional payment.

Alternatively, you could make the fractional payment together with the 327th payment. (Doing so will result in a somewhat smaller total of all payments, since you will not have to pay interest during the 328th payment period.) You can calculate this final, larger, 327th payment (essentially a baloon payment) as follows:

Keystrokes	Display	
327 C	327.00	Stores number of full payments.
'	–141.87	Calculates FV — which is the balance remaining after 327 full payments.
*	–325.00	Recalls payment amount.
	–466.87	Final, balloon payment.

Instead of having a fractional (or balloon) payment at the end of the loan, you might wish to make 327 or 328 equal payments. Refer to "Calculating the Payment Amount" on page 46 for a complete description of this procedure.

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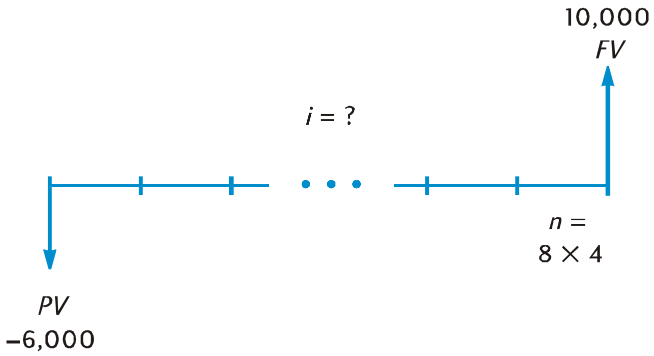
* You could skip this step, since 328 is already stored in the n register. If you do so, however, you will need to press ' twice in the next step (for the reason discussed in the first footnote on page 32; you would not have to press ' twice if you had not pressed 12 M after K in the example above.) We choose to show this and the following example in a parallel format so that the procedure is easy to remember: the number you key is the number of the final payment — either the fractional payment or the balloon payment — whose amount is to be calculated.

Example 2: You’re opening a savings account today (the middle of the month)

Example: What annual interest rate must beobtained to accumulate $10,000 in 8 years on an investment of$6,000 with quarterly compounding ?



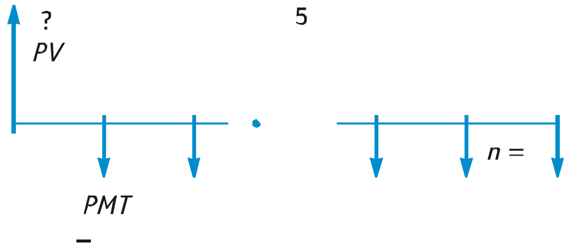
Keystrokes	Display	
= CLEAR		
8 3 4 R K	32.00	Calculates and storesn.
6000 o	–6,000.00	StoresPV (with minus sign for cash paid out).
10000 '	10,000.00	StoresFV.
Y	1.61	Periodic (quarterly) interest rate.
4 R	6.44	Annual interest rate.

Calculating the Present Value

1. Press = CLEAR to clear the financial registers.
2. Enter the number of payments or periods, using C or .
3. Enter the periodic interest rate, using Y or .
4. Enter either or both of the following:
   - z Payment amount, using * .
   - z Future value, using ' .

   Note: Remember to observe the cash flow sign convention.
5. If a PMTwas entered, press > h or > [to set the payment mode.
6. Press to calculate the present value.

Example 1: You're financing a new car purchase with a loan from an institution that requires 15% interest compounded monthly over the 4-year term of the loan. If you can make payments of $150 at the end of each month and your down payment will be $1,500, what is the maximum price you can pay for the car? (Assume the purchase date is one month prior to the date of the first payment.)



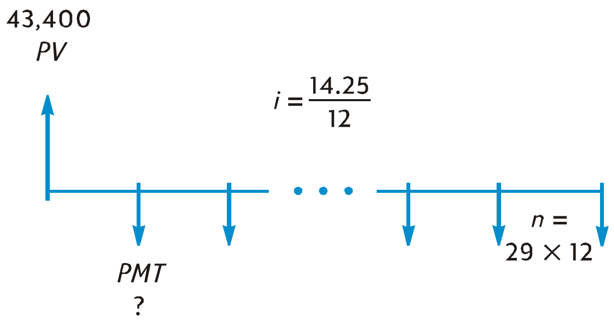
Keystrokes	Display	
= CLEAR!		
5 C	5.00	Stores n.
12 Y	12.00	Stores i.
17500 *	17,500.00	Stores PMT. Unlike in the previous problem, here PMT is positive since it represents cash received.
540000 '	540,000.00	Stores FV.
> [	540,000.00	Sets payment mode to End.
	–369,494.09	The maximum purchase price to provide a 12% annual yield. PV is displayed with a minus sign since it represents cash paid out.

Calculating the Payment Amount

1. Press = CLEAR! to clear the financial registers.
2. Enter the number of payments or periods, using C or .
3. Enter the periodic interest rate, using Y or .
4. Enter either or both of the following:
   - Present value, using .
   - Future value, using ' .

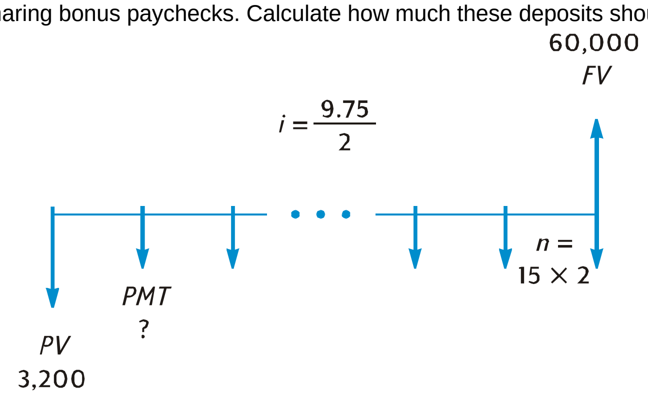
   Note: Remember to observe the cash flow sign convention.
5. Press > h or > [to set the payment mode.
6. Press * to calculate the payment amount.

Example 1: Calculate the payment amount on a 29-year, \$43,400 mortgage at $14^{1}/_{4}$% annual interest.



Keystrokes	Display	
= CLEAR!		
29 >	348.00	Calculates and stores n.
14.25 >	1.19	Calculates and stores i.
43400	43,400.00	Stores PV.
> [	43,400.00	Sets payment mode to End.
*	–523.99	Monthly payment (with minus sign for cash paid out).

Example 2: Looking forward to retirement, you wish to accumulate $60,000 after 15 years by making deposits in an account that pays 9¾% interest compounded semiannually. You open the account with a deposit of $3,200 and intend to make semiannual deposits, beginning six months later, from your profit-sharing bonus paychecks. Calculate how much these deposits should be.



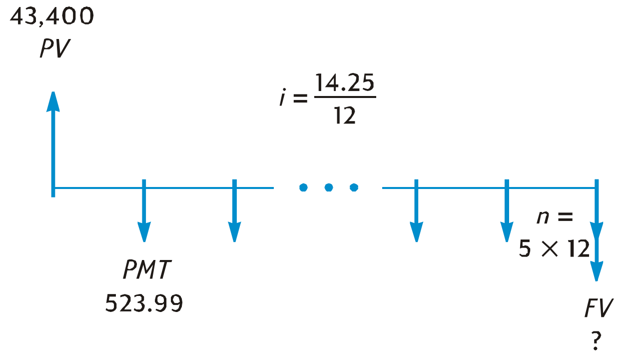
Keystrokes	Display	
= CLEAR!		
15 3 2 X K	30.00	Calculates and stores n.
9.75 3 2 M Y	4.88	Calculates and stores i.
3200 o	–3200.00	Stores PV (with minus sign for cash paid out).
60000 '	60,000.00	Stores FV.
> [	60,000.00	Sets payment mode to End.
*	–717.44	Semiannual payment (with minus sign for cash paid out).

Calculating the Future Value

1. Press = CLEAR' to clear the financial registers.
2. Enter the number of payments or periods, using C or .
3. Enter the periodic interest rate, using Y or .
4. Enter either or both of the following:
   - Present value, using .
   - Payment amount, using * .

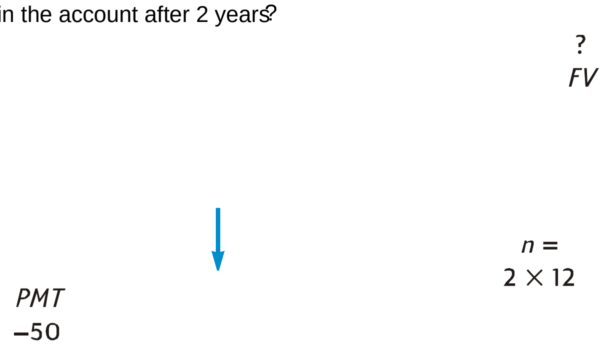
   Note: Remember to observe the cash flow sign convention.
5. If a PMT was entered, press > h or > [to set the payment mode.
6. Press ' to calculate the future value.

Example 1: In Example 1 on page 46, we calculated that the payment amount on a 29-year, $43,400 mortgage at 14 $^{1}/_{4}$% annual interest is $523.99. If the seller requests a balloon payment at the end of 5 years, what would be the amount of the balloon?



Keystrokes	Display	
= CLEAR'		
5 >	60.00	Calculates and stores n.
14.25 >	1.19	Calculates and stores i.
43400	43,400.00	Stores PV.
523.99 o *	–523.99	Stores PMT (with minus sign for cash paid out).
> [	–523.99	Sets payment mode to End.
'	–42,652.37	Amount of balloon payment.

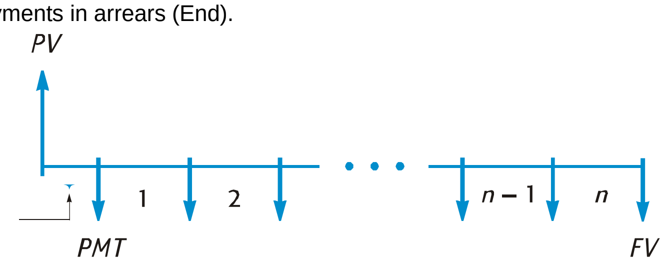
Example 2: If you deposit $50 a month (at the beginning of each month) into a new account that pays $6^1/_4$% annual interest compounded monthly, how much will you have in the account after 2 years?



Keystrokes	Display	
2 o Y	–2.00	Storesi (with minus sign for a “negative interest rate”).
32000 o	–32,000.00	StoresPV(with minus sign for cash paid out).
'	28,346.96	Property value after 6 years.

Odd-Period Calculations

The cash flow diagrams and examples presented so far have dealt with financial transactions in which interest begins to accrue at the beginning of the first regular payment period. However, interest often begins to accrue prior to the beginning of the first regular payment period. The period from the date interest begins accruing to the date of the first payment, being not equal to the regular payment periods is sometimes referred to as an “odd first period”. For simplicity, in using the hp 12c we will always regard the first period as equal to the remaining periods, and we will refer to the period between the date interest begins accruing and the beginning of the first payment period as simply the “odd period” or the “odd days”. (Note that the odd period is always assumed by the calculator to occur before the first full payment period.) The following two cash flow diagrams represent transactions including an odd period for payments in advance (Begin) and for payments in arrears (End).



You can calculate i, PV, PMT, and FV for transactions involving an odd period simply by entering a noninteger n. (A noninteger is a number with at least one nonzero digit to the right of the decimal point.) This places the calculator in Odd-Period mode.* The integer part of n (the part to the left of the decimal point) specifies the number of full payment periods, and the fractional part (the part to the right of the decimal) specifies the length of the odd period as a fraction of a full period. The odd period, therefore, cannot be greater than one full period.

The fractional part of n can be determined using either the actual number of odd days or the number of odd days counted on the basis of a 30-day month.† The d function can be used to calculate the number of odd days either way. The fractional part of n is a fraction of a payment period, so the number of odd days

Example 1: A 36-month loan for $4,500 accrues interest at a 15% annual percentage rate (APR), with the paymentsmade at the end of each month. If interest begins accruing on this loan onFebruary 15, 2004 (so that the first period begins on March 1, 2004), calculate the monthly payment, with the odd days counted on the basis of a 30-day month and compound interest used for the odd period.

Keystrokes	Display	
= CLEAR!		Clears financial registers.
> f		Sets date format to month-day-year.
> [		Sets payment mode to End.
\		Turns on theC indicator in the display, so that compound interest will be used for the odd period.
2.152004 3	2.15	Keys in the date interest begins accruing and separates it from the next date entered.
3.012004	3.012004	Keys in the date of the beginning of the first period.
> d	15.00	Actual number of odd days.
O	16.00	Number of odd days counted on the basis of a 30-day month.
30 M	0.53	Divides by the length of a monthly period to get the fractional part of n.
36 C	36.53	Adds the fractional part of n to the number of complete payment periods, then stores the result in n.
15 >	1.25	Calculates and stores i.
4500	4,500.00	Stores PV.
*	–157.03	Monthly payment.

Example 2: A 42-month car loan for $3,950 began accruing interest on July 19, 2004, so that the first period began on August 1, 2004. Payments of $120 are made at the end of each month. Calculate the annual percentage rate (APR), using the actual number of odd days and simple interest for the odd period.

Keystrokes	Display	
= CLEAR		Clears financial registers.
\		Turns off the C indicator in the display, so that simple interest will be used for the odd period.
7.192004 3	7.19	Keys in the date interest begins accruing and separates it from the next date entered.
8.012004	8.012004	Keys in the date of the beginning of the first period.
> d	13.00	Actual number of odd days.
30 M	0.43	Divides by the length of a monthly period to get the fractional part of n.
42 C	42.43	Adds the fractional part of n to the number of complete payment periods, then stores the result in n.
3950	3,950.00	Stores PV.
120 o *	–120.00	Stores PMT (with minus sign for cash paid out).
Y	1.16	Periodic (monthly) interest rate.
12 R	13.95	Annual percentage rate (APR).

Amortization

The hp 12c enables you to calculate the amounts applied toward principal and toward interest from a single loan payment or from several payments, and also tells you the remaining balance of the loan after the payments are made*.

