HEWLETT-PACKARD

HIP50 Owner's Handbook



Owner's Handbook

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About H-P

Hewlett-Packard's interest in computation evolved as a natural extension of our traditional involvement in measurement problem solving. At an early date, HP recognized the growing need for a family of computational products designed to work easily and effectively with scientific instruments.

In 1966 we introduced the first digital minicomputer specifically designed to meet this need. Soon after, we followed up with our first programmable desktop calculator. From these beginnings, HP has now become an acknowledged leader in the field of computational problem solving. Many thousands of HP programmable desktop calculators and digital computers are at work in a wide range of applications in science, industry, education, medicine, and business. Their effectiveness is further enhanced by a complete line of accessory devices, ranging from digital tape and disc drives, to card and tape readers, printers and plotters.

Lately we've coupled our experience in scientific problem solving and computational technology to bring you new dimensions in personal computation—the HP-35 Scientific Pocket Calculator, the HP-45 Advanced Scientific Pocket Calculator, the HP-65 Programmable Pocket Calculator for engineering/scientific applications, and the HP-80 Financial Pocket Calculator for solving problems in business and finance. The acceptance of our pocket calculator products has been significant—over 300,000 have been sold to date. Now we bring you the HP-70 Business Pocket Calculator whose capabilities are directed to those applications most commonly encountered in business.

Table of Contents

Introduction	7
1. Fundamental Operations	
Getting Started	10
Keyboard	10
Keying in and Entering Numbers	12
Clearing	13
Performing Simple Arithmetic	14
Combined Arithmetic Processes	16
Serial Calculation	16
Chained Calculation	16
Mixed Calculation	19
Keying in Negative Numbers	20
Rounding the Display	20
Fixed Decimal Notation	21
Scientific Notation	22
Repositioning Numbers	22
Reviewing/Verifying Numbers Entered	22
Reversing Operand Order	23
Performing Simple Functions	24
Calculating Percentage Problems	24
Raising a Number to a Power–Exponentiation	26
Extracting Roots	27
Storing and Recalling Numbers	27
M-Register	28
K-Register	
Accumulation	29

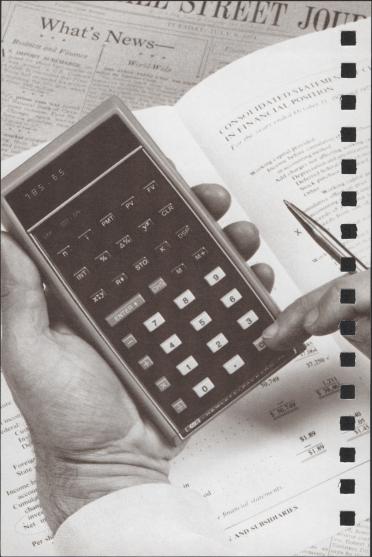
2. Using Financial Functions

The Nature of Time and Money Calculations						33
Formatting the Calculation						34
Compounding Period Conversions						36
Payment Calculations						37
Recalling and Displaying Input Values						38
Changing Output Values						39
Changing Input Values						39
Simple Interest Amount and Discounted Notes	5					41
Common Logarithms						41
Financial Applications						41

3. Applications Casebook

Ground Rules
Simple Interest Amount
Accrued Interest-360-Day Basis
Accrued Interest-365-Day Basis
Discounted Notes
Compounded Amounts (Compound Interest)
Future Value of Compounded Amount 45
Present Value of Compounded Amount
Rate of Interest for Compounded Amount
Number of Periods for Compounded Amount
Compounded Amount and Interest Earned
Nominal Rate Converted to Effective Annual Rate 49
Effective Annual Rate Converted to Nominal Rate 50
Direct Reduction Loans
Periodic Payment Amount (Ordinary Annuity) 50
Interest Rate Per Period, Annual Interest Rate
(Ordinary Annuity)
Number of Periods Required to Amortize Loan
(Ordinary Annuity)
Loan Amount (Present Value of Ordinary Annuity) 52
Amortization Schedule (Ordinary Annuity) 53
Accumulated Interest with Remaining Balance
(Ordinary Annuity)
Remaining Balance Only (Ordinary Annuity)
Payment Amount for Mortgage with Balloon Payment
(Ordinary Annuity)
Sinking Funds
Future Value of Sinking Fund (Ordinary Annuity) 58
Rate of Interest for Sinking Fund (Ordinary Annuity) 59
Payment Amount for Sinking Fund (Ordinary Annuity) 59
Number of Periods for Sinking Fund (Ordinary Annuity 60
Consumer Finance
Add-on Interest-to-APR Conversion; Finding
Monthly Payment
APR-to-Add-on Interest Conversion
Rule-of-78 Rebate
Savings Calculations
Number of Time Periods for Savings Calculation
(Annuity Due)
Rate of Interest for Savings Calculation
(Annuity Due)

Payment Amount Required for Some Future Value—Savings	
Calculation (Annuity Due)	. 65
Future Value of a Series of Deposits (Annuity Due)	. 65
Leases and Rents (Payments in Advance)	
Number of Payments in Advance (Annuity Due)	. 66
Interest Rate for Payments in Advance (Annuity Due)	
Periodic Payment Amount, for Payments in Advance	
(Annuity Due)	. 68
Present Value of Payments in Advance (Annuity Due)	
Straight-Line Depreciation	
Declining Balance Depreciation	
Sum-of-the-Years'-Digits Depreciation	
Discounted Cash Flow Analysis–Net Present Value	
Merchandising, Purchasing	
Cost and Price (Markup, Chain Discounts)	
U.Sto-Foreign Currency Conversion	
Foreign-to-U.S. Currency Conversion	
0	. //
Appendixes	
Appendix A: Operating Characteristics	
Execution Time	
Roundoff Error	
Calculating Range	
Improper Operations	. 80
Overflow Display Format	. 80
	. 80 81
Appendix B: Operational Stack	
Stack Registers	82
Solution Method Model	
Appendix C: Formulas for Financial Problems	. 91
	. 95
	. 95
Battery Pack Replacement	. 96
Appendix E: Service and Warranty	. 99
Servicing	. 99
Shipping List	100
Warranty	100
Shipping Instructions	101
Appendix F: Accessories	103
Applications Directory	105
General Index	115
Keyboard Summary and Index	120
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Introduction

Few professions demand so much of their members as does business. Throughout history, the staggering array of personal qualities deemed necessary for success in business might have been drawn from a combination of the Discourses of Machiavelli, a biography of Albert Einstein and the Boy Scout oath. Even Aristotle warned "...he who proposes to manage any branch of economy should be naturally clever, and by choice industrious and just; for if any one of these qualities be wanting, he will make many mi\$take\$..."

20th century business, even more demanding and fraught with peril, has tried to solve some of its problems through automation. The basic idea was good, but contributed a new problem—most machines tend to make automatons of their users! Human beings must act as mere cogs in the machinery, must be compatible components, must not deviate from a rigid procedure at the machine's level. A business can't survive long if its principals indulge in much of this mind-deadening activity.

We at HP believe machines should solve problems, not create them-that people should not become the tool of their tools. This philosophy is exemplified in your HP-70 Business Pocket Calculator-the *rehumanizing* machine.

The HP-70 performs all the drudgery of complex (and simple) business calculations, yet demands very little of you in the way of memorizing rigid data entry procedures, since it's a relatively freeform process. Weighing just 9 ounces (you can take it anywhere you go), it replaces tomes of tricky tables and other such "inundata." What's more, it never gets fatigued or bored, its attention doesn't wander, and it never makes subjective errors.

To give you a sample of what you can do with your HP-70, switch the calculator to ON and we'll work a typical compound interest problem. Suppose you wanted to calculate the annual rate of return on an investment as a basis for evaluating various investment opportunities. If you could buy property today for \$10,000 and could expect to sell it in 7 years for \$15,000, what would be the annual rate of return on your original investment? To solve, simply enter the known values **in any order**:

Press **CLR**. Key in 7 (number of years) and press **n** (number of periods in terms of time), key in 10000 (initial investment) and press

8 Introduction

PV (present value), key in 15000 (amount to be returned) and press FV (future value), then press i (interest). Find your answer (annual rate of return) on the display: 5.96 %

Compare that with the painful procedure used with the conventional calculation method:

Conventional Method	HP-70 Method
Use basic formula: $S = P (1 + i)^n$ $(1 + i)^n = \frac{S}{P}$	Key in: 7 1 10000 PV 15000 EV i Find answer displayed:
where: S = future value P = present value i = effective periodic rate n = number of periods Thus:	5.96 %
$(1 + i)^n = \frac{\$15000}{\$10000} = 1.50$	
Next, consult compound interest table to find the table value closest to 1.5000000. The table value of 5% for seven years is 1.4071004227, while the value for 6% is 1.5036302590. There- fore, the exact annual rate of return is some- where between 5% and 6%.	
Now for interpolation (note that since method used is linear interpolation, the answer is only approximate). Let:	
X = amount between actual and low value .01 (or 1%) = difference between two table values .0928995773 = difference between lower table amount of 1.4071004227 and actual of 1.50 .0965298363 = difference between higher and lower table amounts.	
Then, set up the equation as a proportion: $\frac{X}{.01} = \frac{.0928995773}{.0965298363}$	
Cross-multiply: .0965298363X = .01 x .0928995773 = .000928995773	
Divide by .0965298363: X = .000928995773 .0965298363 = .00962392363448 or .96%	
Finally: Annual rate of return = lower table rate of 5% + .96% or 5.96%.	

Introduction 9

This problem is typical of a large class of financial calculations dealing with relationships between time and money. It's just one of many preprogrammed into your HP-70. Furthermore, your HP-70 provides an automatic percent and net amount feature (useful for chained discounts, etc); two general purpose memory registers—one with accumulation capability; five special purpose memory registers; as well as the four-register operational stack with RPN* so you never have to store intermediate results or reformat equations.

In addition to its more exotic features, the HP-70 is fast, accurate, and convenient to use. It handles numbers as small as $10^{-9.9}$ (that's a decimal point followed by 98 zeros and a 1), and numbers as large as $10^{9.9}$ (1 followed by 99 zeros), automatically places the decimal point, and allows you to round the display to settings ranging from zero to nine decimal places. It does everything a conventional four-function desk calculator does, too—only better. (Ecology note: your HP-70 uses less power than an ordinary flashlight battery.)

One thing your HP-70 *doesn't* have is an equals key. And you may notice that while your HP-70 works in a consistent and natural way, it *is* a slight departure from other pocket calculators. We designed it this way on purpose (we could have done it the conventional way more easily) because we believe our logic system is the simplest, most consistent and most practical for pocket calculator users. It allows you to concentrate on problem solving instead of worrying about how to reorganize a problem to fit the calculator logic or what to do with intermediate results. Once you get accustomed to the way it works (which should take about an hour), you won't want it any other way.

In short, with your HP-70, you're not just a cog in the machinery, you're the brains of the outfit-the creative one. And, your HP-70 respects you for it.

Getting Started

Your HP-70 is shipped fully assembled with its rechargeable battery pack in place. Slide the power switch to ON. If anything other than 0.00 appears on the display, refer to Servicing, page 99. Be sure to read battery operation instructions (appendix D) before operating the calculator on battery power. Note that you can operate the calculator on ac power while the battery pack is being charged.