To obtain an amortization schedule:

1. Press = CLEAR! to clear the financial registers.
2. Enter the periodic interest rate, using Y or .
3. Enter the amount of the loan (the principal), using .
4. Key in the periodic payment, then press o * (the sign of PMT must be negative, in accordance with the cash flow sign convention).
5. Press > h or (for most direct reduction loans) > [to set the payment mode.
6. Key in the number of payments to be amortized.
7. Press =

Keystrokes	Display	
573.35 o *	–573.35	Enters PMT (with minus sign for cash paid out).
> [	–573.35	Sets payment mode to End.
12 =	–6,608.89	Portion of first year's payments (12 months) applied to interest.
O	–271.31	Portion of first year's payments applied to principal.
	49,728.69	Balance remaining after 1 year.
C	12.00	Total number of payments amortized.

The number of payments keyed in just before = is pressed is taken to be the payments following any that have already been amortized. Thus, if you now press 12 = , your hp 12c will calculate the amounts applied to interest and to the principal from the second year's payments (that is, the second 12 months):

Keystrokes	Display	
12 =	–6,570.72	Portion of second year's payments applied to interest.
O	–309.48	Portion of second year's payments applied to principal.
; ;	12.00	Number of payments just amortized.
	49,419.21	Balance remaining after 2 years.
C	24.00	Total number of payments amortized.

Pressing or C displays the number in the PV or n register. When you did so after each of the last two calculations, you may have noticed that PV and n had been changed from their original values. The calculator does this so that you can easily check the remaining balance and the total number of payments amortized. But because of this, if you want to generate a new amortization schedule from the beginning, you must reset PV to its original value and reset n to 0.

For example, suppose you now wanted to generate an amortization schedule for each of the first two months:

Keystrokes	Display	
50000	50,000.00	Resets PV to original value.
0 C	0.00	Resets n to zero.

Keystrokes	Display	
1 =	–552.08	Portion of first payment applied to interest.
O	–21.27	Portion of first payment applied to principal.
1 =	–551.85	Portion of second payment applied to interest.
O	–21.50	Portion of second payment applied to principal.
C	2.00	Total number of payments amortized.

If you want to generate an amortization schedule but do not already know the monthly payment:

1. Calculate PMT as described on page 46.
2. Press 0 C to reset n to zero.
3. Proceed with the amortization procedure listed on page 54 beginning with step 6.

Example: Suppose you obtained a 30-year mortgage instead of a 25-year mortgage for the same principal ($50,000) and at the same interest rate (13¼%) as in the preceding example. Calculate the monthly payment, then calculate the amounts applied to interest and to the principal from the first month's payment. Since the interest rate is not being changed, do not press = CLEAR ; to calculate PMT, just enter the new value for n, reset PV, then press * .

Keystrokes	Display	
30 >	360.00	Enters n.
50000	50,000.00	Enters PV.
*	–562.89	Monthly payment.
0 C	0.00	Resets n to zero.
1 =	–552.08	Portion of first payment applied to interest.
O	–10.81	Portion of first payment applied to principal.
	49,989.19	Remaining balance.

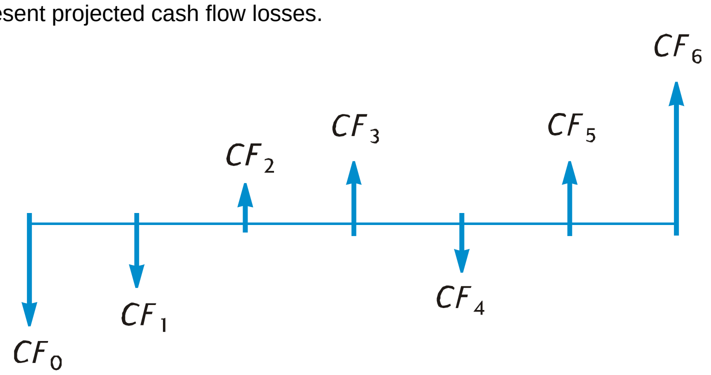
Section 4

Additional Financial Functions

Discounted Cash Flow Analysis: NPV and IRR

The hp 12c provides functions for the two most widely-used methods of discounted cash flow analysis: A (net present value) and & (internal rate of return). These functions enable you to analyze financial problems involving cash flows (money paid out or received) occurring at regular intervals. As in compound interest calculations, the interval between cash flows can be any time period; however, the amounts of these cash flows need not be equal.

To understand how to use A and & , let's consider the cash flow diagram for an investment that requires an initial cash outlay (CF_0) and generates a cash flow (CF_1) at the end of the first year, and so on up to the final cash flow (CF_6) at the end of the sixth year. In the following diagram, the initial investment is denoted by CF_0, and is depicted as an arrow pointing do wn from the time line since it is cash paid out. Cash flows CF_1 and CF_4 also point down from the time line, because they represent projected cash flow losses.



NPV is calculated by adding the initial investment (represented as a negative cash flow) to the present value of the anticipated future cash flows. The interest rate, i, will be referred to in this discussion of NPV and IRR as the rate of return.* The value of NPV indicates the result of the investment:

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* Other terms are sometimes used to refer to the rate of return. These rr arem 0.0009 Tc 4 l 230798 64 2

- If NPV is positive, the financial value of the investor's assets would be increased: the investment is financially attractive.
- If NPV is zero, the financial value of the investor's assets would not change: the investor is indifferent toward the investment.
- If NPV is negative, the financial value of the investor's assets would be decreased: the investment is not financially attractive.

A comparison of the NPV's of alternative investment possibilities indicates which of them is most desirable: the greater the NPV, the greater the increase in the financial value of the investor's assets.

IRR is the rate of return at which the discounted future cash flows equal the initial cash outlay: IRR is the discount rate at which NPV is zero. The value of IRR relative to the present value discount rate also indicates the result of the investment:

- If IRR is greater than the desired rate of return, the investment is financially attractive.
- If IRR is equal to the desired rate of return, the investor is indifferent toward the investment.
- If IRR is less than the desired rate of return, the investment is not financially attractive.

Calculating Net Present Value (NPV)

Calculating NPV for Ungrouped Cash Flows. If there are no equal consecutive cash flows, use the procedure described (and then summarized) below. With this procedure, NPV (and IRR) problems involving up to 20 cash flows (in addition to the initial investment CF_0) can be solved. If two or more consecutive cash flows are equal — for example, if the cash flows in periods three and four are both $8,500 — you can solve problems involving more than 20 cash flows, or you can minimize the number of storage registers required for problems involving less than 20 cash flows, by using the procedure described next (under Calculating NPV for Grouped Cash Flows, page 61).

The amount of the initial investment (CF_0) is entered into the calculator using the $ key. Pressing > $ stores CF_0 in storage register R_0 and also stores the number 0 in the n register.

The amounts of the subsequent cash flows are stored – in the order they occur – in the remaining storage registers: CF_1 thru CF_9 in R_1 thru R_9, and CF_{10} thru CF_{19} in $R_{.0}$ thru $R_{.9}$, respectively. If there is a CF_{20}, that amount is stored in the FV register.*

Each cash flow (CF_1, CF_2, etc.) is designated CF_j, where j takes on values from 1 up to the number of the final cash flow. The amount of a cash flow is entered using the % key. Each time > % is pressed, the amount in the display is stored in the next available storage register, and the number in the n register is increased by 1. This register therefore counts how many cash flow amounts (in addition to the initial investment CF_0) have been entered.

> Note: When entering cash flow amounts — including the initial investment CF_0 — remember to observe the cash flow sign convention by pressing o after keying in a negative cash flow.

In summary, to enter the cash flow amounts:

1. Press = CLEAR' to clear the financial and storage registers.
2. Key in the amount of the initial investment, press o if that cash flow is negative, then press > $. If there is no initial investment, press 0> $.
3. Key in the amount of the next cash flow, press o if the cash flow is negative, then press > %. If the cash flow amount is zero in the next period, press 0 > %.
4. Repeat step 3 for each cash flow until all have been entered.

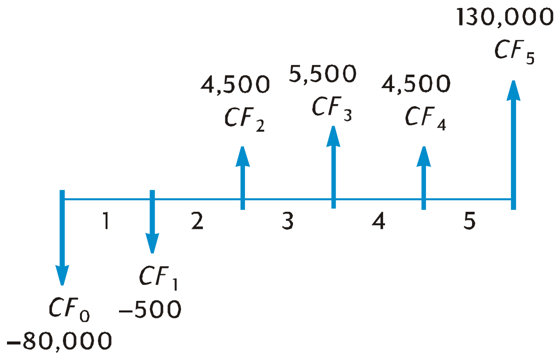
With the amounts of the cash flows stored in the calculator's registers, you can calculate NPV as follows:

1. Enter the interest rate, using Y or .
2. Press = A .

The calculated value of NPV appears in the display and also is automatically stored in the PV register.

* If you have stored a program in the calculator, the number of registers available for storing cash flow amounts may be less than 21. (Storage registers are automatically allocated to program lines beginning with R_9 and proceeding in reverse order to R_7, as described on pages 93 thru 95.) The maximum number of cash flow amounts (in addition to CF_0) that can be stored is the number that appears at the right of the display when > (is pressed. If the

Example: An investor has an opportunity to buy a duplex for $80,000 and would like a return of at least 13%. He expects to keep the duplex 5 years and then sell it for $130,000; and he anticipat es the cash flows shown in the diagram below. Calculate NPV to determine whether the investment would result in a return or a loss.



Note that although a cash flow amount ($4,500) occurs twice, these cash flows are not consecutive. Therefore, these cash flows must be entered using the method described above.

Keystrokes	Display	
= CLEAR'	0.00	Clears financial and storage registers.
80000 o > $	–80,000.00	StoresCF$_0$ (with minus sign for a negative cash flow).
500 o > %	–500.00	StoresCF$_1$ (with minus sign for a negative cash flow).
4500 > %	4,500.00	StoresCF$_2$.
5500 > %	5,500.00	StoresCF$_3$.
4500 > %	4,500.00	StoresCF$_4$.
130000 > %	130,000.00	StoresCF$_5$.
C	5.00	Checks number of cash flow amounts entered (in addition to CF$_0$).
13 Y	13.00	Storesi.
= A	212.18	NPV.

Since NPV is positive, the investment wouldincrease the financial value of the investor’s assets.

Calculating *NPV* for Grouped Cash Flows. A maximum of 20 cash flow amounts (in addition to the initial investment CF_0) can be stored in the hp 12c.* However, problems involving more than 20 cash flows can be handled if among the cash flows there are equal consecutive cash flows. For such problems, you merely enter along with the amounts of the cash flows the number of times — up to 99 — each amount occurs consecutively. This number is designated N_j, corresponding to cash flow amount CF_j, and is entered using the 8 key. Each N_j is stored in a special register inside the calculator.

This method can, of course, be used for problems involving fewer than 20 cash flows — and it will require fewer storage registers than the method described above under Calculating NPV for Ungrouped Cash Flows. Equal consecutive cash flows can be entered using that method — provided there are enough storage registers available to accommodate the total number of individual cash flows. The facility of grouping equal consecutive cash flows is provided to minimize the number of storage registers required.

> Note: When entering cash flow amounts — including the initial investment CF_0 — remember to observe the cash flow sign convention by pressing o after keying in the amount for a negative cash flow.

In summary, to enter the amounts of the cash flows and the number of times they occur consecutively:

1. Press = CLEAR' to clear the financial and storage registers.
2. Key in the amount of the initial investment, press o if that cash flow is negative, then press > $. If there is no initial investment, press 0 > $.
3. If the initial investment consists of more than one cash flow of the amount entered in step 2, key in the number of those cash flows, then press > 8 . If > 8 is not pressed, the calculator assumes that N_0 is 1.
4. Key in the amount of the next cash flow, press o if that cash flow is negative, then press > % . If the cash flow amount is zero in the next period, press 0 > % .
5. If the amount entered in step 4 occurs more than once consecutively, key in the number of times that cash flow amount occurs consecutively, then press > 8 . If > 8 is not pressed, the calculator assumes that N_j is 1 for the CF_j just entered.
6. Repeat steps 4 and 5 for each CF_j and N_j until all cash flows have been entered.

With the amounts of the cash flows and the number of times they occur consecutively stored in the calculator, NPV can be calculated by entering the interest rate and pressing = A , just as described earlier.

---

* If you have stored a program in the calculator, the number of registers available for storing cash flow amounts may be less than 21.

Example: An investor has an opportunity to purchase a piece of property for $79,000; and he would like a 13 $^{1}/_{2}$% return. He expects to be able to sell it after 10 years for $100,000 and anticipates the ye arly cash flows shown in the table below:

Year	Cash Flow	Year	Cash Flow
1	$14,000	6	$9,100
2	$11,000	7	$9,000
3	$10,000	8	$9,000
4	$10,000	9	$4,500
5	$10,000	10	$100,000

Since two cash flow amounts ($10,000 and $9,000) are repeated consecutively, we can minimize the number of storage registers required by using the method just described.

Keystrokes	Display	
= CLEAR'	0.00	Clears financial and storage registers.
79000 o > $	–79,000.00	Initial investment (with minus sgn for a negative cash flow).
14000 > %	14,000.00	First cash flow amount.
11000 > %	11,000.00	Next cash flow amount.
10000 > %	10,000.00	Next cash flow amount.
3 > 8	3.00	Number of times this cash flow amount occurs consecutively.
9100 > %	9,100.00	Next cash flow amount.
9000 > %	9,000.00	Next cash flow amount.
2 > 8	2.00	Number of times this cash flow amount occurs consecutively.
4500 > %	4,500.00	Next cash flow amount.
100000 > %	100,000.00	Final cash flow amount.
C	7.00	Seven different cash flow amounts have been entered.
13.5 Y	13.50	Storesi.
= A	907.77	NPV.

Since NPV is positive, the investment wouldincrease the financial value of the investor’s assets by $907.77.