The first thing most new calculator owners want to know is how to add two numbers. To start, let's add 2 and 3. Press 2 **ENTER+** 3 **+**, then see the answer (5.00) displayed. Another thing you might like to know is that the display blinks if you attempt an improper operation; it stops blinking when you press **CLX**.

Of course, your HP-70 does a lot more than just simple arithmetic. A great deal of the power of HP pocket calculators only becomes apparent after you have used other pocket calculators. What is the difference-beyond the highly sophisticated preprogrammed functions? The big difference is the working storage area-called the operational stack-consisting of four pigeonholes "stacked" one on top of the other. (For sake of convenience, we have named these pigeonholes the X-register, Y-register, Z-register, and T-register.) This feature enables you to perform arithmetic operations in any order, which means you don't have to analyze problems for mathematical ambiguity. Further, you don't have to write down or manually store intermediate results; they will be there when you need them-automatically.

Although it's not necessary for you to understand the operational stack to solve any of the sample problems in this handbook, knowing how the stack works will allow you to make full use of your HP-70's power, and will enable you to extend your application repertoire beyond those applications we have provided. The rules are few, simple, and gratifyingly consistent. They are described in conjunction with each of the fundamental operations that follow. If theory intrigues you, refer to the in-depth discussion of the operational stack in appendix B.

Keyboard

The HP-70 keyboard is illustrated in figure 1. A summary of all keys and an index to where they are described and used are provided on page 120 at the back of this handbook.

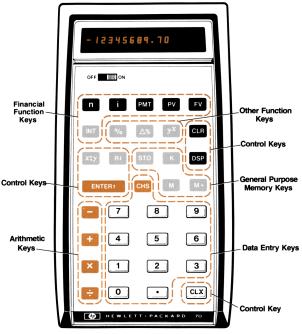


Figure 1. Keyboard Layout

Keying In and Entering Numbers: 0 through 9, •, ENTER+

Key in the following numbers:

Press	See Displayed
1	1.
2	12.
3	123.

Note that the decimal point moved one position to the right each time you keyed in a digit. Until you press the decimal point key, or run out of digit positions in the display, the decimal point continues to move to the right. To continue,

Press

See Displayed

.42

The display is actually a window that shows the contents of the bottom register (X-register) of the stack. Imagine that all stack registers were visible at once. Your stack would look like this when you turned on the calculator:

т	0.00	This is the top register.
z	0.00	
Y	0.00	
x	0.00	This is the bottom register and the one that is displayed.

Remember: The stack is filled with zeros every time the power switch is turned on.

When you keyed in 123.42, it was recorded in the stack as follows:

 T
 0.00

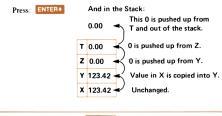
 Z
 0.00

 Y
 0.00

 X
 123.42

Remember: Each time a value is keyed in, it goes into the X-register and is displayed.

To put this number into position for a calculation,



Remember: Every time **ENTER** \bullet is pressed, the value in X is copied into Y. The contents of Y and Z are pushed up; the contents of T are pushed up and out of the stack.

Now key in a second number-say 5.



Remember: When a number is keyed in immediately following **ENTER**, the new value overwrites the contents of X and is displayed. The contents of the stack are *not pushed up*.

Clearing: CLX , CLR

If you make a mistake keying in a number, press \boxed{CLX} to clear the display. Then key in the correct number. For example, assume that you have filled up the stack with numbers and you need to change the last number keyed in.



Remember: $\boxed{\mathbb{CLX}}$ overwrites the contents of the X-register with zero; the contents of the stack *are not pushed up*. When a number is keyed in immediately following $\boxed{\mathbb{CLX}}$, the number overwrites the contents of X and is displayed; again, the contents of the stack *are not pushed up*.

An important point about your HP-70 is that it isn't necessary to clear it between arithmetic calculations.* Because of the operational stack, intermediate results are there *automatically* when you want them; but they don't get in the way if you don't need them.

CLR clears the entire operational stack including the display (X-register). **CLR** also clears special storage registers related to financial functions. These are described starting on page 33.

Clearing with CLX and CLR doesn't have any effect on the two general-purpose memory registers, K and M. When new values are stored, they simply overwrite any existing values, so there is no need to clear.

Note that the entire calculator is cleared when the power switch is turned off; when turned back on, all registers are automatically reset to zero, with the exception of the K-register which is reset to 12 (more about that later in the section on storing and recalling numbers, page 29).

Performing Simple Arithmetic: 🚹 , 🚍 , 🔀 , 😫

If you have operated an ordinary adding machine, you already know how to use your HP-70 for simple arithmetic problems. The + key adds the last number keyed in to the number in the Y-register. Likewise, the - key subtracts the number keyed in from the number in the Y-register. For example, add 12 and 3, then subtract 9. Press See Displayed



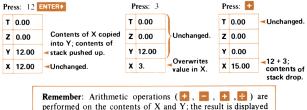


6.00

Repeat the same problem and see how it affects the stack.

Note: For the sake of simplicity, in the following examples, we are going to assume that the stack contains no data from previous examples.

* Financial functions utilizing the top row keys have special clearing requirements; these are outlined on page 35.



in X, and the operands are lost. The contents of Z are *pushed* down into Y, and the contents of T are *copied* into Z.

Now subtract 9 from 15.



Remember: When you key in a number after performing an arithmetic operation, the contents of the stack *are pushed up*.

The principle is the same for \times and \div . For example, multiply 12 by 3.

Press

12 ENTER $+3 \times$

Now divide 12 by 3.

Press

12 ENTER+ 3	÷	
-------------	---	--

S	ee	Dis	pla	yed
	36	.00		

See	Displ	layed
-----	-------	-------

Combined Arithmetic Processes

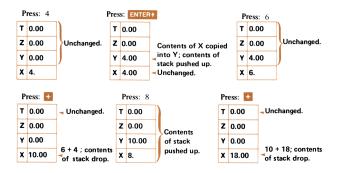
The HP-70 performs combined arithmetic operations-serial, mixed, and chained calculations-with unprecedented ease.

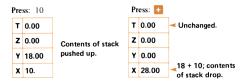
Serial Calculation

As you observed in a previous example, any time a new number is keyed in after an arithmetic calculation, the HP-70 pushes up the result of the calculation automatically. This feature permits serial calculation (while generating a series of intermediate results) without writing down or manually storing any of the intermediate results. For example, find the sum of 4, 6, 8 and 10.



The same principle applies to serial multiplication, division and subtraction, too. An equals key (=) is not needed since results are displayed when an arithmetic or function key is pressed. This point becomes clear upon analysis of the stack when solving the problem.





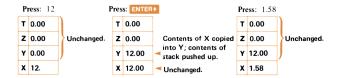
Chained Calculation

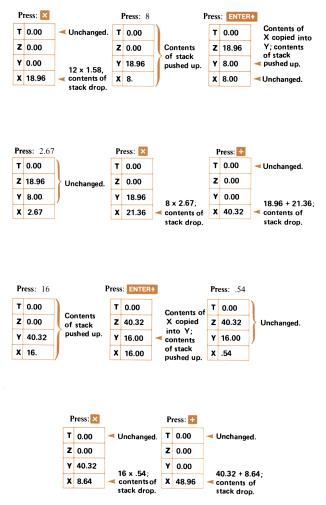
Chained calculations are things like adding the results of two or more multiplication operations (sums of products), or multiplying the results of two or more addition operations (products of sums). For example, if you sold 12 items at \$1.58 each, 8 items at \$2.67 each, and 16 items at \$0.54 each, the gross sale is

 $(12 \times 1.58) + (8 \times 2.67) + (16 \times 0.54)$



With ordinary calculators you have to make two passes for this type of problem by first calculating the items in parentheses and then adding the results. With your HP-70, you merely key in the numbers from left to right and perform all arithmetic operations possible; or, if none are possible, press **ENTER** and continue. The reason that you are able to handle this problem so easily is revealed as you review the stack.





Remember: Key in the problem and perform all possible operations between two numbers after they are both in the stack (X- and Y-registers). If you can't perform one or more operations, press **ENTER** and continue until the calculation is complete.

Products of sums are calculated in the same way. Try this:

$$(2+3) \times (4+5) = 45$$

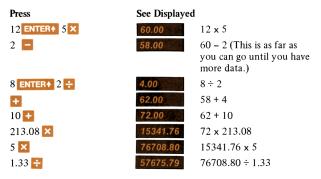
Press	See Displayed	1
2 ENTER+ 3 +	5.00	2 and 3 are summed.
4 ENTER+ 5 +	9.00	4 and 5 are summed.
×	45.00	5 and 9 are multiplied.

Notice that you perform this calculation (products of sums) in exactly the same way–left to right–as the previous calculation (sums of products). Further, chained calculations aren't limited to addition and multiplication; subtraction and division are handled the same way.

Mixed Calculation

Calculations may be performed with any combination of arithmetic operations. To give you an idea of how the stack tames a complicated problem, calculate the following and use the left-to-right entry rules.

 $[(12 \times 5) - 2 + (8 \div 2) + 10] \times 213.08 \times 5 \div 1.33 = 57675.79$



You could do this same problem several ways. Refer to Solution Method Model, page 87 for examples varying the calculation procedure.

Keying In Negative Numbers: CHS

CHS changes the sign of displayed numbers. To key in a negative number, key in the number, then press **CHS** (change sign key). The number, preceded by a minus sign (-), will appear on the display. For example,



Numbers retain their given signs until changed, even when the numbers are moved about in the stack. To change the sign of either a negative number or positive number* press CHS. For example, to change the sign of -3.00 now in the display,

Press	See Displayed
CHS	- 3.00

Rounding the Display

When you turn on your HP-70 the display is automatically set to two decimal places. However, you can display up to 15 characters: sign (-), 10-digit number, decimal point, exponent sign (-), and 2-digit exponent.



Figure 2. Display

Two display modes (fixed decimal and scientific notation) are provided. When you round off the display, it's only the display itself that is affected; the HP-70 always maintains 10 digits internally.

*Numbers not preceded by a minus sign are always assumed to be positive.

Fixed Decimal Notation: DSP 0 through 9

Fixed decimal notation is specified by pressing **DSP** followed by any number key **O** through **9** The display is then rounded to the number of decimal places corresponding to the number key pressed. The display is left-justified and may include trailing zeros within the setting specified. For example.

Press	See Displayed
123.456	123.456
DSP 0	123.
DSP 1	123.5
DSP 4	123.4560
DSP 7	123.4560000
DSP 2	123.46

If the number you key in combined with the display mode you specify exceed the display capacity, the result is truncated in the 10th digit. For example,

Press	See Displayed	
DSP 9	123.4560000	Compare this with the
		DSP 7 result above.

The display setting is retained until a different one is specified or the calculator is turned off. For example,

Press	See Displayed
CLX	0.000000000
DSP 2	0.00

If the result of a calculation is too small in magnitude for the display mode selected, it will be displayed as zero. In this event, change the display mode to include more decimal places. For example, calculate 1/400.