Calculating Internal Rate of Return (IRR)

1. Enter the cash flows using either of the methods described above under Calculating Net Present Value.
2. Press = & .

The calculated value of IRR appears in the display and also is automatically stored in the i register.

> Note: Remember that the & function may take a significant amount of time to produce an answer, during which the calculator displays running .

Example: The NPV calculated in the preceding example was positive, indicating that the actual rate of return (that is, the IRR) was greater than the $13^1/_2$ used in the calculation. Find the IRR.

Assuming the cash flows are still stored in the calculator, we need only press = & :

Keystrokes	Display	
= &	13.72	IRR is 13.72%.

Note that the value calculated by & is the periodic rate of return. If the cash flow periods are other than years (for example, months or quarters), you can calculate the nominal annual rate of return by multiplying the periodic IRR by the number of periods per year.

As noted above, the calculator may take several seconds or even minutes to produce an answer for IRR. This is because the mathematical calculations for finding IRR are extremely complex, involving a series of iterations — that is, a series of successive calculations. In each iteration, the calculator uses an estimate of IRR as the interest rate in a computation of NPV. The iterations are repeated until the computed NPV reaches about zero.*

If you do not want to wait for the computation of IRR to be completed, press any key. This halts the computation of IRR and displays the estimated value of IRR being used in the current iteration.† You can then check how good this estimate is by calculating NPV using this estimate: if the estimate is close to IRR, the NPV calculated with it should be close to zero.* The values of IRR is put into the i register at the end of each iteration. Therefore, to check how good an estimate of IRR is after that estimate is in the display, just press = A .

---

* In practice, because the complex mathematical calculations inside the calculator are done with numbers rounded to 10 digits, NPV may never reach exactly zero. Nevertheless, the interest rate that results in a very small NPV is very close to the actual IRR.

† Provided the first iteration has been completed.

The complex mathematical characteristics of the IRR computation have an additional ramification: Depending on the magnitudes and signs of the cash flows, the computation of IRR may have a single answer, multiple answers, a negative answer or no answer.*

For additional information regarding & , refer to Appendix B. For an alternative method of calculating IRR, refer to Section 13.

Reviewing Cash Flow Entries

- To display a single cash flow amount, press , then key in the number of the register containing the cash flow amount to be displayed. Alternatively, store the number of that cash flow amount (that is, the value of j for the CF_j desired) in the n register, then press > % .
- To review all the cash flow amounts, press > % repeatedly. This displays the cash flow amounts in reverse order — that is, beginning with the final cash flow and proceeding to CF_0.
- To display the number of times a cash flow amount occurs consecutively — that is, to display the N_j for a CF_j — store the number of that cash flow amount (that is, the value of j) in the n register, then press > 8 .
- To review all the cash flow amounts together with the number of times each cash flow amount occurs consecutively (that is, to review each CF_j and N_j pair), press > 8 > % repeatedly. This displays N_j followed by CF_j beginning with the final cash flow amount and proceeding to N_0 and CF_0.

  Note: Neither & nor A change the number in the n register. However, each time > % is pressed, the number in the n register is decreased by 1. If this is done, or if you manually change the number in the n register in order to display a single N_j and/or CF_j, be sure to reset the number in the n register to the total number of cash flow amounts originally entered (not including the amount of the initial investment CF_0). If this is not done, NPV and IRR calculations will give incorrect results; also, a review of cash flow entries would begin with N_n and CF_n, where n is the number currently in the n register.

For example, to display the fifth cash flow amount and the number of times that amount occurs consecutively:

Keystrokes	Display	
5	9,000.00	CF_5
5 C	5.00	Stores the value of j in the n register.

---

* In the case of multiple answers for IRR, the decision criteria listed on page 57 should be modified accordingly.

Keystrokes	Display	
> 8	2.00	N_5
7 C	7.00	Resets the number in the n register to its original value.

To display all the cash flow amounts and the number of times they occur consecutively:

Keystrokes	Display	
> 8	1.00	N_7
> %	100,000.00	CF_7
> 8	1.00	N_6
> %	4,500.00	CF_6
> 8	2.00	N_5
> %	9,000.00	CF_5
.	.	.
.	.	.
.	.	.
> 8	1.00	N_1
> %	14,000.00	CF_1
> 8	1.00	N_0
> %	–79,000.00	CF_0
7 C	7.00	Resets the number in the n register to its original value.

Changing Cash Flow Entries

- To change a cash flow amount:
  1. Key the amount into the display.
  2. Press .
  3. Key in the number of the register containing the cash flow amount to be changed.
- To change the number of times a cash flow amount occurs consecutively — that is, to change the N_j for a CF_j:
  1. Store the number of that cash flow amount (that is j) in the n register.
  2. Key the number of times the cash flow amount occurs consecutively into the display.
  3. Press > 8 .

Note: If you change the number in the n register in order to change an N_j, be sure to reset the number in the n register to the total number of cash flow amounts originally entered (not including the amount of the initial investment CF_0). If this is not done, NPV and IRR calculations will give incorrect results.

Example 1: With the cash flows now stored in the calculator, change CF_2 from \$11,000 to \$9,000, then calculate the new NPV for a 13 $^1/_2$% return.

Keystrokes	Display	
9000 2	9,000.00	Stores the new CF_2 in R_2.
13.5 Y	13.50	Stores i.*
= A	–644.75	The new NPV.

Since this NPV is negative, the investment would decrease the financial value of the investor's assets.

Example 2: Change N_5 from 2 to 4, then calculate the new NPV.

Keystrokes	Display	
5 C	5.00	Stores j in the n register.
4 > 8	4.00	Stores the new N_5.
7 C	7.00	Resets the number in the n register to its original value.
= A	–1,857.21	The new NPV.

Bond Calculations

The hp 12c enables you to solve for bond price (and the interest accrued since the last interest date) and the yield to maturity.† The and - calculations are done assuming a semiannual coupon payment and using an actual/actual basis (such as for U.S. Treasury bonds and U.S. Treasury notes). In accordance with market convention, prices are based on a redemption (par) value of 100.

* This step is necessary in this example because we have calculated IRR since the first time we calculated NPV. The IRR calculation replaced the 13.5 we keyed into i before calculating NPV with the result for IRR – 13.72.

† All bond calculations are performed in accordance with. the Securities Industry Association's recommendations as contained in Spence, Graudenz, and Lynch, Standard Securities Calculation Methods, Securities Industry Association, New York, 1973.

To calculate bond price and yield for a 30/360 bond (that is, using the basis of a 30day month and a 360-day year — such as for municipal bonds, corporate bonds, and state and local government bonds), and to calculate bond price for bonds with an annual coupon payment, refer to Section 16: Bonds.

Bond Price

1. Enter the desired yield to maturity (as a percentage), using Y .
2. Enter the annual coupon rate (as a percentage), using * .
3. Key in the settlement (purchase) date (as described on page 29), then press 3 .
4. Key in the maturity (redemption) date.
5. Press = .

The price is shown in the display and also is stored in the PV register. The interest accrued since the last interest date is held inside the calculator: to display the interest, press O ; to add the interest to the price, press .

Example: What price should you pay on April 28, 2004 for a 6 $^{3}/_{4}$% U.S. Treasury bond that matures on June 4, 2018, if you want a yield of 8 $^{1}/_{4}$%. Assume that you normally express dates in the month-day-year format.

Keystrokes	Display	
8.25 Y	8.25	Enters yield to maturity.
6.75 *	6.75	Enters coupon rate.
> f	6.75	Sets date format to month-day-year.
4.282004 3	4.28	Enters settlement (purchase) date.
6.042018	6.042018	Enters maturity (redemption) date.
=	87.62	Bond price (as a percent of par).
	90.31	Total price, including accrued interest.

Bond Yield

1. Enter the quoted price (as a percent of par), using .
2. Enter the annual coupon rate (as a percentage), using * .
3. Key in the settlement (purchase) date, then press 3 .
4. Key in the maturity (redemption) date.
5. Press = - .

The yield to maturity is shown in the display and also is stored in the i register.

> Note: Remember that the - function may take a significant amount of time to produce an answer, during which the calculator displays running .

Example: The market is quoting $88^3/_8$% for the bond described in the preceding example. What yield will that provide ?

Keystrokes	Display	
3 3 8 M	0.38	Calculates $^3/_8$.
88	88.38	Enters quoted price.
6.75 *	6.75	Enters coupon rate.
4.282004 3	4.28	Enters settlement (purchase) date.
6.042018	6.042018	Enters maturity (redemption) date.
= -	8.15	Bond yield.

Depreciation Calculations

The hp 12c enables you to calculate depreciation and the remaining depreciable value (book value minus salvage value) using the straight-line, sum-of-the-years-digits, and declining-balance methods. To do so with any of these methods:

1. Enter the original cost of the asset, using .
2. Enter the salvage value of the asset, using' . If the salvage value is zero, press 0' .
3. Enter the expected useful life of the asset (in years), usingC .
4. If the declining-balance method is being used, enter the declining-balance factor (as a percentage), using Y . For example, $1^1/_4$ times the straight-line rate — 125 percent declining-balance — would be entered as 125 Y .
5. Key in the number of the year for which depreciation is to be calculated.
6. Press:

   z = / for depreciation using the straight-line method.

   z = n for depreciation using the sum-of-the-years digits method.

   z = for depreciation using the declining-balance method.

/ , n , and each place the amount of depreciation in the display. To display the remaining depreciable value (the book value less the salvage value) after the depreciation has been calculated, press O .

Example: A metalworking machine, purchased for $10,000, is depreciated over 5 years. Its salvage value is estimated at $500. Find the depreciation and remaining depreciable value for the first 3 years of the machine's life using the declining-balance method at double the straight-line rate (200 percent declining-balance).

Keystrokes	Display	
10000	10,000.00	Enters original cost.
500 '	500.00	Enters salvage value.
5 C	5.00	Enters expected useful life.
200 Y	200.00	Enters declining-balance factor.
1 =	4,000.00	Depreciation in first year.
O	5,500.00	Remaining depreciable value after first year.
2 =	2,400.00	Depreciation in second year.
O	3,100.00	Remaining depreciable value after second year.
3 =	1,440.00	Depreciation in third year.
O	1,660.00	Remaining depreciable value after third year.

To calculate depreciation and the remaining depreciable value when the acquisition date of the asset does not coincide with the beginning of the fiscal accounting year, refer to the procedures in Section 13. That section also includes a procedure for depreciation calculations when changing from the declining-balance method to the straight-line method, and a procedure for calculating excess depreciation.

Section 5

Additional Operating Features

Continuous Memory

The calculator's Continuous Memory contains the data storage registers, the financial registers, the stack and LAST X registers, program memory, and status information such as display format, date format, and payment mode. All information in Continuous Memory is preserved even while the calculator is turned off. Furthermore, information in Continuous Memory is preserved for a short time when the batteries are removed, so that you can change the batteries without losing your data and programs.

Continuous Memory may be reset if the calculator is dropped or otherwise traumatized, or if power is interrupted. You can also manually reset Continuous Memory as follows:

1. Turn the calculator off.
2. Hold down the key, and press .

When Continuous Memory is reset:

- All registers are cleared.
- Program memory consists of eight program lines, each containing the instruction > 00.
- Display format is set to the standard format with two decimal places.
- Date format is set to month-day-year.
- Payment mode is set to End.

Whenever Continuous Memory has been reset, the display will show Pr Error . Pressing any key will clear this message from the display.

The Display

Status Indicators

Six indicators that appear along the bottom of the display signify the status of the calculator for certain operations. These status indicators are described elsewhere in this handbook where the relevant operation is discussed.

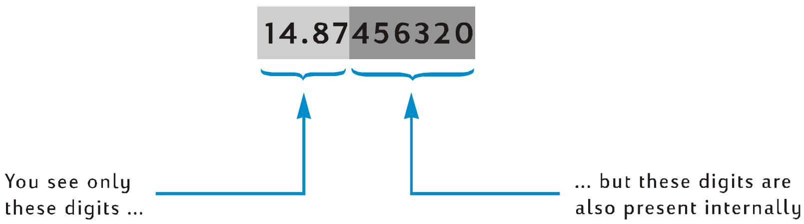
f g BEGIN D.MY C PRGM

Number Display Formats

When the calculator is first turned on after coming from the factory or after Continuous Memory has been reset, answers are displayed with two decimal places.

Keystrokes	Display
19.8745632 3	19.87
5	14.87

Although you see only two decimal places, all calculations in your hp 12c are performed with full 10-digit numbers.



When only two decimal places are displayed, numbers are rounded to two decimal places: if the third digit is 5 through 9, the second digit is increased by one; if the third digit is 0 through 4, the second digit is not affected. Rounding occurs regardless of how many decimal places are displayed.

Several options are provided for controlling how numbers appear in the display. But regardless of which display format or how many displayed decimal places you specify, the number inside the calculator — which appears altered in the display — is not altered unless you use the , , / , n , or functions.

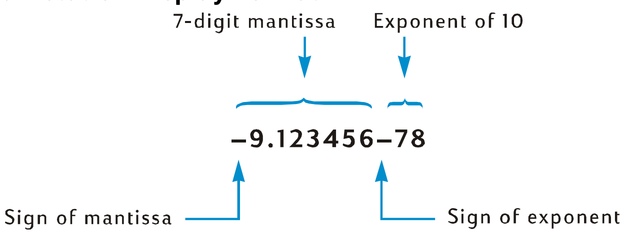
Standard Display Format. The number 14.87 now in your calculator is currently being displayed in the standard display format with two decimal places shown. To display a different number of decimal places, press = followed by a digit key (0 through 9) specifying the number of decimal places. In the following examples, notice how the displayed form of the number inside the calculator — 14.87456320 — is rounded to the specified number of digits.

Keystrokes	Display	
= 4	14.8746	
= 1	14.9	
= 0	15.	
= 9	14.87456320	Although nine decimal places were specified after = , only eight are displayed since the display can show a total of only 10 digits.

The standard display format, plus the specified number of decimal places, remain in effect until you change them; they are not reset each time the calculator is turned on. However, if Continuous Memory is reset, when the calculator is next turned on numbers will be displayed in the standard display format with two decimal places shown.

If a calculated answer is either too small or too large to be displayed in the standard display format, the display format automatically switches to scientific notation (described below). The display returns to the standard display format for all numbers that can be displayed in that format.

Scientific Notation Display Format



In scientific notation, a number is displayed with its mantissa at the left and a two-digit exponent at the right. The mantissa is simply the first seven digits in the number, and has a single, nonzero digit to the left of the decimal point. The exponent is simply how many decimal places you would move the decimal point in the mantissa before writing down the number in standard format. If the exponent is negative (that is, there is a minus sign between it and the mantissa), the decimal point should be moved to the left; this occurs for any number less than 1. If the exponent is positive (that is, there is a blank space between it and the mantissa), the decimal point should be moved to the right; this occurs for any number greater than or equal to 1.

To set the display format to scientific notation, press = . For example (assuming the display still shows 14.87456320 from the preceding example):

Keystrokes	Display
=	1.487456 01

The exponent in this example indicates that the decimal point should be moved one decimal place to the right, giving the number 14.87456, which is the first seven digits of the number previously in the display.

To set the display back to standard display format, press = followed by the desired number of decimal places. Scientific notation display format remains in effect until you change to the standard display format; it is not reset each time the calculator is turned on. However, if Continuous Memory is reset, when the calculator is next turned on the standard display format, with two decimal places, will be used.

Mantissa Display Format. Because both the standard display format and scientific notation display format often show only a few digits of a number, you may occasionally want to see all 10 digits — the full mantissa — of the number inside the calculator. To do so, press = CLEAR0 and hold down the 0 key. The display will show all 10 digits of the number as long as you hold down the 0 key; after you release the key, the number will again be displayed in the current display format. For instance, if the display still contains the result from the preceding example:

Keystrokes	Display	
= CLEAR0	1487456320	All 10 digits of the number inside the calculator.
	1.487456 01	Display returns to its former contents when the 0 key is released.
= 2	14.87	Returns display to standard format.

Special Displays

Running. Certain functions and many programs may take several seconds or more to produce an answer. During these calculations, the word running flashes in the display to let you know that the calculator is running.

Overflow and Underflow. If a calculation results in a number whose magnitude is greater than 9.999999999 $\times 10^{99}$, the calculation is halted and the calculator displays 9.999999 99 (if the number is positive) or –9.999999 99 (if the number is negative).

If a calculation results in a number whose magnitude is less than 10^{-99}, the calculation is not halted, but the value 0 is used for that number in subsequent calculations.

Errors. If you attempt an improper operation — such as division by zero — the calculator will display the word Error followed by a digit (0 through 9). To clear the Error display, press any key. This does not execute that key's function, but does restore the calculator to its condition before the improper operation was attempted. Refer to Appendix C for a list of error conditions.

Pr Error. If power to the calculator is interrupted, the calculator will display Pr Error when next turned on. This indicates that Continuous Memory — which contains all data, program, and status information — has been reset.

The x≷y key

Suppose you need to subtract $25.83 from $144.25, and you (mistakenly) key in 25.83, press 3 , then key in 144.25. But then you realize that when written down on paper, the desired calculation reads 144.25 – 25.83, so that you have unfortunately keyed in the second number first. To correct this mistake, merely exchange the first and second numbers by pressing O , the exchange key.

Keystrokes	Display	
25.83 3 144.25	144.25	Oops! You mistakenly keyed in the second number first.
O	25.83	Exchanges the first and second numbers. The first number keyed in is now in the display.
	118.42	The answer is obtained by pressing the operation key.

The O key is also useful for checking the first number entered to make sure you keyed it in correctly. Before pressing the operation key, however, you should press O again to return the second number entered to the display. Regardless of how many times you press O , the calculator considers the number in the display to be the second number entered.

The LSTx Key

Occasionally you may want to recall to the display the number that was there before an operation was performed. (This is useful for doing arithmetic calculations with constants and for recovering from errors in keying in numbers.) To do so, press > (last x).

Arithmetic Calculations With Constants

Example: At Permex Pipes a certain pipe fitting is packaged in quantities of 15, 75, and 250. If the cost per fitting is $4. 38, calculate the cost of each package.

Keystrokes	Display	
15 3	15.00	Keys first quantity into calculator.
4.38	4.38	Keys unit cost into display.
R	65.70	Cost of a package of 15.
75	75.	Keys second quantity into display.
>	4.38	Recalls unit cost — which was last number in display before R was pressed — into display.
R	328.50	Cost of a package of 75.
250	250.	Keys third quantity into display.
>	4.38	Recalls unit cost into display again.
R	1,095.00	Cost of a package of 250.

Another method for doing arithmetic calculations with constants is described on page 177.

Recovering From Errors in Digit Entry

Example: Suppose you want to divide the total annual production for one of your firm's products (429,000) by the number of retail outlets (987) in order to calculate the average number distributed by each outlet. Unfortunately, you mistakenly key in the number of outlets as 9987 rather than as 987. It's easy to correct:

Keystrokes	Display	
429000 3	429,000.00	
9987	9,987.	You haven't noticed your mistake yet.
M	42.96	About 43 products per outlet — but that seems too low!
>	9,987.00	Recalls to the display the number that was there before you press M . You see that you keyed it in wrong.
429000 3	429,000.00	Begins the problem over.
987 M	434.65	The correct answer.

Section 6

Statistics Functions

Accumulating Statistics

The hp 12c can perform one- or two-variable statistical calculations. The data is entered into the calculator using the 6 key, which automatically calculates and stores statistics of the data into storage registers R_1 through R_6. (These registers are therefore referred to as the "statistics registers.")

Before beginning to accumulate statistics for a new set of data, you should clear the statistics registers by pressing = clear U .*

In one-variable statistical calculations, to enter each data point — referred to as an "x-value" — key the x-value into the display, then press 6 .

In two-variable statistical calculations, to enter each data pair — referred to as the "x and y-values":

1. Key the y-value into the display.
2. Press 3 .
3. Key the x-value into the display.
4. Press 6 .

Each time you press 6 , the calculator does the following:

- The number in R_1 is increased by 1, and the result is copied into the display.
- The x-value is added to the number in R_2.
- The square of the x-value is added to the number in R_3.
- The y-value is added to the number in R_4.
- The square of the y-value is added to the number in R_5.
- The product of the x and y-values is added to the number in R_6.

* This also clears the stack registers and the display.

The table below shows where the accumulated statistics are stored.

Register	Statistic
R_1 (and display)	n: number of data pairs accumulated.
R_2	6x: summation of x-values.
R_3	6x^2: summation of squares of x-values.
R_4	6y: summation of y-values.
R_5	6y^2 summation of squares of y-values.
R_6	6xy: summation of products of x-values and y-values.

Correcting Accumulated Statistics

If you discover you have entered data incorrectly, the accumulated statistics can easily be corrected:

- If the incorrect data point or data pair has just been entered and 6 has been pressed, press > > 5 .
- If the incorrect data point or data pair is not the most recent one entered, key in the incorrect data point or data pair again as if it were new, but press > 5 instead of 6 .

These operations cancel the effect of the incorrect data point or data pair. You can then enter the data correctly, using 6 , just as if it were new.

Mean

Pressing > g calculates the means (arithmetic averages) of the x-values ($\bar{x}$) and of the y-values ($\bar{y}$). The mean of the x-values appears in the display after g is pressed; to display the mean of the y-values, press O .

Example: A survey of seven salespersons in your company reveals that they work the following hours a week and sell the following dollar volumes each month. How many hours does the average salesperson work each week? How much does the average salesperson sell each month?

Salesperson	Hours/Week	Hours/Week
1	32	$17,000
2	40	$25,000
3	45	$26,000
4	40	$20,000
5	38	$21,000
6	50	$28,000
7	35	$15,000

To find the average workweek and sales of this sample:

Keystrokes	Display	
= CLEARU	0.00	Clears statistics registers.
32 3 17000 6	32.00 1.00	First entry.
40 3 25000 6	40.00 2.00	Second entry.
45 3 26000 6	45.00 3.00	Third entry.
40 3 20000 6	40.00 4.00	Fourth entry.
38 3 21000 6	38.00 5.00	Fifth entry.
50 3 28000 6	50.00 6.00	Sixth entry.
35 3 15000 6	35.00 7.00	Total number of entries in the sample.
> g	21,714.29	Mean dollar sales per month ($\bar{x}$).
O	40.00	Mean workweek in hours ($\bar{y}$).

Standard Deviation

Pressing > J calculates the standard deviation of the x-values (s_x) and of the y-values (s_y). (The standard deviation of a set of data is a measure of the dispersion around the mean.) The standard deviation of the x-values appears in the display after J is pressed; to display the standard deviation of the y-values, press O .

Example: To calculate the standard deviations of the x-values and of the y-values from the preceding example:

Keystrokes	Display	
> J	4,820.59	Standard deviation of sales.
O	6.03	Standard deviation of hours worked.

The formulas used in the hp 12c for calculating s_x, and s_y give best estimates of the population standard deviation based on a sample of the population. Thus, current statistical convention calls them sample standard deviations. So we have assumed that the seven salespersons are a sample of the population of all salespersons, and our formulas derive best estimates of the population from the sample.

What if the seven salespersons constituted the whole population of salespersons. Then we wouldn't need to estimate the population standard deviation. We can find the true population standard deviation (V) when the data set equals the total population, using the following keystrokes:*

Keystrokes	Display	
> g	21,714.29	Mean (dollars)
6	8.00	Number of entries + 1.
> J	4,463.00	V_x
O	5.58	V_y

To continue summing data pairs, press > g > 5 before entering more data.

* It turns out that if you sum the mean of the population into the set itself and find the new s, computed using the formulas on page 192, that s will be the population standard deviation, V, of the original set.

Linear Estimation

With two-variable statistical data accumulated in the statistics registers, you can estimate a new y-value ($\hat{y}$) given a new x-value, and estimate a new x-value ($\hat{x}$) given a new y-value.

To calculate $\hat{y}$:

1. Key in a new x-value.
2. Press > , .

To calculate $\hat{x}$:

1. Key in a new y-value.
2. Press > + .

Example: Using the accumulated statistics from the preceding problem, estimate the amount of sales delivered by a new salesperson working 48 hours per week.

Keystrokes	Display	
48 > +	28,818.93	Estimated sales for a 48 hour workweek.

The reliability of a linear estimate depends upon how closely the data pairs would, if plotted on a graph, lie in a straight line. The usual measure of this reliability is the correlation coefficient, r. This quantity is automatically calculated whenever $\hat{y}$ or $\hat{x}$ is calculated; to display it, press O . A correlation coefficient close to 1 or –1 indicates that the data pairs lie very close to a straight line. On the other hand, a correlation coefficient close to 0 indicates that the data pairs do not lie closely to a straight line; and a linear estimate using this data would not be very reliable.

Example: Check the reliability of the linear estimate in the preceding example by displaying the correlation coefficient.

Keystrokes	Display	
O	0.90	The correlation coefficient is close to 1, so the sales calculated in the preceding example is a good estimate.

To graph the regression line, calculate the coefficients of the linear equation y = A + Bx.

1. Press 0> , to compute the y-intercept (A).
2. Press 1> , O ; O to compute the slope of the line (B).

Example: Compute the slope and intercept of the regression line in the preceding example.

Keystrokes	Display	
0 > ,	15.55	y-intercept (A); projected value forx = 0.
1 > , O ; O	0.001	Slope of the line (B); indicates the change in the projected values caused by an incremental change in the x value.

The equation that describes the regression line is:

$$y = 15.55 + 0.001x$$

Weighted Mean

You can compute the weighted mean of a set of numbers if you know the corresponding weights of the items in question.

1. Press = CLEARU .
2. Key in the value of the item and press 3 , then key in its weight and press 6 . Key in the second item's value, press 3 , key in the second weight, and press 6 . Continue until you have entered all the values of the items and their corresponding weights. The rule for entering the data is "item 3 weight 6 ."
3. Press > ? to calculate the weighted mean of the items.

Example: Suppose that you stop during a vacation drive to purchase gasoline at four stations as follows: 15 gallons at $1.16 per gallon, 7 gallons at $1.24 per gallon, 10 gallons at $1.20 per gallon, an d 17 gallons at $1.18 per gallon. You want to find the average cost per gallon of gasoline purchased. If you purchased the same quantity at each station, you could determine the simple arithmetic average or mean using the g key. But since you know the value of the item (gasoline) and its corresponding weight (number of gallons purchased), use the? key to find the weighted mean:

Keystrokes	Display	
= CLEARU	0.00	Clears statistics registers.
1.16 3 15 6	1.00	First item and weight.
1.24 3 7 6	2.00	Second item and weight.
1.20 3 10 6	3.00	Third item and weight.
1.18 3 17 6	4.00	Fourth item and weight.

Keystrokes	Display	
> ?	1.19	Weighted mean cost per gallon.

A procedure for calculating the standard deviation and standard error (as well as the mean) of weighted or grouped data is included in the hp 12c Solutions Handbook.

Section 7

Mathematics and Number-Alteration Functions

The hp 12c provides several keys for mathematical functions and for altering, numbers. These functions are useful for specialized financial calculations as well as for general mathematics calculations.

One-Number Functions

Most of the mathematics functions require that only one number be in the calculator (that is, the number in the display) before the function key is pressed. Pressing the function key then replaces the number in the display by the result.

Reciprocal. Pressing L calculates the reciprocal of the number in the display — that is, it divides 1 by the number in the display.

Square Root. Pressing > F calculates the square root of the number in the display.

Logarithm. Pressing > S calculates the natural logarithm (that is, the logarithm to the base e) of the number in the display. To calculate the common logarithm (that is, the logarithm to the base 10) of the number in the display, calculate the natural logarithm, then press 10> S M .

Exponential. Pressing > calculates the exponential of the number in the display — that is, it raises the base e to the number in the display.

Factorial. Pressing > < calculates the factorial of the number in the display — that is, it calculates the product of the integers from 1 to n, where n is the number in the display.