Press	
1 ENTER+	400 🚼
DSP 6	
DSP 2	



Scientific Notation: DSP •

Scientific notation is a convenient and economical way of expressing very large or very small numbers. In scientific notation, a number has the form $N \times 10^{n}$ where N is a number having a magnitude between 1 and 10, and n is a positive or negative integer.

If you want to display in scientific notation, merely press **DSP** •. The display is left-justified and trailing zeros are deleted. For example,

Press	See Displayed
1000	1000.
DSP •	1. 03
DSP 2	1000.00

Table 1. Examples of Numbers in Scientific Notation

Number	Scientific Notation Form	Scientific Notation Display
1000	1 × 10 ³	1. 03
-1000	-1×10^{3}	-1. 03
.1000000	1 × 10 ⁶	1. 06
.000059	5.9 × 10 ⁻⁵	5.9 - 05

If you key in a very large number whose digits exceed the 10-digit display capacity-say 1 trillion-it will be displayed automatically in scientific notation.

```
Press
```

See Displayed 1.000000000

1000000000000

This represents 1×10 raised to the 12th power.

Calculations whose results have a magnitude greater than the display capacity will be displayed in scientific notation automatically. For example, calculate 1,000,000 x 1,000,000. (Terminate the displayed number with **CLR**.)

Press	,
CLR	
1000000 ENTER+	×

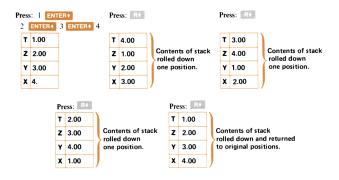
See Displayed



Repositioning Numbers Reviewing/Verifying Numbers Entered : R+

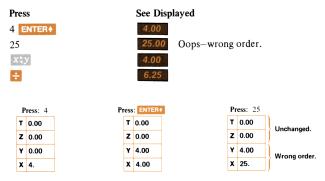
The R* (roll down) key permits you to review and/or reposition the contents of the stack registers. Each time R* is pressed, the contents of each stack register move into the display in last-in/first-out order. No

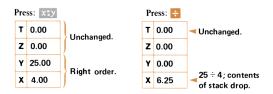
data are lost by rotating the register contents; after a complete circuit (R* R* R* R*) they return to the same locations they occupied before rotation. For example, 1 ENTER* 2 ENTER* 3 ENTER* 4 can be keyed in, then viewed and returned to their respective registers by pressing R* four times as follows:



Reversing Operand Order :

Frequently you will want to subtract or divide when the number displayed must be interchanged with a previously displayed number. To do so press **xzy** For example, say you wanted to divide 25 by 4, but the latter number was keyed in first as follows:





Performing Simple Functions

Calculating Percentage Problems

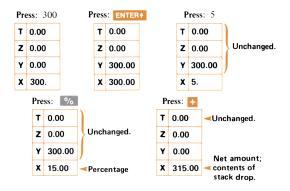
The HP-70 simplifies the calculation of percentage problems because you don't have to convert percents to their decimal equivalents before using them; just press the % key after keying in the percent value. Equations used for calculating percentage problems are included in appendix C, Formulas for Financial Problems.

Finding Percentage: % . To find the percentage of a number, key in the base number and press **ENTER+** . Then key in the percent and press % . For example, find 14% of 300.

Press	See Displa	yed
300 ENTER+ 14 %	42.00	Percentage amount
calculated, the Y-register sti	ll contains t	• After the percentage is he base number from which you simply pressing • or • ,
Press	See Displa	yed
300 ENTER↑ 14 %	42.00	Percentage amount.
+	342.00	Net amount (base
		plus percentage amount).
or		
Press	See Displa	yed
300 ENTER↑ 14 %	42.00	Percentage.
	258.00	Net amount (base
		less percentage amount).

The reason you can do this problem without writing down the base (300) is because our percent function is specially programmed so that the base number remains in the Y-register after a percent calculation—where it is ready for a net amount calculation.

Take a look at the stack while calculating a net amount problem. For example, if the tax on a 3300 item is 5%, what is the amount of tax (percentage) and the total cost?



Finding Percent Difference Between Two Numbers: Δ %. To find the percent difference between a number and the base, key in the base number and press **ENTERS**. Key in the second number and press Δ %. For example, find the percent of increase of your current house payment (\$240/month) over what you were paying in rent 15 years ago (\$70/month).



Finding Proportion: To find what percent one number is of another, key in the percentage and press \blacksquare , then key in the base and press \blacksquare . Since this type of percentage problem is a straight division calculation, the result is displayed as a decimal rather than %. For example, 120 is what percent of 240?

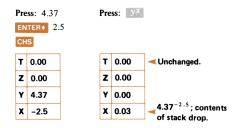


Raising a Number to a Power — Exponentiation:

permits you to raise a positive number (integer/decimal) to a positive or negative power. In many calculators you'd have to perform a number of serial calculations to do this sort of problem. For example, calculate 2⁹ (2x2x2x2x2x2x2x2x2x2).

Press	See Displayed
2 ENTER 9 yx	512.00
Now find $4.37^{-2.5}$.	
Press	See Displayed
4.37 ENTER♦ 2.5 CHS УX	0.03

Calculations have the same effect on the stack as arithmetic operations; that is, the value in the Y-register is raised to the power in the X-register, where the result is displayed. (Remember, the stack drops, the contents of T are duplicated into Z, and the operands are lost.) To illustrate, let's analyze the last problem.



If you try to raise zero or a negative number to a power you will see an error message (flashing zeros) on the display.

Extracting Roots

To extract roots of positive numbers, key in and enter the number, key in and enter 1, key in the root desired, divide to get the reciprocal of the root, then press 10^{10} . For example, find the square root of 25. (Note that this could be expressed as $\sqrt{25}$ or $25^{\frac{1}{2}}$ or 25^{-5} .)



Find the cube root of 5 (again, this could also be expressed as $\sqrt[3]{5}$ or $5^{1/3}$).

Pres	s			See Displayed						
5 E	NT	ER+				5.00				
1 E	NT	ER+				1.00				
3						0.33 Reciprocal of 3.				
y3	¢.					1.71	Cube roo	ot c	of 5.	
And	in	the sta	ck,							
Press	: :	ENTER	+	Pr	ess: 🗧			Pre	ess: yx	
	l	ENTER	• 3							
	т	0.00		т	0.00	-Unch	anged.	т	0.00	 Unchanged.
	z	5.00		z	0.00	1		z	0.00	
	Y	1.00		Y	5.00	1		Y	0.00	22
	x	3.		X	0.33		; contents ack drop.	X	1.71	5 ^{.33} ; contents of stack drop.

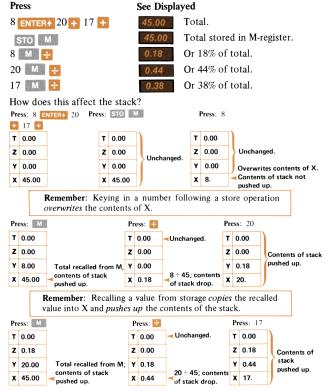
Storing and Recalling Numbers

Two general purpose memory registers are provided apart from the stack. One memory register (M) is primarily useful when you need to store data for use in subsequent problems or for accumulation. The other memory register (K) will probably be most convenient to use in repetitive calculations where one value remains the same (constant).

Although the store and recall functions work identically for both memory registers, since each has been assigned special purpose features to extend its use, we have described them separately.

M-Register: STO M , M

When the calculator is turned on, the M-register is automatically reset to zero. To store a displayed value (whether the result of a calculation or a keyboard entry) in the M-register, press **STO M**. To retrieve the value merely press **M**. A copy of the recalled value appears on the display; the original value remains in the M-register. For example, add 8, 20, 17; store the result in M; and divide the individual numbers by the stored sum to find what part each is of the total.





As you have now observed, recalling the contents of M displays the copy in the X-register and pushes up the stack. Whatever value resides in the T-register (top) is pushed out and lost.

To enter a new value or to clear the M-register, merely store another value or zero.

K-Register: STO K, K

This register operates exactly the same as the M-register for storing and recalling values; that is **STO K** stores the displayed value in the K-register, and **K** recalls and displays a copy of the value. A special feature of the K-register is that it is set automatically to 12 each time you turn on your calculator. Try it. Turn the power switch off, then on. Now recall the value.

Press

κ

See Displayed

12.00

Why 12? Since financial functions require that interest rates and compounding periods (usually 12 per year) be expressed in compatible units, you may frequently have to multiply or divide by 12.* Therefore, it is usually a good idea to save the K-register for this special purpose unless the compounding frequency is other than monthly. Then it will probably be more convenient to store the appropriate constant in K, in place of 12.

Accumulation : M+ , M

The M-register can also be used as an accumulator; that is, you can add a value displayed in the X-register to the contents in M by pressing M^{\bullet} . Further, to subtract a value from the M-register, press CHS to change the sign of the displayed value before pressing M^{\bullet} . For example, store 5 in the M-register, increase it by 3, decrease it by 2.

*See discussion of compounding period conversions, page 36.



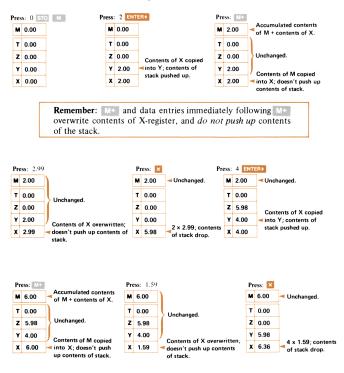
Now if you go on to other calculations or clear the display, you can still recall the current value of M.

Press	See Displayed
CLX	0.00
M	6.00

Note: If you want to use M as a counter, first set it to zero with 0 sto M.

Another feature of the accumulation function is that you are able to calculate two separate running totals—one in the stack and the other in the M-register. For example, suppose you sold two large ski caps at \$2.99, four medium caps at \$1.59, and three small caps at \$.99. What is the gross sale and the total number of ski caps sold?

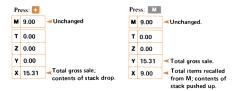
Press	See Displayed	
0 STO M	0.00	M-register set to zero.
2 ENTER↑ M+ 2.99 ×	\$ 5.98	2 large caps @ 2.99.
4 ENTER↑ M+ 1.59 ×	\$ 6.36	4 medium caps @ 1.59.
+	\$ 12.34	Subtotal gross sale.
3 ENTER↑ M+ .99 ×	\$ 2.97	3 small caps @ .99.
±	\$ 15.31	Total gross sale (accumulated in stack).
М	9.00	Total items (accumu- lated in M-register).



A look at the stack and the M-register shows how this works.







2. Using Financial Functions

The Nature of Time and Money Caiculations: _ _ , _ i , _ , _ PMT , PV , FV , INT .

In your HP-70 you have the solution to myriad financial calculations, involving time and money relationships, literally at your fingertips. To give you an idea of typical applications, work through the examples that follow (take the keystrokes on faith—we'll explain following the examples).

Suppose you had \$10,000 to invest in one of the following enterprises:

	Investment A	Investment B
Initial investment:	\$10,000	\$10,000
Expected return:	\$25,000	\$15,000
Time:	7 years	3 years

Which investment is more profitable, assuming all other considerations such as risk, inflation, etc., are equal?