Round. The display format specifies to how many decimal places a number inside the calculator is rounded when it appears in the display; but the display format alone does not affect the number itself inside the calculator. Pressing = , however, changes the number inside the calculator to match its displayed version. Thus, to round a number in the display to a given number of decimal places, temporarily set the display format (as described on page 71) to show the desired number of decimal places, then press= .

Integer. Pressing > c replaces the number in the display by its integer portion — that is, it replaces each digit to the right of the decimal point by 0. The number is changed inside the calculator as well as in the display. The original number can be recalled to the display by pressing > .

File name: hp 12c_user's guide_English_HDPMBF12E44 Page: 83 of 209
Printered Date: 2005/7/29 Dimension: 14.8 cm x 21 cm

Fractional. Pressing > . replaces the number in the display by its fractional portion — that is, it replaces all digits to the left of the decimal point by 0. Like c , . changes the number inside the calculator as well as its displayed version. The original number can be recalled to the display by pressing > .

All of the above functions are used basically in the same way. For example, to find the reciprocal of 0.258:

Keystrokes	Display	
.258	0.258	Keys the number into the display.
L	3.88	The reciprocal of 0.258, the ori ginal number.

Any of the above functions can be done with a number in the display resulting from a previous calculation, as well as with a number you have just keyed in.

Keystrokes	Display	
= CLEAR0	3875968992	Displays all 10 digits of the number inside the calculator.
	3.88	Display returns to normal format when 0 key is released.
=	3.88	The number now in the display appears the same as before, but …
= 0	3880000000	Displaying all 10 digits of the number inside the calculator shows has changed the number to match its displayed version.
	3.88	Display returns to normal format.
> c	3.00	The integer portion of the number previously displayed.
>	3.88	Recalls the original number to the display.
> .	0.88	The fractional portion of the number previously displayed.

The Power Function

Pressing E calculates a power of a number — that is, y^x. Like the arithmetic function , E requires two numbers:

1. Key in the base number (which is designated by they on the key).
2. Press 3 to separate the second number (the exponent) from the first (the base).
3. Key in the exponent (which is designated by thex on the key).
4. Press E to calculate the power.

To Calculate	Keystrokes	Display
$2^{1.4}$	2 3 1.4 E	2.64
$2^{-1.4}$	2 3 1.4 o E	0.38
$(-2)^3$	2 o 3 3 E	–8.00
$\sqrt[3]{2}$ or $2^{1/3}$	2 3 3 L E	1.26

Part II

Programming

Section 8

Programming Basics

Why Use Programs?

A program is simply a sequence of keystrokes that is stored in the calculator. Whenever you have to calculate with the same sequence of keystrokes several times, you can save a great deal of time by incorporating these keystrokes in a program. Instead of pressing all the keys each time, you press just one key to start the program: the calculator does the rest automatically!

Creating a Program

Creating a program consists simply of writing the program, thenstoring it:

1. Write down the sequence of keystrokes that you would use to calculate the quantity or quantities desired.
2. Press = G to set the calculator to Program mode. When the calculator is in Program mode, functions are not executed when they are keyed in, but instead are stored inside the calculator. The PRGM status indicator in the display is lit when the calculator is in Program mode.
3. Press = CLEAR a to erase any previous programs that may be stored inside the calculator. If you want to create a new program without erasing a program already stored, skip this step and proceed as described in Section 11, Multiple Programs.
4. Key in the sequence of keystrokes that you wrote down in step 1. Skip the beginning keystrokes that enter data, which would differ each time the program is used.

Example: Your office supplies dealer is selling selected stock at 25% off. Create a program that calculates the net cost ofan item after the discount is subtracted and the $5 handling charge is added.

First, we'll manually calculate the net cost of an item listing for $200.

Keystrokes	Display	
200	200.	Keys in cost of item.
3	200.00	Separates cost of item from percentage to be keyed in next.
25 9	50.00	Amount of discount.

Keystrokes	Display	
	150.00	Price less discount.
5	5.	Handling charge.
	155.00	Net cost (price less discount plus handling charge).

Next, set the calculator to Program mode and erase any program(s) already stored:

Keystrokes	Display	
= G	00-	Sets calculator to Program mode.
= CLEARa	00-	Clears program(s).

Finally, press the keys that we used above to solve the problem manually. Do not key in 200; this number will vary each time the program is used. Don't be concerned right now about what appears in the display as you press the keys; we'll discuss that later in this section.

Keystrokes	Display	
3	01-	36
2	02-	2
5	03-	5
9	04-	25
	05-	30
5	06-	5
	07-	40

Running a Program

To run (sometimes called "execute") a program:

1. Press = G to set the calculator back to Run mode. If the calculator is already in Run mode (that is, thePRGM status indicator in the display is not lit), skip this step.
2. Key any required data into the calculator, just as if you were calculating manually. When a program is run, it uses the data already keyed into the display and the registers inside the calculator.
3. Press H to begin program execution.

Example: Run the program created above to calculate the net cost of a typewriter listing for $625 and an executive chair listing for $159.

Keystrokes	Display	
= G	155.00	Sets calculator to Run mode. Display shows number previously calculated.
625	625.	Keys in price of typewriter.
H	473.75	Net cost of typewriter.
159	159.	Keys in list price of chair.
H	124.25	Net cost of chair.

That's all there is to creating and running simple programs! But if you want to use programs frequently, you'll want to know more about programming — such as how to check what keystrokes are stored in program memory, how many keystrokes can be stored in program memory, how to correct or otherwise modify programs, how to skip keystrokes when running a program, and so on. Before you can understand these aspects of programming, we need to briefly discuss how keystrokes are treated by the calculator when they are stored in Program mode and when they are executed in Run mode.

Program Memory

Keystrokes entered into the calculator in Program mode are stored in program memory. Each digit, decimal point, or function key is called an instruction and is stored in one line of program memory — usually referred to simply as a program line. Keystroke sequences beginning with the = , > , , , and @ prefix keys are considered to comprise a complete instruction and are stored in only one program line.

When a program is run, each instruction in program memory is executed — that is, the keystroke in that program line is performed, just as if you were pressing the key manually — beginning with the current line in program memory and proceeding sequentially with the higher-numbered program lines.

Whenever the calculator is in Program mode (that is, whenever the PRGM status indicator in the display is lit), the display shows information about the program line to which the calculator is currently set. At the left of the display is the number of the program line within program memory. The remaining digits in the display comprise a code that indicates what instruction has been stored in that program line. No code is shown for program line 00, since no regular instruction is stored there.

Identifying Instructions in Program Lines

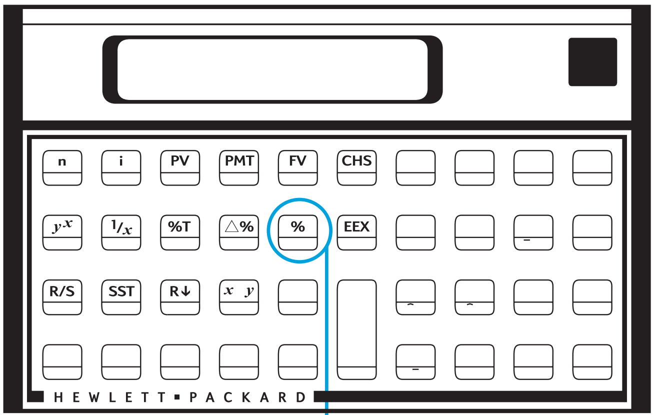
Each key on the hp 12c keyboard — except for the digit keys 0 through 9 — is identified by a two-digit "keycode" that corresponds to the key's position on the keyboard. The first digit in the keycode is the number of the key row, counting from row 1 at the top; the second digit is the number of the key in that row, counting from 1 for the first key in the row through 9 for the ninth key in the row and 0 for the tenth key in the row. The keycode for each digit key is simply the digit on the key. Thus, when you keyed the instruction 9 into program memory, the calculator displayed

04– 25

This indicates that the key for the instruction in program line 04 is in the second row on the keyboard and is the fifth key in that row: the 9 key. When you keyed the instruction into program memory, the calculator displayed

07– 40

This indicates that the key for the instruction in program line 07 is in the fourth row on the keyboard and is the tenth key in that row: the key. When you keyed the digit 5 into program memory, the keycode displayed was only the digit 5.



Second row, fifth key

Displaying Program Lines

Pressing = G to set the calculator from Run mode to Program mode displays the line number and keycode for the program line to which the calculator is currently set.

Occasionally you'll want to check several or all of the instructions stored in program memory. The hp 12c enables you to review program instructions either forward or backward through program memory:

- Pressing ` (single step) while the calculator is in Program mode advances the calculator to the next line in program memory, then displays that line number and the keycode of the instruction stored there.
- Pressing > m (back step) while the calculator is in Program mode sets the calculator back to the previous line in program memory, then displays that line number and the keycode of the instruction stored there.

For example, to display the first two lines of the program now stored in program memory, set the calculator to Program mode and press ` twice:

Keystrokes	Display		
= G	00-		Sets calculator to Program mode and displays current line of program memory
`	01-	36	Program line 01: 3
`	02-	2	Program line 02: digit 2.

Pressing > m does the reverse:

Keystrokes	Display		
> m	01-	36	Program line 01.
> m	00-		Program line 00.

If either the ` key or the m key is held down, the calculator displays all of the lines in program memory. Press ` again now, but this time hold it down until program line 07 is displayed.

Keystrokes	Display		
`	01-	36	Program line 01
	.		.
	.		.
	.		.
(Release `)	07-	40	Program line 07

Program line 07 contains the last instruction you keyed into program memory. However, if you press ` again, you'll see that this is not the last line stored in program memory:

Keystrokes	Display	
`	08- 43, 33 00	Program line 08

As you should now be able to tell from the keycodes displayed, the instruction in program line 08 is > @ 00.

The GTO 00 Instruction and Program Line 00

Whenever you run the program now stored in program memory, the calculator executes the instruction in line 08 after executing the seven instructions you keyed in. This @ 00 instruction — as its name implies — tells the calculator to "go to" program line 00 and execute the instruction in that line. Although line 00 does not contain a regular instruction, it does contain a "hidden" instruction that tells the calculator to halt program execution. Thus, after each time the program is run, the calculator automatically goes to program line 00 and halts, ready for you to key in new data and run the program again. (The calculator is also automatically set to program line 00 when you press = G to set the calculator from Program mode to Run mode.)

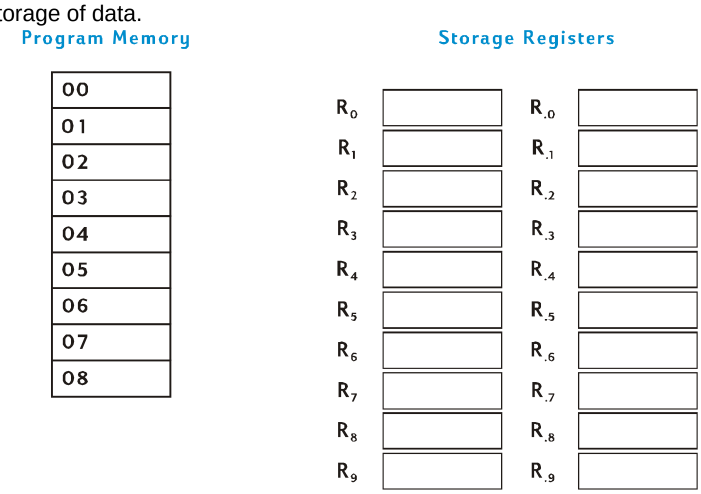
The @ 00 instruction was already stored in line 08 — in fact, in all program lines — before you keyed in the program. If no instructions have been keyed into program memory, if Continuous Memory is reset, or if = CLEAR a is pressed (in Program mode), the instruction @ 00 is automatically stored in program lines 01 through 08. As you key each instruction into program memory, it replaces the @ 00 instruction in that program line.

If your program should consist of exactly eight instructions, there would be no @ 00 instructions remaining at the end of program memory. Nevertheless, after such a program is executed the calculator automatically returns to program line 00 and halts, just as if there were a @ 00 instruction following the program.

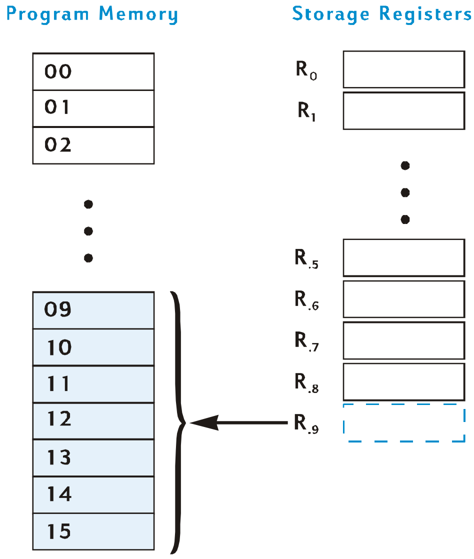
If you key in more than eight instructions, program memory automatically expands to accommodate the additional instructions.

Expanding Program Memory

If no instructions have been keyed intoprogram memory, if Continuous Memory has been reset, or if = CLEARa has been pressed (in Program mode), program memory consists of 8 program lines, and there are 20 storage registers available for storage of data.

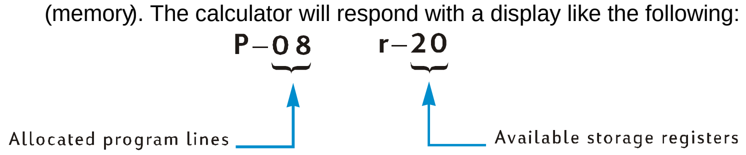


As you key in a ninth instruction, storage register $R_{.9}$ is automatically converted into seven new lines of program memory. The instruction you key in is stored in program line 09, and the instruction @ 00 is automatically stored in program lines 10 through 15.



Program memory is automatically expanded like this whenever another seven instructions have been keyed into program memory — that is, when you key an instruction into program line 16, 23, 30 etc. In each case, the additional program lines made available are converted, seven lines at a time, from the last available data storage register (whether or not data has been stored in that register; if it has, it will be lost). Furthermore, the six new program lines (following the 16th, 23th etc.) will each contain the instruction @ 00.