To solve this problem on your HP-70, first calculate the annual rate of return for investment A.

Press	See Displayed	
CLR	0.00	
10000 PV	\$ 10000.00	Initial investment (present value).
25000 FV	\$ 25000.00	Expected return (future value) for investment A.
7 n	7.00	Number of years.
i	13.99	% annual rate of return (interest).

Now calculate the annual rate of return for investment B. Since the initial investment, \$10,000, is the same, you only need change the values for expected return and number of years as follows:

Press	See Displayed	
15000 FV	\$ 15000	Expected return (future value) for investment B.
3 n	3.00	Number of years.
	33	

14.47

% annual rate of return (interest)-clearly the better investment.

Previously, this problem was extremely difficult to calculate-unless you had access to a large computer-because it could only be handled after lengthy calculations and interpolations of table values before a comparison could be made. It is typical of an entire class of calculations involving time and money-particularly the interest compounding process.

Your HP-70 has the most common business calculations (including the associated tables) preprogrammed into the top row keys (compound interest keys). Since you may also have occasion to calculate simple (or accrued) interest, we have included a simple interest key (INT) to be used along with the applicable top row keys. The entire set of financial function keys, including some of the values associated with each, are shown in figure 3.

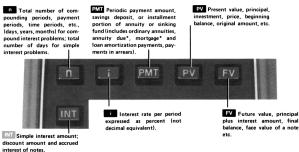


Figure 3. Financial Function Keys

Formatting the Calculation

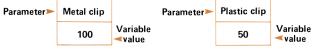
In computer technology and mathematics there is a very useful word that—as far as this writer knows—has no equivalent in everyday English. The word is "parameter" meaning—in the context of this handbook—a name that classifies or identifies a value as to kind; the *name* remains *constant* (fixed) but the *value* may *change* (is variable). Think of a parameter as a box with a label on it. If you were counting all your paperclips, regardless of kind, the total (say 150) would be put in the box and the label (parameter) would say "paperclips".

*Used with keystroke routine combining preprogrammed financial functions with additional keystrokes.

i



Now, if you were sorting paperclips according to kind, you would need as many boxes as you have different kinds of paperclips. And, if you took a new count every day or so, the values would probably change.

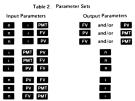


Now think of each of the top row keys as a box; the lettered symbol is the label (parameter). The values you put into the box (by pressing the appropriate top row key) are variable.

The nature of financial calculations in the HP-70 requires three input parameters to solve for one or two output parameters. This means you have a total of five parameters (**n i PMT PV FV**) of which three must be input, and one or two can be output. Input parameters can be entered in any order; output parameters can be executed in any order. Both **n** and **i** are essential to all calculations and must be included as two of the input parameters, or as one input parameter and one output parameter.

Note: Always press **CLR** before using a different input parameter set to clear parameters of any existing values.

The following table shows all possible parameter combinations.

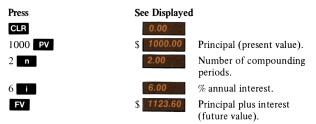


Try the following examples to get a feeling for keying in problems.

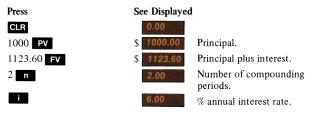
If you invested \$1000 for 2 years at a rate of 6% per year,* what is the total amount you would receive at the end of 2 years?

^{*}Interest is always expressed as an annual rate in examples unless otherwise specified.

36 Using Financial Functions



If you know the future value and want to figure the annual interest rate,



Compounding Period Conversions

Throughout the following examples, compounding periods, payment periods, time periods, and periods are synonymous and are used interchangeably. Furthermore, payment periods and compounding periods are assumed to be both equal and coincident, that is, interest is compounded and periodic payments are due at the same time.

The **n** parameter represents the total number of compounding periods, i.e., the total number of times interest is compounded.

If the total number of compounding periods is not given, it must be calculated by multiplying the number of years by the number of compounding periods per year. For example, if the interest is compounded monthly on a 30-year loan, the total number of compounding periods is $360 (30 \times 12 = 360)$.

The **i** parameter represents the interest rate per period (expressed as a percent rather than the decimal equivalent).

If the interest rate per period is not given (usually it is expressed as an annual rate), it must be calculated by dividing the annual interest rate by the number of compounding periods per year. For example, if the interest on that 30-year loan is expressed as 12% (annual interest) and is compounded monthly, the interest rate per period is 1% ($12 \div 12 = 1$).

You'll save time if you use the K-register for repetitive conversion constants. (Remember—the K-register is set to 12 for monthly compounding whenever you turn the calculator on; it remains set to 12 until you store another value in K, and is not affected by \boxed{CLX} or \boxed{CLR} operations.) If you are using a compounding period other than monthly, merely store the appropriate value in K and recall it as needed.

For example, with K set to 12, calculate the total number of compounding periods on a 30-year loan having interest compounded monthly.

Press See Displayed 30 K × n 360.00 Further, 9% interest per year is equal to .75% per month (9 ÷ 12 = .75). Again, it can be keyed directly into i following the conversion calculation: Press See Displayed

Remember, you don't change percent values to decimal equivalents in financial functions.

Payment Calculations

Values associated with the PMT (payment) key assume an ordinary annuity problem; that is, payments are assumed to be equal, equally spaced, and occurring at the end of the payment period. However, because the HP-70 was designed to accommodate a wide variety of applications beyond the basic preprogrammed functions, annuity due (payments occurring at the beginning of a payment period) and balloon payment problems can be solved with a few extra steps as shown in the applicable sample cases (Applications Casebook, section 3).

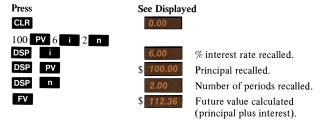


You may note some slight discrepancies between what happens in the real world and what you see displayed on your HP-70 in calculations involving periodic payments. The reason is that your HP-70 gives you results carried out to 10 significant digits. Since, in the real world, things rarely come out evenly, the amount and/or number of payments may have to be adjusted. Otherwise, you would have to write checks for amounts like \$242.764537, or make 360.25 payments on a 30-year loan. Therefore, institutions (banks, etc.) generally round or truncate the payment amount to the nearest cent in a fully amortized loan, then make up the difference by adjusting the final payment amount or number of payments. If you want to compare an actual (adjusted) loan with the HP-70 equivalent, be sure to use the payment amount as established by your lender instead of computing it with the top row keys. This will allow for any real world adjustments.

Recalling and Displaying Input Values

A separate memory register is reserved for each of the five top row keys; only the three input values can be stored at a time. Values are stored by keying in a number and pressing a financial function key. To retrieve an input value, merely press **DSP** (display), then press the key associated with the desired input value **n i PMT PV FV**. A copy of the value will appear on the display which, in turn, pushes up the contents of the stack. The original value is retained in its storage register until you press **CLP**, overwrite it with a new value, or turn your calculator off. This store and recall feature can be very useful for follow-on calculations, or for picking up where you left off should your phone ring or you are otherwise interrupted.

For example, calculate the future value of 100 at 6% for 2 years (assuming interest is compounded annually), then display some of the original values.





\$ 100.00

Principal recalled (future value pushed up into Y-register).

Now calculate the total interest amount.

Press

See Displayed

Interest amount (future value less principal).

Changing Output Values

After three input parameters have been selected and their respective values entered, either or both of the remaining parameters may be calculated (as output parameters) without reentering any of the input values.

For example, recalculate the previous problem to solve for payment instead of future value. (If you cleared out your calculator, go back and key in the input parameters and solve for future value before proceeding.)

Press

PMT



\$ 54.54 Payment amount.

Changing Input Values

You may change the *value* of one or more existing input parameters (the parameters themselves must not change) and perform repetitive calculations without re-entering remaining input data. This feature is particularly useful when examining various combinations of interest rates, compounding periods and dollars.

For example, if you invest \$10,000 in a venture paying 8% compounded annually, how much money will you have at the end of 3 years? 7 years? 15 years?



40 Using Financial Functions

Try another example. Suppose you plan to take a trip around the world as soon as you have saved up \$5,000 (well-maybe a trip to Disneyland?). After paying for all your necessaries you can afford to set aside up to \$150 at the end of each month. Assuming that you can get a fixed 6% on savings, how long must you wait to take the trip? (The input parameters for this problem are different from the previous problem, so press **CLR** before proceeding.)



But what if you can only save \$100/month?

Press	See Displayed	
100 PMT		
n	44.74	Months.
к÷	3.73	Years.

And if you're really profligate and have only \$50/month left over?

Press	See Displa	yed
50 PMT		
n	81.30	Months.
к ÷	6.77	Years.

What if you could get a better return on your money-say 10%?



And so on-until you get a combination of time and money that you can live with.

Be sure to press **CLR** before calculating problems having a different set of input parameters. If you don't, errors will result. However, don't press **CLR** if you are merely changing values of existing input parameters or selecting the other output parameter.

Simple Interest Amount and Discounted Notes

The simple interest calculation requires **i n** and **PV** as input parameters to solve for **NT** (simple interest amount), for both a 360and 365-day basis. Refer to page 42 for detailed examples of simple interest problems for accrued interest and discounted note applications.

Common Logarithms

You might like to know that because compound interest formulas are based on logarithms (refer to appendix C, Compound Interest Formula, when used to solve for n), you can calculate common logarithms with your HP-70. "Who needs it?" you say. (Well, as long as you've got it you may as well know about it—right?) At any rate, if you ever have occasion to find the common log (\log_{10}) of a number, key in the number, press **EV** 900 **i** 1 **PV n**. For example, find the common log of 15.



Financial Applications

Now you should be ready to turn to the Applications Directory, page 104. There you'll find a representative list of financial calculations listed alphabetically and cross referenced according to the various names by which they are commonly known. Included are page numbers where examples may be found. Or, if you prefer, go through the Applications Casebook, section 3, and work the problems in order. Along the way, be sure to try a few of your own. You may come up with some goodies we've never thought of and that's part of the satisfaction of owning an HP-70.

The applications and examples that follow are arranged according to generic categories. An alphabetic listing by specific calculation type is provided in the Applications Directory, starting on page 105. A list of business calculation formulas used for HP-70 are included in appendix C. Examples given are merely representative of a wide range of possible calculations. Included are a number of extended applications using combinations of preprogrammed functions and stack manipulations. After a short familiarization you should be able to tailor the preprogrammed functions to your particular needs.

Ground Rules

To maintain continuity where annual compounding period calculations are required, we have shown the longer conversion method. In actual practice, however, we suggest you use the K-register for repetitive conversion constants. If you are using a compounding period other than monthly (remember, K is initially set to 12), merely store the appropriate value in K and recall it as needed.

Be sure to clear any values remaining in the top row key registers with **CLR** before calculating a problem having a different input parameter set.

Simple Interest Amount

Accrued Interest — 360 Day Basis

This calculation finds the amount of accrued interest on a 360-day basis, when the number of days, interest rate, and principal (present value) are known. A nice feature is the ability to add the accrued interest to the principal which is returned to the Y-register during the calculation.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in principal, press PV.
 - Key in annual interest rate, press
 - Key in number of days, press n.
- 3. Press NT to obtain the amount of accrued interest on a 360-day basis.

4. Press + to obtain the net amount (sum of the principal and interest) on a 360-day basis.

Sample Case: What is the amount of accrued interest and the net amount on \$450 for 50 days at 7%, figured on a 360-day basis?



Accrued Interest — 365 Day Basis

This calculation finds the amount of accrued interest on a 365-day basis, when the number of days, interest rate, and principal (present value) are known.

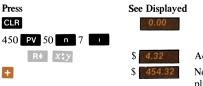
1. Press CLR.

Solution:

- 2. Enter the following information in any order:
 - Key in principal, press PV .
 - Key in interest rate, press
 - Key in number of days, press
- 3. Press INT R* X: y to obtain the accrued interest on a 365-day basis.
- Press
 to obtain the net amount (interest plus principal) on a 365-day basis.

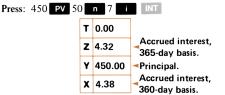
Sample Case: What is the amount of accrued interest and the net amount on the same 450 for 50 days at 7%, figured on a 365-day basis?

Solution:



Accrued interest. Net amount (interest plus principal).

Note: Accrued interest calculations for both 360 and 365 days are actually calculated in the same step. This is possible because we return the principal and both interest amounts to the stack as follows:



Discounted Notes

This calculation finds discount amounts and annual yields on both a 360- and 365-day basis when the number of days, discount rate, and face value of a discounted note are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in number of days, press
 - Key in annual interest rate, press
 - Key in face value (future value), press **FV**.
- 3. Press INT to obtain discount on 360-day basis.
- 4. Press R for annual yield on a 360-day basis.
- 5. Press R+ again for discount on 365-day basis.
- 6. Press R again for annual yield on a 365-day basis.

Sample Case: Calculate the discount amounts and annual yields on a discounted note having a face value of \$1000 discounted at 6%, for 37 days.



Compounded Amounts (Compound Interest)

Future Value of Compounded Amount

This calculation finds the future value of an amount compounded at a certain interest rate over a specified number of periods.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in number of time periods, press .
 - Key in interest rate per period, press
 - Key in principal (present value), press PV.
- 3. Press **FV** to obtain the future value.

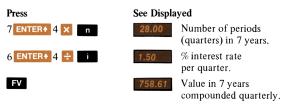
Sample Case 1: What is the future value of \$500 invested at 6% for 7 years if interest is compounded annually?





Sample Case 2: What is the future value of the same \$500 invested at the same rate (6%) for the same number of years (7) if compounded quarterly?

Solution:



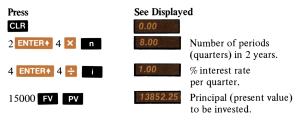
Note that the third parameter value (500 PV) didn't change so it wasn't reentered.

Present Value of Compounded Amount

This calculation finds the present value of a compounded amount when the future value, number of periods and interest rate are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in number of time periods, press
 - Key in interest rate per period, press
 - Key in future value, press FV.
- 3. Press PV to obtain the present value (principal).

Sample Case: If you wanted to establish a fund of \$15,000 for an extended vacation which you planned to take in 2 years, what would be the investment required now if money is worth 4% compounded quarterly?

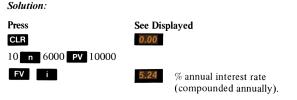


Rate of Interest for Compounded Amount

This calculation finds the interest rate (or the rate of appreciation) needed to amass a given sum if a fixed amount is invested for a specified period.

- 1. Press CLR .
- 2. Enter the following information in any order.
 - Key in the number of periods, press **n**.
 - Key in the amount of investment, press **PV**.
 - Key in the sum required in the future, press **FV**.
- 3. Press i to obtain the required interest rate per period.

Sample Case: What annual rate of interest must be obtained in order to amass a total of \$10,000 in 10 years on an investment of \$6,000?



What if the interest were compounded daily (assume 365 days per year)?

Press	See Displayed	
10 ENTER↑ 365 × n	3650.00	Number of periods (days) in 10 years.
Ĩ	0.01	% daily interest rate (rounded to two decimal places).
365	5.11	% annual interest rate if compounded daily.

Number of Periods for Compounded Amount

This calculation finds the number of periods required to amass a given sum at a specified rate on a given investment.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in rate per period, press
 - Key in present value, press **PV**.
 - Key in future value, press **FV**.
- 3. Press **n** to obtain number of periods.

Sample Case: You now have \$887 in a savings account paying 5.4% compounded monthly. How long will it take to reach one million dollars?

Solution:



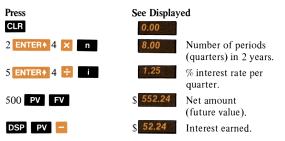
Compounded Amount and Interest Earned

This calculation finds the interest earned (dollar amount) on a fixed amount when the interest is compounded at a specified rate over a given period.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in number of periods, press
 - Key in interest rate per period, press
 - Key in principal (present value), press PV.
- 3. Press **FV** to obtain future value.
- 4. Press DSP PV _ to obtain dollar amount of interest.

Sample Case: What would be the future value and interest earned on \$500 at 5% for 2 years if interest is compounded quarterly?





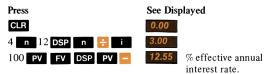
Nominal Rate Converted to Effective Annual Rate

This calculation finds the effective annual interest rate when the number of periods per year and the nominal (stated) annual interest rate are known. Enter the information as follows:

- 1. Press CLR.
- 2. Key in the number of periods per year, press n.
- Key in the nominal rate, press DSP n 🖶 i.
- 4. Key in 100, press PV.
- 5. Press FV .
- 6. Press DSP PV = to obtain effective annual rate.

Sample Case: What is the effective annual rate of interest if the annual nominal rate of 12% is compounded quarterly?





Effective Annual Rate Converted to Nominal Rate

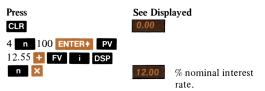
This calculation finds the nominal (annual) rate of interest when the number of periods per year and the effective annual interest rate are known. Enter the information as follows:

1. Press CLR .

- 2. Key in number of periods per year, press
- 3. Key in 100, press ENTER↑ PV .
- 4. Key in effective annual rate, press 🕂 F 🚺 .
- 5. Press DSP **n** X to get nominal rate.

Sample Case: Find the nominal rate if the effective annual rate is 12.55%, compounded quarterly.

Solution:



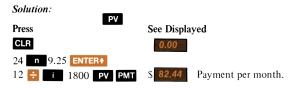
Direct Reduction Loans

Periodic Payment Amount (Ordinary Annuity)

This calculation finds the periodic payment amount to be paid at the end of each period when the principal (present value), number of periods, and interest rate per period are known.

- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in total number of periods, press **n**.
 - Key in interest rate per period, press
 - Key in principal, press PV .
- 3. Press **PMT** to obtain amount of periodic payment.

Sample Case: If a member of a credit union borrows \$1800 to be repaid over 24 months at a 9.25% annual rate, what is his monthly payment?



Interest Rate Per Period, Annual Interest Rate

(Ordinary Annuity)

This calculation finds the periodic and annual interest rates of an annuity when the payment amount, principal, and number of periods are known.

- 1. Press CLR.
- 2. Enter the following information in any order.
 - Key in principal, press **PV**.
 - Key in payment amount, press PMT.
 - Key in number of periods, press
- 3. Press i to obtain periodic interest rate, then multiply by number of periods per year to obtain annual interest rate.

Sample Case: Suppose that you knew your monthly payment in the previous sample case, but didn't know the annual interest rate.

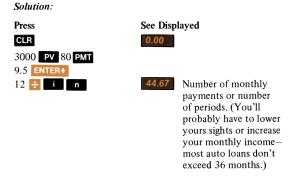


Number of Periods Required to Amortize Loan (Ordinary Annuity)

This calculation finds the number of periods required to pay off a direct reduction loan when the interest rate, principal and payment amount are known.

- 1. Press CLR .
- 2. Enter the following information in any order.
 - Key in principal, press PV .
 - Key in payment amount, press PMT.
 - Key in interest rate per period and press
- 3. Press n to obtain number of periods.

Sample Case: How long will it take to pay off an auto loan if you need to borrow \$3,000? Assume the going rate is 9.5% and you can afford payments of \$80 per month.



Loan Amount (Present Value of Ordinary Annuity)

This calculation finds the principal amount of a direct reduction loan when the interest rate per period, payment amount and number of payments (periods) are known.

- 1. Press CLR.
- 2. Enter the following information in any order.
 - Key in payment amount, press PMT.
 - Key in interest rate per period, press
 - Key in number of payments, press
- 3. Press **PV** to obtain principal (present value).

Sample Case: If you decide to buy a car for which you plan to pay \$80 per month for 36 months, and you are willing to pay 10% annual interest, how much can you afford to pay for the car?

Solution:

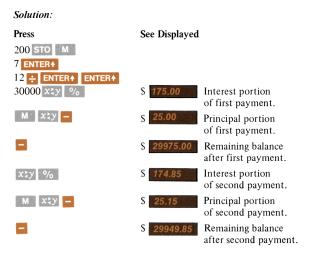


Amortization Schedule (Ordinary Annuity)

This calculation generates an amortization schedule for a fully amortized loan (mortgage) from the first payment to a given payment, when the mortgage amount, periodic interest rate and amount of periodic payment are known. Enter the information as follows:

- 1. Key in periodic payment amount, press STO M.
- 2. Key in periodic interest rate, press ENTER+ ENTER+ .
- 3. Key in loan amount.
- Press x:y
 Press % to obtain the interest portion of the first payment.
- 5. Press **M X**: **Y C** to obtain the principal portion of the first payment.
- 6. Press = to obtain the remaining principal balance.
- 7. Repeat steps 4 through 6 for subsequent periods.

Sample Case: Generate an amortization schedule for the first two months of a \$30,000 loan, at 7%, with monthly payments of \$200.



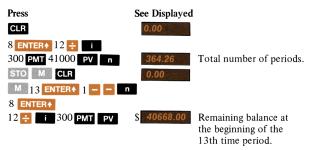
Accumulated Interest with Remaining Balance (Ordinary Annuity)

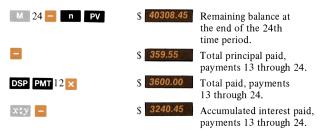
This calculation finds the accumulated interest and remaining balance at any point in the life of a fully amortized mortgage (given the beginning and ending payment numbers), when the mortgage amount, payment amount, and periodic interest rate are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in the interest rate per period, press
 - Key in payment amount, press PMT.
 - Key in amount of mortgage, press **PV**.