To determine at any time how many program lines (including those containing @ 00) are currently in program memory and how many storage registers are currently available for conversion to program lines or for data storage, press > ((memory). The calculator will respond with a display like the following:



Up to 99 instructions can be stored in program memory. Doing so would require the conversion of 13 data storage registers (because 99 = 8 + [13 × 7]), leaving 7 storage registers — R_0 through R_6 — available for data storage.

If you find yourself creating long programs, you should create your programs so that they don't use up program lines unnecessarily, since program memory is limited to 99 program lines. One way to minimize program length is to replace numbers consisting of more than just one digit — like the number 25 in lines 02 and 03 of the program keyed in above — by a instruction, and then storing the number in the designated storage register before running the program. In this case, this would save one program line, since the instruction requires only one program line, not two as are required by the number 25. Of course, doing so uses up data storage registers that you might want to save for other data. As in many business and financial decisions, there is a trade off involved; here it is between program lines and data storage registers.

Setting the Calculator to a Particular Program Line

There will be occasions when you'll want to set the calculator directly to a particular program line — such as when you're storing a second program in program memory or when you're modifying an existing program. Although you can set the calculator to any line by using] as described above, you can do so more quickly as follows:

- With the calculator in Program mode, pressing > @ followed by two digit keys sets the calculator to the program line specified by the digit keys, and then displays that line number and the keycode of the instruction stored there.

- With the calculator in Run mode, pressing > @ followed by two digit keys sets the calculator to the program line specified by the digit keys. Since the calculator is not in Program mode, the line number and keycode are not displayed.

The decimal point is not necessary if the calculator is in Run mode, but it is necessary if the calculator is in Program mode.

For example, assuming the calculator is still in Program mode, you can set it to program line 00 as follows:

Keystrokes	Display	
> @ 00	00-	Program line 00

Executing a Program One Line at a Time

Pressing] repeatedly with the calculator in Program mode (as described earlier) enables you to verify that the program you have stored is identical to the program you wrote — that is, to verify that you have keyed the instructions in correctly. However, this does not ensure that the program you wrote calculates the desired results correctly: even programs created by the most experienced programmers often do not work correctly when they are first written.

To help you verify that your program works correctly, you can execute the program one line at a time, using the] key. Pressing] while the calculator is in Run mode advances the calculator to the next line in program memory, then displays that line's number and the keycode of the instruction stored there, just as in Program mode. In Run mode, however, when the] key is released the instruction in the program line just displayed is executed and the display then shows the result of executing that line.

For example, to execute the program stored in the calculator one line at a time:

Keystrokes	Display	
= G	124.25	Sets calculator to Run mode and to line 00 in program memory. (Display shown assumes results remain from previous calculation.)
625	625.	Keys in price of typewriter.
]	01- 36	Program line 01: 3
	625.00	Result of executing program line 01.
]	02- 2	Program line 02: 2.

Keystrokes	Display		
	2.		Result of executig program line 02.
]	03-	5	Program line 03: 5.
	25.		Result of executig program line 03.
]	04-	25	Program line 04: 9
	156.25		Result of executig program line 04.
]	05-	30	Program line 05:
	468.75		Result of executig program line 05.
]	06-	5	Program line 06: 5
	5.		Result of executig program line 06.
]	07-	40	Program line 07:
	473.75		Result of executig program line 07 (the last line of the program).

Pressing > m while the calculator is in Run mode sets the calculator to the previous line in program memory, then displays that line's number and the keycode of the instruction stored there, just as in Program mode. In Run mode, however, when the m key is released the display again shows the same number as it did before > m was pressed: no instruction in program memory is executed.

Interrupting Program Execution

Occasionally you'll want a program to stop executing so that you can see an intermediate result or enter new data. The hp 12c provides two functions for doing so: I (pause) and H (run/stop).

Pausing During Program Execution

When a running program executes a I instruction, program execution halts for about 1 second, then resumes. During the pause, the calculator displays the last result calculated before the I instruction was executed.

If you press any key during a pause, program execution is halted indefinitely. To resume program execution at the program line following that containing the I instruction, press H .

Example: Create a program that calculates the entries in the AMOUNT, TAX, and TOTAL columns for each item on the jewelry distributor's invoice shown on the next page, and also calculates the total in each of these columns for all items on the invoice. Assume the sales tax is $6\frac{3}{4}$%.

To conserve lines of program memory, instead of keying in the tax rate before the 9 instruction we'll store it in register R_0 and recall it before the 9 instruction. Before storing the program in program memory, we'll calculate the required amounts for the first item on the invoice manually. The keystroke sequence will use storage register arithmetic (described on page 24) in registers R_1, R_2, and R_3 to calculate the column sums. Since these registers are cleared when = CLEAR U is pressed, we'll press those keys before beginning the manual calculation — and also later, before running the program — to ensure that the column sums are "initialized" to zero. (Pressing = CLEAR' would clear registers R_1 through R_3, but would also clear R_0, which will contain the tax rate.)

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ORDER DATE	CONFIRMING	SHIP VIA: SURFACE ☐ AIR ☐ UPS ☐ VENDOR ☐ WILL CALL ☐ OTHER ☐

ITEM	QTY.	DESCRIPTION	UNIT PRICE	AMOUNT	TAX 6.75%	TOTAL
1	13	SS4 Star Sapphire	$68.50	?	?	?
2	18	RG13 Ruby Ring	72.90	?	?	?
3	24	GB87 Gold Band	85.00	?	?	?
4	5	DG163 Diamond	345.00	?	?	?
5						

Pressing the > I keys is not necessary when we do the calculations manually, since in Run mode the result of every intermediate calculation is displayed automatically; but we'll include I instructions in the program so that the intermediate results AMOUNT and TAX are automatically displayed when the program is executed.

Keystrokes	Display	
6.75 0	6.75	Stores tax rate in R_0.
= CLEARU	0.00	Clears the registers in R_1 through R_6.
13	13.	Keys in quantity of item.
3	13.00	Separates quantity of item from cost of item to be keyed in next.
68.5	68.5	Keys in cost of item.
R	890.50	AMOUNT.
1	890.50	Adds AMOUNT to sum of AMOUNT entries in register R_1.
0	6.75	Recalls tax rate to display.
9	60.11	TAX.
2	60.11	Adds TAX to sum of TAX entries in register R_2.
	950.61	TOTAL.
3	950.61	Adds TOTAL to sum of TOTAL entries in register R_3.

Now, we'll store the program in program memory. Do not key in the quantity and cost of each item; these numbers will vary each time the program is run.

Keystrokes	Display	
= G	00-	Sets calculator to Program mode.
= CLEARa	00-	Clears program memory.
R	01- 20	
> I	02- 43 31	Pauses to display AMOUNT.
1	03- 44 40 1	
0	04- 45 0	
9	05- 25	

Keystrokes	Display	
> I	06- 43 31	Pauses to display TAX.
2	07- 44 40 2	
	08- 40	
3	09- 44 40 3	

Now, to run the program:

Keystrokes	Display	
= G	950.61	Sets calculator to Run mode.
= CLEARU	0.00	Clears registers R_1– R_6.
6.75 0		Stores tax rate.
13 3 68.5	68.5	Enters quantity and price of first item on invoice.
H	890.50	AMOUNT for first item.
	60.11	TAX for first item.
	950.61	TOTAL for first item.
18 3 72.9	72.9	Enters quantity and price of second item on invoice.
H	1,312.20	AMOUNT for second item.
	88.57	TAX for second item.
	1,400.77	TOTAL for second item.
24 3 85	85.	Enters quantity and price of third item on invoice.
H	2,040.00	AMOUNT for third item.
	137.70	TAX for third item.
	2,177.70	TOTAL for third item.
5 3 345	345.	Enters quantity and price of fourth item on invoice.
H	1,725.00	AMOUNT for fourth item.
	116.44	TAX for fourth item.
	1,841.44	TOTAL for fourth item.
1	5,967.70	Sum of AMOUNT column.
2	402.82	Sum of TAX column.
3	6,370.52	Sum of TOTAL column.

If the duration of the pause is not long enough to write down the number displayed, you can prolong it by using more than one I instruction. Alternatively, you can have the program automatically stop as described next.

Stopping Program Execution

Stopping Program Execution Automatically. Program execution is automatically halted when the program executes a H instruction. To resume executing the program from the program line at which execution was halted, press H .

Example: Replace the program above by one containing H instructions instead of I instructions.

Keystrokes	Display	
= G	00-	Sets calculator to Program mode.
= CLEARa	00-	Clears program memory.
R	01- 20	
H	02- 31	Stops program execution to display AMOUNT.
1	03- 44 40 1	
0	04- 45 0	
9	05- 25	
H	06- 31	Stops program execution to display TAX.
2	07- 44 40 2	
	08- 40	
3	09- 44 40 3	
= G	6,370.52	Sets calculator to Run mode.
= CLEARU	0.00	Clears registers R_1 through R_6.
13 3 68.5	68.5	First item.
H	890.50	AMOUNT for first item.
H	60.11	TAX for first item.
H	950.61	TOTAL for first item.
18 3 72.9	72.9	Second item.
H	1,312.20	AMOUNT for second item.
H	88.57	TAX for second item.
H	1,400.77	TOTAL for second item.

Keystrokes	Display	
24 3 85	85.	Third item.
H	2,040.00	AMOUNT for third item.
H	137.70	TAX for third item.
H	2,177.70	TOTAL for third item.
5 3 345	345.	Fourth item.
H	1,725.00	AMOUNT for fourth item.
H	116.44	TAX for fourth item.
H	1,841.44	TOTAL for fourth item.
1	5,967.70	Sum of AMOUNT column.
2	402.82	Sum of TAX column.
3	6,370.52	Sum of TOTAL column.

Program execution is also automatically halted when the calculator overflows (refer to page 73) or attempts an improper operation that results in an Error display. Either of these conditions signifies that the program itself probably contains an error.

To determine at which program line execution has halted (in order to locate the error), press any key to clear the Error display, then press = G to set the calculator to Program mode and display that program line.

You may also want to display the current program line (by pressing = G) if your program has halted at one of several H instructions in your program and you want to determine which one that is. To continue executing the program afterward:

1. Press = G to set the calculator back to Run mode.
2. If you want to resume execution from the program line at which execution halted rather than from line 00, press > @ followed by two digit keys that specify the program line desired.
3. Press H to resume execution.

Stopping Program Execution Manually. Pressing any key while a program is running halts program execution. You may want to do this if the calculated results displayed by a running program appear to be incorrect (indicating that the program itself is incorrect).

To halt program execution during a pause in a running program (that is, when I is executed), press any key.

After stopping program execution manually, you can determine at which program line execution has halted and/or resume program execution as described above.

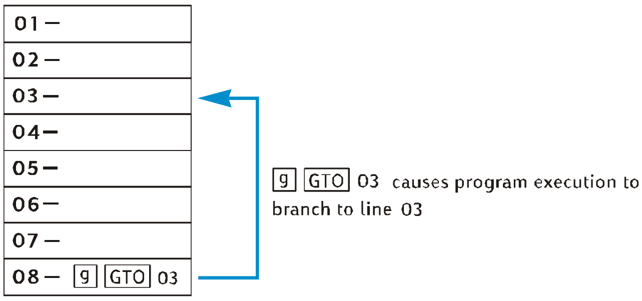
Section 9

Branching and Looping

Although the instructions in a program normally are executed in order of their program line numbers, in some situations it is desirable to have program execution transfer or "branch" to a program line that is not the next line in program memory. Branching also makes it possible to automatically execute portions of a program more than once — a process called "looping."

Simple Branching

The @ (go to) instruction is used in a program to transfer execution to any program line. The program line desired is specified by keying its two-digit line number into the program line containing the @ instruction. When the @ instruction is executed, program execution branches or "goes to" the program line specified and then continues sequentially as usual.



You have already seen a common use of branching: the @ 00 instruction (that is stored in program memory after the program you key in) transfers execution to program line 00. A @ instruction can be used to branch not only backward in program memory — as in the case of @ 00 and as illustrated above — but also forward in program memory. Backward branching is typically done to create loops (as described next); forward branching is typically done in conjunction with an D or B instruction for conditional branching (as described afterward).

Looping

If a @ instruction specifies a lower-numbered line in program memory, the instructions in the program lines between the specified line and the @ instruction will be executed repeatedly. As can be seen in the illustration above under Simple Branching, once the program begins executing the "loop" it will execute it again and again.

If you want to terminate the execution of a loop, you can include an D or B instruction (described below) or an H instruction within the loop. You can also terminate execution by pressing any key while the loop is being executed.

Example: The following program automatically amortizes the payments on a home mortgage without requiring you to press = for each payment. It will amortize one month's payments each time or one year's payments each time the loop is executed, depending on whether the number 1 or 12 is in the display when you start running the program. Before running the program, we'll "initialize" it by storing the required data in the financial registers — just as we would do if we were amortizing a single payment manually. We'll run the program for a $50,000 mortgage at 12 $^{3}/_{4}$% for 30 years, and we'll key 1 into the display just before running it in order to amortize monthly payments. For the first two "passes" through the loop we'll execute the program one line at a time, using] , so that we can see the looping occurring; then we'll use H to execute the entire loop a third time before terminating execution.

Keystrokes	Display		
= G	00-		Sets calculator to Program mode.
= CLEARa	00-		Clears program memory
0	01-	44 0	Stores the number from the display into register R_0. This number will be the number of payments to be amortized.

Keystrokes	Display	
0	02- 45 0	Recalls the number of payments to be amortized. This program line is the one to which program execution will later branch. It is included because after the first time the loop is executed, the number in the "display"* is replaced by the result of .
=	03- 42 11	Amortizes payment(s).
> I	04- 43 31	Pauses to display amount of payment(s) applied to interest.
O	05- 34	Brings amount of payment(s) applied to principal into "display."*
> I	06- 43 31	Pauses to display amount of payment(s) applied to principal.
> @ 02	07- 43, 33 02	Transfers program execution to line 02, so that the number of payments to be amortized can be recalled to the display before the instruction in line 03 is executed.
= G	0.00	Sets calculator to Run mode. (Display shown assumes no results remain from previous calculations.)
= CLEAR	0.00	Clears financial registers.
30 >	360.00	Enters n.
12.75 >	1.06	Enters i.
50000	50,000.00	Enters PV.
> [	50,000.00	Sets payment to End.
*	–543.35	Calculates the monthly payment.
0 C	0.00	Resets n to zero.
1	1.	Keys 1 into the display to amortize monthly payments.
`	01- 44 0	Line 01: 0.
	1.00	

* More precisely, the number in the X-register.

Keystrokes	Display	
`	02- 45 0	Line 02: 0. This is the beginning of the first pass through the loop.
	1.00	
`	03- 42 11	Line 03: = .
	–531.25	Portion of first month's payment applied to interest.
`	04- 43 31	Line 04: > I .
	–531.25	
`	05- 34	Line 05: O .
	–12.10	Portion of first month's payment applied to principal.
`	06- 43 31	Line 06: > I .
	–12.10	
`	07- 43, 33 02	Line 07: > @ 02. This is the end of the first pass through the loop.
	–12.10	
`	02- 45 0	Line 02: 0. Program execution has branched to the beginning of the loop for the second pass through it.
	1.00	
`	03- 42 11	Line 03: = .
	–531.12	Portion of second month's payment applied to interest.
`	04- 43 31	Line 04: > I .
	–531.12	
`	05- 34	Line 05: O .
	–12.23	Portion of second month's payment applied to principal.
`	06- 43 31	Line 06: > I .
	–12.23	

Keystrokes	Display	
`	07- 43, 33 02	Line 07: > @ 02. This is the end of the second pass through the loop.
	–12.23	
H	–530.99	

Full- and Partial-Year Depreciation with Crossover

When calculating declining-balance depreciation it is often advantageous for tax purposes to switch from declining balance to straight-line depreciation at some point. This hp 12c program calculates the optimum crossover point and automatically switches to straight-line depreciation at the appropriate time. The crossover point is the end of the year in which the declining-balance depreciation last exceeds or equals the amount of straight-line depreciation. The straight-line depreciation is determined by dividing the remaining depreciable value by the remaining useful life.

Given the desired year and the number of months in the first year, this program calculates the depreciation for the desired year, the remaining deprecia the

KEYSTROKES	DISPLAY	KEYSTROKES	DISPLAY
R	17- 20	C	66- 11
1	18- 44 1	0	67- 0
	19- 45 13	6	68- 44 6
O	20- 34	1	69- 1
	21- 30	2	70-44 30 2
	22- 13	0	71-44 40 0
3	23- 36	5	72- 45 5
>	24- 43 36	1	73-44 30 1
O	25- 34	3	74- 45 3
'	26- 45 15	= /	75- 42 23
	27- 30	1	76-44 40 1
O	28- 34	1	77- 1
0	29- 45 0	0	78-44 30 0
1	30- 1	2	79-44 40 2
> D	31- 43 34	3	80-44 40 3
> @ 39	32-43, 33 39	;	81- 33
;	33- 33	0	82- 45 0
;	34- 33	1	83- 1
1	35- 1	> D	84- 43 34
> I	36- 43 31	> @ 74	85-43, 33 74
;	37- 33	;	86- 33
H	38- 31	;	87- 33
1	39- 1	2	88- 45 2
2	40-44 40 2	> I	89- 43 31
0	41-44 30 0	;	90- 33
=	42- 42 25	H	91- 31

KEYSTROKES	DISPLAY	KEYSTROKES	DISPLAY
1	43-44 40 1	6	92- 45 6
5	44- 44 5	> B	93- 43 35
	45- 45 13	> @ 74	94-43, 33 74
'	46- 45 15	> @ 58	95-43, 33 58
	47- 30	= G	

REGISTERS			
n: Life	i: Factor	PV: Dep. Value	PMT: Unused
FV: Salvage	R_0: Used	R_1: Dep.	R_2: Counter
R_3: Used	R_{4}: Used	R_{5}: Used	R_{6}: Used

1. Key in the program.
2. Press = CLEAR' .
3. Key in the book value then press .
4. Key in the salvage value then press ' .
5. Key in the life in years (an integer) then press C .
6. Key in the declining-balance factor as a percentage then press Y .
7. Key in the desired year and press 3 .
8. Key in the number of months in the first year* then press H † to calculate the amount of depreciation for the desired year.
9. If desired, press O to see the remaining depreciable value.
10. If desired, press 1 to see the total depreciation through the current year.
11. Continue pressing H * to find the amount of depreciation for the successive years. Steps 9 and 10 may be repeated for each year.
12. For a new case press > @ 00 and return to step 2.

* Refer to straight-line depreciation note page 137.

† The display will pause with the year number before displaying the amount of depreciation for that year.

Example: An electronic instrument is purchased for $11,000, with 6 months remaining in the current fiscal year. The instrument's useful life is 8 years and the salvage value is expected to be $500. Using a 200% declining-balance factor, generate a depreciation schedule for the instrument's complete life. What is the remaining depreciable value after the first year? What is the total depreciation after the 7th year?

Keystrokes	Display	
= CLEAR'	0.00	
11000	11,000.00	Book value.
500 '	500.00	Salvage value.
8 C	8.00	Life.
200 Y	200.00	Declining-balance factor.
1 3	1.00	First year depreciation desired.
6 H	1.00 1,375.00	First year: depreciation,
O	9,125.00	remaining depreciable value.
H	2.00 2,406.25	Second year: depreciation.
H	3.00 1,804.69	Third year: depreciation.
H	4.00 1,353.51	Fourth year: depreciation.
H	5.00 1,015.14	Fifth year: depreciation.
H	6.00 761.35	Sixth year: depreciation.*
H	7.00 713.62	Seventh year: depreciation.
1	9,429.56	Total depreciation through the seventh year.
H	8.00 713.63	Eight year: depreciation
H	9.00 356.81	Ninth year: depreciation.

* By observation the crossover was year 6. Years 7, 8, and 9 use straight-line depreciation.

Excess Depreciation

When accelerated depreciation is used, the difference between total depreciation charged over a given period of time and the total amount that would have been charged under straight-line depreciation is called excess depreciation. To obtain excess depreciation:

1. Calculate the total depreciation then press 3 .
2. Key in the depreciable amount (cost less salvage) then press 3 . Key in the useful life of the asset in years then press M . Key in the number of years in the income projection period then press R to get the total straight-line depreciation charge.
3. Press to get the excess depreciation.

Example: What is the excess depreciation in the previous example over 7 calendar years? (Because of the partial first year, there are $6^1/_2$ years depreciation in the first 7 calendar years.)

Keystrokes	Display	
9429.56 3	9,429.56	Total depreciation through seventh year.
10500 3	10,500.00	Depreciable amount.
8 M	1,312.50	Yearly straight-line depreciation.
6.5 R	8,531.25	Total straight-line depreciation.
	898.31	Excess depreciation

Modified Internal Rate of Return

The traditional Internal Rate of Return (IRR) technique has several drawbacks which hamper its usefulness in some investment applications. The technique implicitly assumes that all cash flows are either reinvested or discounted at the computed yield rate. This assumption is financially reasonable as long as the rate is within a realistic borrowing and lending range (for example, 10% to 20%). When the IRR becomes significantly greater or smaller, the assumption becomes less valid and the resulting value less sound as an investment measure.

IRR also is limited by the number of times the sign of the cash flow changes (positive to negative or vice versa). For every change of sign, the IRR solution has the potential for an additional answer. The cash flow sequence in the example that follows has three sign changes and hence up to three potential internal rates of return. This particular example has three positive real answers: 1.86, 14.35, and 29. Although mathematically sound, multiple answers probably are meaningless as an investment measure.

This Modified Internal Rate of Return procedure (MIRR) is one of several IRR alternatives which avoids the drawbacks of the traditional IRR technique. The procedure eliminates the sign change problem and the reinvestment (or discounting) assumption by utilizing userstipulated reinvestment and borrowing rates.

Negative cash flows are discounted at a safe rate that reflects the return on an investment in a liquid account. The figuregenerally used is a short-term security (T-Bill) or bank passbook rate.

Positive cash flows are reinvested at a reinvestment rate which reflects the return on an investment of comparable risk. An average return rate on recent market investments might be used.

The steps in the procedure are:

1. Calculate the future value of the positive cash flows (NFV) at the reinvestment rate.
2. Calculate the present value of the negative cash flows (NPV) at the safe rate.
3. Knowing n, PV, and FV, solve for i.

Example: An investor has the following unconventional investment opportunity. The cash flows are:

Group	# of Months	Cash Flow ($)
0	1	–180,000
1	5	100,000
2	5	–100,000
3	9	0
4	1	200,000

Calculate the MIRR using a safe rate of 6% and a reinvestment (risk) rate of 10%.

Keystrokes	Display	
= CLEAR'	0.00	
0 > $	0.00	First cash flow.
100000 > %		
5 > 8	5.00	Second through sixth cash flows.
0 > % 5 > 8	5.00	Next five cash flows.
0 > % 9 > 8	9.00	Next nine cash flows.
200000 > %	200,000.00	Last cash flow.

Keystrokes	Display	
10 > = A o	657,152.37	NPV of positive cash flows.
20 C '	775,797.83	NFV of positive cash flows.
180000 o > $		
0 > % 5 > 8		
100000 o %		
5 > 8		
6 > = A	-660,454.55	NPV of negative cash flows.
20 C Y	0.81	Monthly MIRR
12 R	9.70	Annual MIRR.

Annual Coupon Bonds

For bonds which have annual coupons, use the following hp 12c program to evaluate price and accrued interest on an Actual/Actual day basis. This program may be modified for annual coupon bonds to be calculated on a 30/360 day basis.

KEYSTROKES	DISPLAY	KEYSTROKES	DISPLAY
= G		> d	19- 43 26
= CLEARa	00-	7	20- 44 7
= CLEAR!	01- 42 34	6	21- 45 6
> [	02- 43 8	4	22- 45 4
0	03- 45 0	> d	23- 43 26
C	04- 11	7	24- 45 7
2	05- 45 2	M	25- 10
*	06- 14	C	26- 11
1	07- 45 1	0	27- 0
Y	08- 12	*	28- 14
3	09- 45 3	'	29- 15
'	10- 15	o	30- 16
	11- 13	C	31- 45 11
5	12- 45 5	2	32- 45 2
\	13- 26	o	33- 16
6	14- 6	R	34- 20
o	15- 16	H	35- 31
	16- 30		36- 30
6	17- 44 6	= G	
5	18- 45 5		

REGISTERS			
n: Used	i: Yield	PV: Used	PMT: Cpn. or 0
FV: Used	R_0: # Periods (n)	R_1: Yield	R_2: Coupon
R_3: Redemption	R_4: Settlement	R_5: Next Cpn.	R_6: Last Coupon
R_7: Used	R_8–$R_{.5}$: Unused		

For annual coupon bonds calculated on a 30/360 day basis, insert ; after > d at steps 19 and 23 (making the program two steps longer).

1. Key in the program and press _ if the C status indicator is not displayed.
2. Key in the total number of coupons which are received and press 0.
3. Key in the annual yield as a percentage then press 1.
4. Key in the amount of the annual coupon then press 2.*
5. Key in the redemption value then press 3.*
6. Key in the settlement (purchase) date† then press 4.
7. Key in the date of the next coupon then press 5.
8. Press H to obtain the amount of accrued interest.
9. Press H to determine the priceof the bond.
10. For a new case, return to step 2.

Example: What is the price and accrued interest of a 20-year Eurobond with annual coupons of 6.5% purchased on August 15, 2004 to yield 7%. The next coupon is received on December 1, 2004.

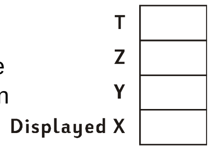
Keystrokes	Display	
\		Set compound interest mode if the C indicator is not on.
20 0	20.00	Total number of coupons.
7 1	7.00	Annual yield.
6.5 2	6.50	Annual coupon rate.
100 3	100.00	Redemption value.
8.152004 4	8.15	Settlement date.
12.012004 5	12.01	Next coupon date.
H	–4.58	Accrued interest.
H	–94.75	Purchase price.

* Positive for cash received; negative for cash paid out.

† For information about date format see pages 29 to 30.

Appendixes

The Automatic Memory Stack



Four special registers in the hp 12c are used for storing numbers during calculations. To understand how these registers are used, they should be visualized as stacked on top of each other.

(For this reason, they are generally referred to as the "stack registers" or collectively as "the stack.") The stack registers are designated X, Y, Z, and T. Unless the calculator is in Program mode, the number shown in the display is the number in the X-register (modified according to the current display format).

The number in the X-register — and, for two-number functions, the number in the Y-register — are the number(s) used in calculations. The Z- and T-registers are used primarily for the automatic retention of intermediate results during chain calculations, as described in section 1.

Before we discuss the details of the stack operation, let's take a quick look at how the stack is used in a simple arithmetic calculation and in a chain calculation. For each key pressed in the keystroke sequence, the diagram illustrating the calculation shows, above the key, the numbers in each of the stack registers after that key is pressed.

First, let's consider the calculation of 5 – 2:

T →	0	0	0	0
Z →	0	0	0	0
Y →	0	5	5	0
Displayed X →	5	5	2	3
Keys →	5	ENTER	2	−

The diagram shows why we said in section 1 that the 3 key separates the second number entered from the first number entered. Note also that this positions the 5 in the Y-register above the 2 in the X-register — just like they would be positioned if you wrote the calculation vertically on paper:

5
-2

Now let's see what happens in the stack during a chain calculation:

$$\frac{(3 \; ι \; 4) \quad (5 \; ι \; 6)}{7}$$

T	0	0	0	0
Z	0	0	0	0
Y	0	3	3	0
X	3	3	4	12

the ¼battery power indicator) should turn on.* If the display shows Error 9 , goes blank, or otherwise does not show the proper result, the calculator requires service.†

Note: Tests of the calculator's electronics are also performed if the key or the M key is held down when is released.‡ These tests are included in the calculator to be used in verifying that it is operating properly during manufacturing and service.