- 3. Press **n** to obtain the total number of periods throughout the life of the mortgage.
- 4. Press STO M CLR.
- 5. Press M to recall the total number of periods.
- Key in payment number associated with beginning of the time frame to be examined, press ENTER 1 - in .
- 7. Key in the interest rate per period again, press
- 8. Key in payment amount, press PMT.
- 9. Press **PV** to obtain the remaining balance at the beginning of the time frame.
- 10. Press to recall total number of periods; key in last payment number of the time frame, then press **n**, **PV** to obtain the remaining balance at the end of the time frame.
- 11. Press do obtain the total principal paid during the time frame (the difference between the beginning and ending principal balances).
- 12. Press **DSP PMT** to recall payment amount; key in number of payments made during the time frame, press **X** to obtain total amount paid in time frame.
- 13. Press x:y to obtain accumulated interest paid during the time frame.

Sample Case: If you have an 8%, \$41,000 mortgage, with monthly payments of \$300, what is the accumulated interest paid for payments 13 through 24 inclusive, and remaining balance?





Remaining Balance Only (Ordinary Annuity)

This calculation finds the remaining balance of a fully amortized mortgage, when the mortgage amount, payment amount, and periodic interest are known.

- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in periodic interest rate, press
 - Key in periodic payment amount, press PMT.
 - Key in loan amount, press **PV n** to obtain the total number of time periods required to amortize the loan.
- 3. Press STO M, CLR.
- 4. Press M to recall the total number of periods. Key in the payment number associated with the end of the time frame, press

 In
- 5. Key in periodic interest rate, press
- 6. Key in payment amount, press PMT.
- 7. Press **PV** to obtain remaining balance.

Sample Case: Find the remaining balance on an 8.5%, \$45,000 loan after 24 monthly payments of \$346 each.





Payment Amount for Mortgage with Balloon Payment

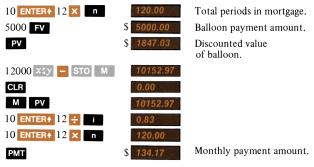
(Ordinary Annuity)

This calculation finds the periodic payment amount when the total number of payments, periodic interest rate, principal (mortgage amount), and balloon payment amount are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in periodic interest rate, press
 - Key in total number of payment periods (not including balloon payment), press **n**.
 - Key in balloon payment amount, press **FV**.
- 3. Press PV.
- 4. Key in principal, press x zy STO M .
- 5. Press CLR.
- 6. Enter the following information in any order:
 - Key in total number of payment periods, press n .
 - Key in periodic interest rate, press
 - Press M PV.
- 7. Press PMT to obtain periodic payment amount.

Sample Case: A borrower has a 12,000, 10%, 10-year mortgage with a balloon payment coinciding with the final periodic payment. If he specifies that the balloon payment is not to exceed 5,000, what is the minimum monthly payment required?





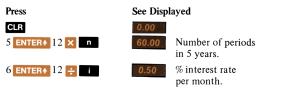
Sinking Funds

Future Value of Sinking Fund (Ordinary Annuity)

This calculation finds the amount to be amassed at the end of a specified number of periods when the amount of the periodic payment and interest rate per period are known.

- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in number of periods, press .
 - Key in interest rate per period, press
 - Key in amount of periodic payment, press PMT.
- 3. Press **FV** to obtain future value.

Sample Case: How much money will you have at the end of 5 years if you invest \$250 at the end of each month in a venture paying 6% compounded monthly?



250 PMT FV



Value in 5 years, compounded monthly.

Rate of Interest for Sinking Fund (Ordinary Annuity)

This calculation finds the rate of interest for a sinking fund when the amount to be amassed (future value), the number of time periods, and the periodic payment amount are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in number of periods, press
 - Key in amount of payment, press PMT.
 - Key in future value, press **FV**.
- 3. Press i to obtain required rate of interest per period.

Sample Case: What annual rate of interest must be obtained to amass a total of \$10,000 in 10 years on an annual investment of \$600?

Solution:

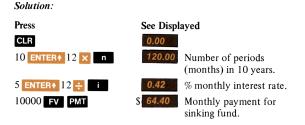


Payment Amount for Sinking Fund (Ordinary Annuity)

This calculation finds the periodic payment to be set aside for a sinking fund, when the future value, number of periods, and interest rate per period are known.

- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in number of periods, press **n**.
 - Key in interest rate per period, press
 - Key in future value, press **FV**.
- 3. Press PMT to obtain amount of periodic payment for sinking fund.

Sample Case: As a farsighted parent, you are planning ahead for your children's education. How much money must be invested at the end of each month to amass \$10,000 in 10 years, when interest is earned at a rate of 5% compounded monthly?

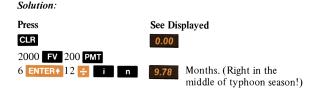


Number of Periods for Sinking Fund (Ordinary Annuity)

This calculation finds the number of periods required to amass a specific sum when the periodic payment amount and interest rate per period are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in future value, press FV.
 - Key in payment amount, press PMT.
 - Key in interest rate per period, press
- 3. Press **n** to obtain the number of periods.

Sample Case: It's January 1, 1975. You are going to sail to Tahiti as soon as you can save \$2,000 but—since you are a so-so sailor and tend to seasickness—would like to avoid the typhoon season (August to November). Assume money is worth 6% and you can save only \$200 per month. After you sell all your earthly goods (you're not coming back are you?), should you invest the proceeds in art supplies or Dramamine?



Consumer Finance

Add-on Interest-to-APR Conversion; Finding Monthly Payment

This calculation finds the annual percentage rate $(APR)^*$ and monthly payment when the add-on interest rate,** loan amount, and number of months are known. Enter the information as follows:

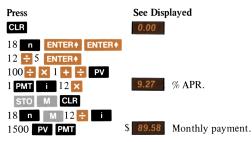
- 1. Press CLR .
- 2. Key in number of months in loan, press **n** ENTER+ ENTER+ 12 ÷.
- 3. Key in add-on rate, press ENTER↑ 100 ÷ × 1 + ÷ PV 1 PMT.
- 4. Press 12 \times to obtain the APR.
- 5. Press STO M CLR.
- Key in term of loan in months, press n, recall APR by pressing
 ; press 12 ÷ i.
- 7. Key in loan amount, press **PV PMT** to obtain monthly payment.

*Actual cost of a loan expressed as an annual percent rate as required by U.S. Federal Reserve (Reg. Z-Truth in Lending) to provide a common, standard measure for comparison of finance charges.

**Method of calculating finance charges, on loans reduced by periodic payments, where simple interest for the full original loan amount and for the full term is added to the loan.

Sample Case: Calculate the APR and monthly payment of a 5% add-on loan in the amount of \$1500 for 18 months.

Solution:

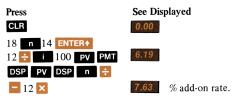


APR-To-Add-On Interest Conversion

This calculation finds the equivalent add-on interest rate when the number of periods (months only) and annual percentage rate (APR) are known.

- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in number of months of loan, press n.
 - Key in APR, press ENTER 12 ÷ ■i
 - Key in 100 PV, press PMT.
- 3. Press DSP PV DSP n 🗧 12 🗙 to obtain add-on rate.

Sample Case: What is the equivalent add-on rate for an 18-month loan with an APR of 14%?



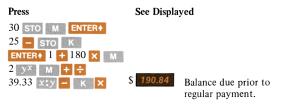
Rule-of-78 Rebate

This calculation finds the balance due for a prepaid consumer loan using the rule-of-78's. The known values are current installment number, total number of installments, total finance charge, and payment amount. Enter the information as follows:

- 1. Key in number of months of the loan, press STO M ENTER+.
- Key in payment number when prepayment occurs, press STO
 K ENTER+ 1 + .
- Key in total finance charge, press X M 2 yx M + .
- 4. Key in periodic payment amount, press xxy K × to obtain balance due prior to regular payment.

Sample Case: A 30-month loan, having a finance charge of \$180, is being repaid at \$39.33 per month. What is the balance due prior to regular payment?

Solution:



Savings Calculations

Number of Time Periods for Savings Calculation (Annuity Due)

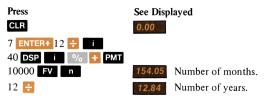
This calculation finds the number of periods required to amass a given sum when the periodic interest rate and payment amount are known. Payments occur at the beginning of each period rather than at the end.

- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in periodic interest rate, press
 - Key in future value, press FV .

- 3. Key in periodic deposit amount, press DSP i 9/6 + PMT.
- 4. Press **n** to obtain the number of time periods.

Sample Case: If you deposit \$40 per month in an account which pays 7% interest compounded monthly, how long will it take to amass \$10,000?

Solution:



Rate of Interest for Savings Calculation (Annuity Due)

This calculation finds the periodic interest rate needed to amass a given sum when the number of periods and payment amount (to be made at the beginning of each period) are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in the number of time periods, press ENTER 1 + n.
 - Key in periodic deposit amount, press PMT.
- 3. Key in future value, press DSP PMT 🕂 FV .
- 4. Press to obtain the periodic interest rate.

Sample Case: If you require \$10,000 at the end of 15 years, and can deposit \$20 per month at the first of each month, what rate of interest, compounded monthly, must you receive?





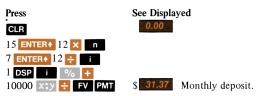
Payment Amount Required for Some Future Value – Savings Calculations (Annuity Due)

This calculation finds the monthly deposit (to be made at the beginning of each period) required to amass a given sum when the number of periods and periodic interest rate are known.

- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in number of deposit periods, press
 - Key in periodic interest rate, press
- 3. Press 1 DSP i % 🕂.
- 4. Key in future value, press x >> 🗧 FV .
- 5. Press **PMT** to obtain the periodic deposit amount.

Sample Case: Suppose a savings plan will pay 7% compounded monthly. What monthly deposit must be made to have \$10,000 in 15 years?

Solution:



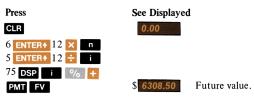
Future Value of a Series of Deposits (Annuity Due)

This calculation finds the future value (principal plus interest) of a series of deposits (to be made at the beginning of each period) when the number of periods and periodic interest rate are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in number of deposit periods, press .
 - Key in periodic interest rate, press
- 3. Key in periodic deposit amount, press DSP i % 🕂 PMT.
- 4. Press **FV** to obtain the future value.

Sample Case: How much money will you have at the end of 6 years, in a savings account paying 5% compounded monthly, if you deposit \$75 each month beginning tomorrow?

Solution:



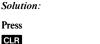
Leases and Rent (Payments in Advance)

Number of Payments in Advance (Annuity Due)

This calculation finds the total number of payment periods required for an initial amount when the payment amount (to be paid at the beginning of each period) and periodic interest rate are known.

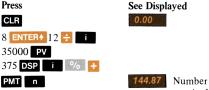
- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in periodic interest rate, press
 - Key in initial amount, press PV .
- 3. Key in periodic payment amount, press DSP 📑 🥂 РМТ
- 4. Press **n** to obtain total payment periods.

Sample Case: How many payments are required to retire a mortgage in the amount of \$35,000 having monthly payments in advance of \$375 and an 8% annual interest rate?



35000 PV

PMT n



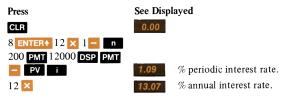
Number of payments required.

Interest Rate for Payments in Advance (Annuity Due)

This calculation finds the periodic interest rate on a given initial amount when the total number of periods and payment amount (to be paid at the beginning of each period) are known.

- Press CLR . 1.
- 2. Enter the following information in any order:
 - Key in number of time periods, press ENTERA 1 -
 - Key in periodic payment amount, press PMT. •
- 3. Key in initial amount, press DSP PMT PV.
- 4. Press to obtain periodic interest rate.

Sample Case: Equipment worth \$12,000 is leased for 8 years with monthly payments in advance of \$200. The equipment is assumed to have no salvage value at the end of the lease. What yield rate does this represent?



Periodic Payment Amount for Payments in Advance (Annuity Due)

This calculation finds the periodic payment amount (to be paid at the beginning of each period) of a given initial amount, when the total number of periods and periodic interest rate are known.

- 1. Press CLR .
- 2. Enter the following information in any order:
 - Key in number of payment periods, press .
 - Key in periodic interest rate, press
- 3. Press 1 DSP i % 🕂 .
- 4. Key in initial amount, press 📖 🕂 PV .
- 5. Press PMT to obtain periodic payment amount.

Sample Case: The owner of a building presently worth \$70,000 intends to lease it for 20 years at the end of which time he assumes the building will be worthless. How much must quarterly payments (in advance) be to achieve a 10% annual yield?

Solution:



Present Value of Payments in Advance (Annuity Due)

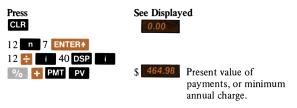
This calculation finds the present value of a series of payments (made at the beginning of each period) when the total number of payments, periodic interest rate, and payment amount are known.

- 1. Press CLR.
- 2. Enter the following information in any order:
 - Key in number of payment periods, press n.
 - Key in periodic interest rate, press

- 3. Key in periodic payment amount, press DSP i 🥂 🕂 PMT.
- 4. Press **PV** to obtain present value.

Sample Case: The owner of a downtown parking lot has achieved full occupancy and a 7% annual yield by renting parking spaces for \$40 per month payable in advance. Several regular customers want to rent their spaces on an annual basis. What annual rent, also payable in advance, will maintain a 7% annual yield rate?

Solution:



Depreciation

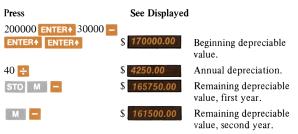
Straight-Line Depreciation Schedule

This calculation finds the depreciation amount and remaining depreciable value for each year of an asset's useful life according to the straight-line method. Required data are the beginning depreciable value (starting book value less salvage value) and the asset's useful life expectancy.

- 1. Key in the beginning depreciable value, press ENTER+ ENTER+ .
- 2. Key in the asset's life, press 🗧 to obtain the depreciation amount for each year.
- 3. Press **STO M** to obtain the remaining depreciable value at the end of the first year.
- 4. Press M = to obtain the remaining depreciable value at the end of the second year.
- 5. Repeat step 4 for subsequent years' remaining depreciable value.

Sample Case: An asset has a starting book value of \$200,000, a salvage value of \$30,000, and a life expectancy of 40 years. Calculate the annual depreciation and the remaining depreciable amount for the first and second years.





Declining Balance Depreciation

This calculation finds depreciation and remaining book value for each year of an asset's depreciable life when the present value, salvage value, and life expectancy are known. Enter the information as follows:

- 1. Key in declining factor, *press ENTER↑ .
- 2. Key in 100 (100% of depreciation), press 🔀
- 3. Key in number of years, press 🚼 to obtain multiplier.
- 4. Press STO M.
- 5. Key in present value of asset.
- 6. Press M, then press % to obtain first year's depreciation.
- 7. Press 🔚 to obtain remaining book value in first year.
- 8. Repeat steps 6 and 7 to obtain each succeeding year's depreciation and remaining book value until the book value is equal to or less than the salvage value. In the latter case, the previous book value is reduced by the salvage value to obtain the final year's depreciation.

^{*}Use the declining factor rather than the declining rate (e.g., 1.5 instead of 150%, 2 instead of 200%).

Sample Case: A fleet car has a value of \$2500, a salvage value of \$400 which is not deducted from the present value, and a life expectancy of 6 years. If you are using the double declining balance method, what is the amount of depreciation and book value for years 1 through 4?



Note that an asset cannot be depreciated beyond salvage value; therefore, depreciation for year 5 would be \$93.83 and book value \$400.

Sum-of-the-Year's-Digits Depreciation

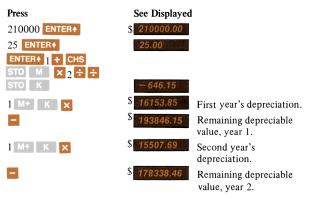
This calculation finds the depreciation and remaining depreciable amount for each year of an asset's useful life according to the sum-of-the-years'-digits method. The known values are the beginning depreciable value (starting book value less salvage value), and years of useful life. Enter the information as follows:

- 1. Key in the beginning depreciable value, press **ENTER** .
- 2. Key in the asset's life, press **ENTER**.
- 3. Press ENTER↓ 1 + CHS STO M × 2 ÷ ÷ STO K.
- 4. Press 1 M+ K X to obtain the first year's depreciation amount.
- 5. Press to obtain the remaining depreciable value at the end of the first year.
- 6. Repeat steps 4 and 5 for subsequent years' depreciation.

Solution:

Sample Case: An office building has a cost basis (excluding land cost and salvage value) of \$210,000, and a useful life expectancy of 25 years. Using the sum-of-the-years'-digits method, what are the depreciation allowances and remaining depreciable values for each of the first two years?





Discounted Cash Flow Analysis—Net Present Value

For purposes of capital budgeting, evaluating investments, etc., it is often necessary to perform a discounted cash flow analysis to see if a particular investment is at least as profitable as some norm (often called cost of capital or discount rate).

This calculation finds the present values of all future cash flows (appropriately discounted by cost of capital, less original investment). If the result is greater than or equal to zero, the venture is deemed profitable-at least to the extent of the discount rate or cost of capital. Conversely, if the net present value is less than zero, it is not profitable.

Known values are the cost of capital (%), amount of original investment (present value), and the expected cash flow schedule.

Press CLR . 1.

- 2. Enter the following information in any order:
 - Key in time period number of the first cash flow, press n.

- Key in periodic interest rate, press
- Key in amount of first cash flow, press **FV**.
- 3. Key in initial investment amount, press CHS STO M .
- 4. Press **PV** M+ to obtain the current net present value.
- 5. Enter the following information in any order:
 - Key in number of next cash flow, press **n**.
 - Key in next cash flow amount, press **FV**.
- 6. Press **PV** M⁺ to obtain the current net present value.
- 7. Repeat steps 5 and 6 for each cash flow period.

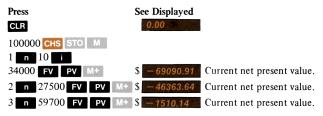
Note 1: For periods with negative cash flows (cash outlays), press CHS before pressing FV.

Note 2: To find the present value of a series of cash flows, skip step 3.

Sample Case: Will the following investment be profitable based on the cash flows?

Original investment	\$100,000
Cost of capital	10%
Cash flow year 1	\$34,000
Cash flow year 2	\$27,500
Cash flow year 3	\$59,700
Cash flow year 4	\$ 7,800

Solution:







Final net present value is positive so deal is okay.

Merchandising, Purchasing

Cost and Price (Markup, Chain Discounts)

Among the most used business calculations are those related to establishing retail prices based upon costs, trade discounts and profit margins.

This calculation finds the amount of markup, net price, dealer discount and list price when the per unit manufacturing/purchase cost, profit margin and dealer discount rates are known. Enter the information as follows:

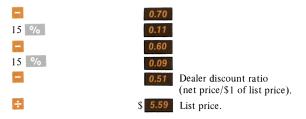
- 1. Key in unit cost, press ENTER .
- 2. Key in profit margin rate, press % to obtain amount of markup.
- 3. Press 🛨 to obtain net price.
- 4. Key in 1, press ENTER↑.
- 5. Key in discount rate, press \infty 🗖 to calculate first discount.
- 6. Repeat step 5 for each discount rate.
- 7. Press 🚼 to obtain list price.

Sample Case: ABC Corporation has produced a valve costing 2.26 to manufacture. They want a profit of 25% over production cost and are offering a trade discount to distributors of 30/15/15. Determine the following per unit amounts:

- Amount of Markup
- Net Price
- Dealer Discount Ratio
- List Price

Solution:





Cash Discounts

Cash discounts are offered to retailers by manufacturers/wholesalers as an incentive for prompt payment. Typical terms of payment would be 2/10, n/30. This means that the buyer is entitled to deduct 2% of the invoice amount if paid within 10 days. Otherwise, the net amount of invoice is due in 30 days. Another type of discount is termed *anticipation* where the buyer is entitled to the 2% discount plus an additional discount of a percentage of the invoice balance if paid within 60 days.

This calculation finds the standard and anticipated discounts, and the net invoice amount when discount rates (terms), amount of invoice, and dates of invoice and payment are known. Enter the information as follows:

- 1. Key in invoice amount, press ENTER+.
- 2. Key in standard discount rate, press 36 to obtain amount of discount.
- 3. Press 🧧 to obtain balance.
- 4. Key in anticipation discount rate, press %.
- 5. Key in days remaining, press 🔀.
- 6. Key in number of days used as interest base (either 360 or 365).
- 7. Press 🚼 to obtain the amount of anticipation discount.
- 8. Press 🧮 to obtain net invoice amount.

Sample Case: An invoice for 600 is dated October 10, 1974 and is paid on October 20. Terms are specified as 2/10, n/60-anticipation allowance is 6%. Determine the following:

76 Applications Casebook

- Amount of 2/10 Discount
- Invoice Balance Remaining (Net Difference)
- Amount of Anticipation Discount
- Net Invoice Amount

Solution:



Denominate Number Conversion

Denominate numbers are used to express units of measure: length, weight, time, currency, etc. The principles illustrated by the following examples of currency conversion can be extended to other types of unit conversion problems. If you do repetitive calculations using the same constant, store it in K or M, and recall it as needed.

U.S.-to-Foreign Currency Conversion

This calculation finds the value of U.S. dollars in terms of foreign currency when the prevailing foreign-to-U.S. currency exchange rate, and the amount of dollars to be converted are known. Enter the information as follows:

- 1. Key in dollar amount to be converted, press ENTER+.
- Key in exchange rate, press
 it to obtain equivalent amount of foreign currency.

Sample Case: If the rate of exchange is 2.233 per £, what is 30.20 worth in English currency?

Solution:



Foreign-to-U.S. Currency Conversion

This calculation finds the value of foreign currency in terms of U.S. dollars when the prevailing foreign-to-U.S. currency exchange rate and amount to be converted are known. Enter the information as follows:

- 1. Key in amount to be converted, press ENTER4.
- 2. Key in exchange rate, press × to obtain equivalent amount of U.S. dollars.