If you had suspected that the calculator was not working properly but the proper display was obtained in step 2, it is likely that you made an error in operating the calculator. We suggest you reread the section in this handbook applicable to your calculation — including, if appropriate, appendix A. If you still experience difficulty, write or telephone Hewlett-Packard at an address or phone number listed under Service (Page 197).

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* The status indicators turned on at the end of this test include some that normally are not displayed on the hp 12c.

† If the calculator displays Error 9 as a result of the / X test or the / test but you wish to continue using your calculator, you should reset Continuous Memory as described on page 70.

‡ The / combination initiates a test that is similar to that described above, but continues indefinitely. The test can be terminated by pressing any key, which will halt the test within 25 seconds. The / M combination initiates a test of the keyboard and the display. When the key is released, certain segments in the display will be lit. To run the test, the keys are pressed in order from left to right along each row, from the top row to the bottom row. As each key is pressed, different segments in the display are lit. If the calculator is operating properly and all the keys are pressed in the proper order, the calculator will display 12 after the last key is pressed. (The 3 key should be pressed both with the third-row keys and with the fourth-row keys.) If the calculator is not working properly, or if a key is pressed out of order, the calculator will display Error 9 . Note that if this error display results from an incorrect key being pressed, this does not indicate that your calculator requires service. This test can be terminated by pressing any key out of order (which will, of course, result in the Error 9 display). Both the Error 9 display and the 12 display can be cleared by pressing any key.

Warranty

hp 12c Financial Calculator; Warranty period: 12 months

1. HP warrants to you, the end-user customer, that HP hardware, accessories and supplies will be free from defects in materials and workmanship after the date of purchase, for the period specified above. If HP receives notice of such defects during the warranty period, HP will, at its option, either repair or replace products which prove to be defective. Replacement products may be either new or like-new.
2. HP warrants to you that HP software will not fail to execute its programming instructions after the date of purchase, for the period specified above, due to defects in material and workmanship when properly installed and used. If HP receives notice of such defects during the warranty period, HP will replace software media which does not execute its programming instructions due to such defects.
3. HP does not warrant that the operation of HP products will be uninterrupted or error free. If HP is unable, within a reasonable time, to repair or replace any product to a condition as warranted, you will be entitled to a refund of the purchase price upon prompt return of the product.
4. HP products may contain remanufactured parts equivalent to new in performance or may have been subject to incidental use.
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Country :	Telephone numbers
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Belgium	+32-2-7126219
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Eastern Europe countries	+420-5-41422523
Finland	+35-89640009
France	+33-1-49939006
Germany	+49-69-95307103
Greece	+420-5-41422523
Holland	+31-2-06545301
Italy	+39-02-75419782
Norway	+47-63849309
Portugal	+351-229570200
Spain	+34-915-642095
Sweden	+46-851992065
Switzerland	+41-1-4395358 (German)
	+41-22-8278780 (French)
	+39-02-75419782 (Italian)
Turkey	+420-5-41422523
UK	+44-207-4580161
Czech Republic	+420-5-41422523
South Africa	+27-11-2376200
Luxembourg	+32-2-7126219
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Country :	Telephone numbers
Australia	+61-3-9841-5211
Singapore	+61-3-9841-5211

L.America

Country :	Telephone numbers
Argentina	0-810-555-5520
Brazil	Sao Paulo 3747-7799; ROTC 0-800-157751
Mexico	Mx City 5258-9922; ROTC 01-800-472-6684
Venezuela	0800-4746-8368
Chile	800-360999
Columbia	9-800-114726
Peru	0-800-10111
Central America & Caribbean	1-800-711-2884
Guatemala	1-800-999-5105
Puerto Rico	1-877-232-0589
Costa Rica	0-800-011-0524

N.America

Country :	Telephone numbers
USA	1800-HP INVENT
Canada	(905)206-4663 or 800-HP INVENT

ROTC = Rest of the country

Please logon to http://www.hp.com for the latest service and support information.

Regulatory Information

This section contains information that shows how the hp 12c financial calculator complies with regulations in certain regions. Any modifications to the calculator not expressly approved by Hewlett-Packard could void the authority to operate the 12c in these regions.

USA

This calculator generates, uses, and can radiate radio frequency energy and may interfere with radio and television reception. The calculator complies with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
However, there is no guarantee that interference will not occur in a particular installation. In the unlikely event that there is interference to radio or television reception(which can be determined by turning the calculator off and on), the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Relocate the calculator, with respect to the receiver.

Canada

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numerique de la classe B est conforme a la norme NMB-003 du Canada.

Japan

B B1-]'ÎB2AÎ ± Ž £! -]'Î%l5 D4Ú ,)D %-Ù Ù ¯/ ³ (VCCI)B1 n 0

B. nB(B %Y Q ± Ž Û- -]'ÎB*B AïB B1-]'ÎB2AÎ … 8!c ºB* ö!ªB BNB B+BU"á"›B+B B)B BAB B AÎB B1-]'ÎB B¤BsBeBGB•B§BŽBsB¢B® > ÏB.1- 'B B) ö!ªB BOBNB+AÎ >4Ú ,BU •B /àB B B B+B B BMBAB Aï

Ò.' ÿ B. åB&B) \B B BM ÒB BUB B)B B#B B Aï

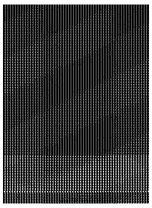
Temperature Specifications

- Operating: 0º to 55º C (32º to 131º F)
- Storage: –40º to 65º C (–40º to 149º F)

Noise Declaration

In the operator position under normal operation (per ISO 7779): LpA < 70dB.

Disposal of Waste Equipment by Users in Private Household in the European Union



This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office, your household waste disposal service or the shop where you purchased the product.

United Kingdom Calculations

The calculations for most financial problems in the United Kingdom are identical to the calculations for those problems in the United States — which are described earlier in this handbook. Certain problems, however, require different calculation methods in the United Kingdom than in the United States, even though the terminology describing the problems may be similar. Therefore, it is recommended that you ascertain the usual practice in the United Kingdom for the financial problem you are solving.

The remainder of this appendix describes three types of financial calculations for which the conventional practice differs significantly between the United Kingdom and the United States.

Mortgages

The amount of the repayments on home loans and mortgages offered by banks in the United Kingdom can usually be calculated as described under Calculating the Payment Amount, page 46. Building Societies in the United Kingdom, however, calculate the amount of these repayments differently. In general, the repayment amount of a Building Society mortgage is calculated as follows: first, the annual repayment amount is calculated using the annual interest rate; second, the periodic repayment amount is calculated by dividing the annual repayment amount by the number of repayment periods in one year.

Furthermore, the calculations used by Building Societies are rounded; therefore, to match their scale repayment figures you would have to round your calculations accordingly.

Annual Percentage Rate (APR) Calculations

In the United Kingdom, the calculation of the Annual Percentage Rate of Charge (APR) in accordance with the United Kingdom Consumer Credit Act (1974) differs from the calculation of the APR in the United States. Unlike the practice in the United States, where the APR can be calculated by multiplying the periodic interest rate by the number of periods per year, in the United Kingdom the APR is calculated by converting the periodic interest rate to the "effective annual rate," then truncating the result to one decimal place. With the periodic interest rate in the display and in the i register, the effective annual rate can be calculated by keying in the number of compounding periods per year, pressing K , then proceeding with step 4 of the procedure given on page 160 for converting a nominal rate to an effective rate.

Bond Calculations

Solutions for the price and yield to maturity of United Kingdom bonds are not included in this handbook. Actual practice differs according to the type of bond; variations such as cumulative and ex-dividend pricing, simple or compound interest discounting, etc., may be encountered.

Application Notes covering such situations may be available in the United Kingdom; check with your local authorized Hewlett-Packard dealer.

Function Key Index

General

Power on /off key (page 16) .

= Shift key. Selects alternate function in gold above the function keys (page 16) . Also used in display formatting (page 71) .

> Shift key. Selects alternate function in blue on the slanted face of the function keys (page 16) .

CLEAR0 after = , > , , or @ , cancels that key (page 18) .

= CLEAR0 also displays mantissa of number in the displayed X-register (page 73) .

Digit Entry

3 Enters a copy of number in displayed X-register into Y-register. Used to separate numbers (pages 19 and 171) .

o Changes sign of number or exponent of 10 in X-register (page 17) .

_ Enter exponent. After pressing, next numbers keyed in are exponents of 10 (page 18) .

— digits. Used for keying in numbers (page 19) and display formatting (page 71).

Decimal point (page 17) . Also used for display formatting (page 71) .

) Clears contents of displayed X-register to zero (page 18) .

Arithmetic

R M N Arithmetic operators (page 19) .

Storage Registers

Store. Followed by number key, decimal point and number key, or top row financial key, stores displayed number in storage register specified (page 23) . Also used to perform storage register arithmetic (page 24) .

Recall. Followed by number key, decimal point and number key, or top-row financial key, recalls value from storage register specified into the displayed X-register (page 23).

CLEAR" Clears contents of stack (X,Y,Z and T), all storage registers, statistical registers, and financial registers (page 24) . Leaves program memory untouched; not programmable.

Percentage

9 Computes x% of y and retains the y-value in the Y-register (page 26) .

q Computes percent of change between number in Y-register and number in displayed X-register (page 27) .

1 Computes percent that x is of number in Y-register (page 28) .

Calendar

e Sets date format to day-month-year (page 30) ; not programmable.

f Sets date format to month-day-year (page 29) ; not programmable.

Changes a date in the Y-register by the number of days in the X-register and displays day of week (page 30) .

d Computes the number of days between two dates in the Y and X-registers (page 31) .

Financial

CLEAR ! Clears contents of financial registers (page 33).

h Sets payment mode to Begin for compound interest calculations involving payments (page 37).

[Sets payment mode to End for compound interest calculations involving payments (page 37).

b Calculates simple interest (page 33).

K Stores or computes number of periods in financial problem (page 32).

Multiplies a number in displayed X-register by 12 and stores the resulting value in the n-register (page 39).

Y Stores or computes interest rate per compounding period (page 32).

Divides number in displayed X-register by 12 and stores the resulting value in the I-register (page 39).

Stores or computes the present value (that is, the initial cash flow) of a financial problem (page 32).

* Stores or computes payment amount (page 32).

' Stores or computes future value (final cash flow) of a financial problem (page 32).

Amortizes x number of periods using values stored in PMT, i, PV, and the display. Updates values in PV and n (page 54).

A Calculates the net present value of up to 20 uneven cash flows and initial investment using values stored with $, % , and 8 (page 58).

& Calculates the internal rate of return (yield) for up to 20 uneven cash flows and initial investment using values stored with $, % , and 8 (page 63).

$ Initial cash flow. Stores contents of displayed X-register in R_0, initializes n to zero, sets N_0 to 1. Used at the beginning of a discounted cash flow problem (page 58).

% Cash flow j. Stores the contents of X-register in R_j, increments n by 1, and sets N_j to 1. Used for all cash flows except the initial cash flow in a discounted cash flow problem (page 58).

/ Calculates depreciation using straight-line method. (page 68).

Calculates bond price, given desired yield to maturity (page 67).

- Calculates yield to maturity, given bond price (page 67).

8 Stores the number (from 1 to 99) of times each cash flow occurs as N_j. Assumes 1 unless otherwise specified (page 61).

n Calculates depreciation using sum-of-the-years-digits method (page 68).

Calculates depreciation using declining-balance method (page 68).

Statistics

CLEAR U Clears statistical storage registers R_1 through R_6 and stack registers (page 76).

6 Accumulates statistics using numbers from X- and Y-registers in storage registers R_1 through R_6 (page 76).

5 Cancels effect of numbers from X- and Y-registers in storage registers R_1 through R_6 (page 77).

g Computes mean (average) of x-values and y-values using accumulated statistics (page 77).

? Computes weighted average of y-(item) and x-(weight) values using accumulated statistics (page 81).

J Computes sample standard deviations of x- and y-values using accumulated statistics (page 79).

, Linear estimate (X-register), correlation coefficient (Y-register). Fits a line to a set of (x,y) data pairs entered using 6, then extrapolates this line to estimate a y-value for a given x-value. Also computes strength of linear relationship (r) among that set of (x, y) data pairs (page 80).

+ Linear estimate (X-register), correlation coefficient (Y-register). Fits a line to a set of (x, y) data pairs entered using 6, then extra-polates this line to estimate an x-value for a given y-value. Also computes strength of linear relationship (r) among that set of (x,y) data pairs (page 80).

Mathematics

F Computes square root of number in displayed X-register(page 83).

E Raises number in Y-register to power of number in X-register (page 85).

L Computes reciprocal of number in displayed X-register(page 83).

< Computes factorial [n•(n–1)... 3•2•1] of number in displayed X-register(page 83).

Natural antilogarithm. Raises e (approximately 2.718281828) to power of number in displayed X-register(page 83).

Z Computes natural logarithm (base e) of number in displayed X-register(page 83).

Number Alteration

Rounds mantissa of 10digit number in X-register to match the display (page 83).

c Leaves only the integer portion of number in displayed X-register by truncating fractional portion (page 83).

. Leaves only the fractional portion of number in displayed X-register by truncating integer portion (page 84).

Stack Rearrangement

O Exchanges contents of X and Y-registers of stack (pages 74 and 172).

; Rolls down contents of stack for viewing in displayed X-register (page 172).

Recalls number displayed before the previous operation back into the displayed X-register(pages 74 and 176).

Programming Key Index

G Program/Run. Toggles into and out of Program mode. Automatically sets program to line 00 when returning to Run mode (page 86).

(Memory map. Describes the current allocation of memory; the number of lines allotted to program memory and the number of available data registers (page 93).

Program Mode	Run Mode
In Program mode, function	