Sample Case: Using the same exchange rate of 2.233 per £, how much is £ 15.11 worth in U.S. money:

See Displayed

\$ 33.74

Solution:

Press

15.11 ENTER+ 2.233 ×

Appendix A

Operating Characteristics

Execution Time

Execution time varies according to the numbers entered. This is especially true for solutions for i in annuity problems. Some solutions for i in extreme cases outside those normally encountered may require minutes—depending upon the values input for **n**, **PMT**, and **pv** or **FV**.

Roundoff Error

The HP-70 rounds numbers to 10 significant digits. This sometimes results in what is known as "roundoff error." An illustration of roundoff error can be seen when using y^{\times} to calculate $(5^{V_2})^2$. The expected answer is 5.000000000; however, rounding 5^{V_2} (square root of 5) to 10 significant digits gives 2.236067977. Squaring this number gives the 19-digit product 4.99999999764872529. Rounding the square to 10 digits gives 4.999999998. If the next larger approximation (2.236067978) is squared, the result is 5.000000002237008484. Rounding this number to 10 significant digits gives 5.000000002. There simply is no 10-digit number whose square is 5.000000000.

Calculating Range

Input Parameters

The algorithms in the HP-70 were designed to accommodate the wide range of values that a business environment might impose. However, extreme input values sometimes cannot be used. For example, financial calculations requiring a value for the periodic interest rate should not be performed when that rate is very close or equal to zero. Specifically, rates between i = -0.0000001% and i = +0.000001% are not handled.

Range Errors

Any computation or data entry resulting in an absolute magnitude greater than or equal to $9.999999999 \times 10^{99}$ triggers an overflow signal (a display of ±9.999999999 99). The result of any computation having an absolute magnitude less than 1×10^{-99} (underflow) is displayed as zero.

80 Operating Characteristics

Improper Operations

If you attempt a calculation containing an improper operation—say division by zero—an error signal is triggered (blinking zeros appear on the display). To reset, press \fbox{CLX} . The following are examples of improper operations:

- 🚼 , where x = 0.
- y^x , where $y \leq 0$.
- **n**, where PV = 0, and FV and i > 0. (PV must be greater than 0 in order to increase in value.)

Note: Some input combinations in financial functions may generate range errors or improper calculations internally. For example, should an algorithm use y^x internally, where $y \leq 0$ because of the particular input values used, the display would show flashing zeros indicating an improper calculation.

Overflow Display Format

Answers greater than or equal to 10^{10} (9,999,999,999+1) are displayed in scientific notation—an abbreviated form of the number showing an exponent of 10 in the last two character positions.

Temperature Range

Mode	Temperature °C	Temperature °F
Operating	0 to +50	32 to 122
Charging	+10 to +40	50 to 104
Storage	-40 to +55	-40 to 131

Appendix B

Operational Stack

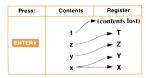
Stack Registers

The HP-70 uses the most efficient way known to computer science for evaluating mathematical expressions: the operational stack and reverse "Polish" notation (so called after its discoverer-Jan Lukasiewicz, the Polish logician and mathematician-because "Lukasiewicz" is so difficult to spell or pronounce).

The four temporary memory locations (number registers)-arranged in the form of a vertical stack are called X (bottom register), Y, Z, and T (top register), respectively.

Contents	Register Name	To avoid confusion betweer
t	т	the name of a register and its
z	z	contents, the register is design nated by a capital letter and
У	Y	the contents by a small letter
x	x	Thus, x, y, z and t are the con-
	ontents of the X lways displayed.	tents of X, Y, Z and T, respec- tively.

When you key in a number, it goes into the X-register-the bottom register and the only one displayed. When you press ENTERA, this number is duplicated into the Y-register. At the same time, y is moved up to Z, z is moved up to T, and t is lost as follows:



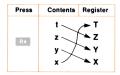
When you press 🚹, x is added to y, and the entire stack drops to display the answer in X. The same thing happens for **=**, **X** and **=**. Whenever the stack drops, t is duplicated from T into Z, and z drops to Y, as follows:

Press:	Contents	Register
➡, ■, × or ₽	$\begin{array}{c} t \\ z \\ y \\ x \end{array} \xrightarrow{y + x} y \times x$	$\begin{array}{c} \mathbf{x} \\ \mathbf{y} \\ \mathbf{y} \\ \mathbf{y} \\ \mathbf{y} \\ \mathbf{x} \end{array} $

Look at the contents of the stack as we calculate $(3 \times 4) + (5 \times 6)$ (figure 4). Directly above the keys pressed you see the information in X, Y, Z and T after the keystroke.

Manipulating The Stack

The **RV** key "rolls down" the stack and lets you review the contents (in last-in/first-out order) without losing data. It is also used to reposition data within the stack. Here is what happens each time you press **RV** :



Example: Load the stack by pressing: 1 ENTER+ 2 ENTER+ 3 ENTER+ 4. (The stack now contains x = 4, y = 3, z = 2, and t = 1). To review the contents of the stack press **R+** four times. The fourth **R+** returns the stack to its original position (x = 4, y = 3, z = 2, and t = 1). Note: the stack is raised and t is lost when a keyboard entry or memory recall operation follows **R+**, unless that entry follows **ENTER+** or **CLX**.

The $x \ge y$ key exchanges x and y as shown below.

Press	Contents Register	
	t► T	
N.P.N	z≻ Z	
A 42	y 🔶 Y	
	x X	

You will often find that x and y should be exchanged before -, \div , and yx operations.

Example: Find 2⁹.

Press	See	Remarks
9	9.	
ENTER+	9.00	
2	2.	x and y are in wrong order.
x;y	9.00	x and y are in right order.
у×.	512.00	

Table 4 provides a summary of all stack operations in capsulized form.

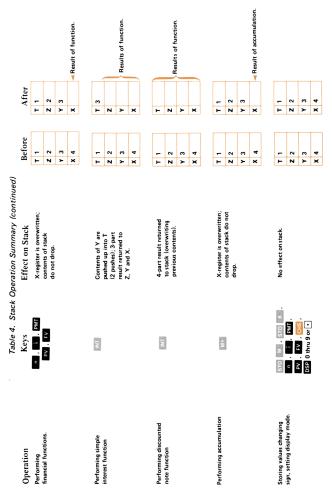


		F									
		z						12.	12.		
		٢		з.	З.		12.	5.	5.	12.	
		X (Display)	з.	3.00	4.	12.00	5.	5.00	6.	30.00 42.00	42.00
Note: 💼 =	ENTER +	Press	e		4	×	2		9	×	÷
3 is in X (display).	lisplay).		4	+	+	+	+	+	+	+	+
3 is duplic	3 is duplicated into Y.										
4 is in X (display).	lisplay).										
Product (1	Product (12.) is formed in Y then drops into X.	into X.									
Automatic	: evrer pushes 12 into Y when 5 is keyed in; display shows 5.	when 5 is keyed	in; dis	splay s	shows	5					
ENTER +	pushes 12 into Z , duplicates 5 into Y , and leaves X unchanged.	5 into Y, and le	aves)	(nncl	Jange	т		7			<u></u>
6 in displa	6 in display overwrites 5 in X since it immediately follows	mediately follo		ENTER +							
Product (3	Product (30) is formed in Y, then 12 drops into Y, 30 drops into X.	ops into Y, 30 dr	ops in	to X.							
Sum (42) i	Sum (42) is formed in Y, then drops into X.	×.									7

						Overwritten							< New value keyed in.				< New value keyed in.				
After	1	z 2	۲ 3	0 ×	0	z 0	۲ 0	0 X		-	Z 2	۲ 3		2	e	4		2	Z 3	Y 4	X 4
	-	N	-	~	+	N	>	×		-	N	>	×	+	N	7	×	-	N	~	*
Before	-	z 2	Υ3	X 4	-	z 2	Υ 3	X 4		-	z 2	γ 3	X 4	1	z 2	۲ 3	X 4	1	Z 2	۲ 3	X 4
Table 4. Stack Operation Summary Effect on Stack	X-register is overwritten	with zero; contents of stack are not pushed up.			Contents of stack overwritten with zeros.					X-register is overwritten;	contents of stack are not pushed up.			Contents of stack pushed up.				Copies value in	X-register into Y- register⊵ contents	of stack are pushed up.	
7 Keys	CLX				CLR					CLX , any number	0 W .			any number				ENTER+			
Operation	Clearing display				Clearing stack					Keying in value following CLX ,	ENTER+ STO K STO	PV (if stored as input	parameters), M+	Keying in value following	any other operation (other than those above)			Loading stack manually			

t T are copied tents of stack z 2 2 2 2 2 1 y 3 y 2 ▲ X 4 X ▲ Keult of function	steck 7 1 7 4 7 2 2 7 1 7 4 7 2 1 7 4 X 3 X 3 X 3 X 3 X 3 X 3 X 3 X 3	X anged. Y 3 Y 4 X 4 X 3	Effect on Stack Before After
4		ation. T 1 a contact down action to of stack to the contact of stack to the context of stack to the co	1 1 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 2 2 3 2 1 1 1 1 2 2 3 3 3 3
	et Nak T		
	Performing basic functions	Rolling down Performing basic	E schanging operands Rolling down Performing basic functions

Operational Stack 85



Solution Method Model

The flowchart in figure 5 represents an algorithm—that is, a series of repetitive procedures for solving a problem. Further, this algorithm is a model of how you go about solving mathematical equations (mathematicians refer to this as "evaluating an express") with calculators having operational stacks and reverse Polish notation. Although the algorithm implies an operational stack of unlimited length, most practical problems would not exceed the capacity of the four-register stack provided in your HP-70.

Before using the algorithm, write your expression in serial form to make it easier to follow in the example. All expressions can be written in serial form. For example,

$$\frac{(2 \times 6) + (4 \times 5)}{4}$$

becomes

$$[(2 \times 6) + (4 \times 5)]/4.$$

According to our algorithm the solution can be obtained for any expression by entering the numbers from left to right as they appear. Use the algorithm to calculate the above expression.

88 Operational Stack

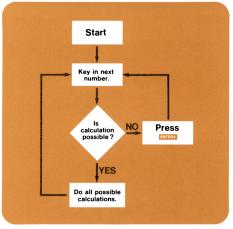


Figure 5. HP-70 Solution Method



This could also be entered as follows:



The idea is that you can key in the problem in whatever order is convenient to you. Among the obvious advantages of the four-register stack and reverse Polish notation are:

- 1. Numbers can be keyed in in the same order as written.
- 2. All intermediate results are displayed.
- 3. It's not necessary to write down or store intermediate results.
- 4. One technique is used for all calculations.
- 5. It's not necessary to clear the calculator between calculations.*

Appendix C

Formulas for Financial Problems

Unless otherwise stated:

n = number of time periods

- i = periodic interest rate expressed, for convenience in the following equations, as a decimal value
- PMT = periodic payment
 - PV = present value or principal
 - FV = future value
 - I = interest amount

Accumulated Interest/Remaining Balance

• Remaining balance after payment H:

$$BAL_{H} = PMT\left[\frac{1 - (1 + i)^{H - n}}{i}\right]$$

where n is the total number of periods required to fully amortize the loan.

• Amount of a loan amortized from payments J through K inclusive:

 $AMORT_{J through K} = BAL_{J-1} - BAL_{K}$

Amount paid to interest by payments J through K inclusive:

 $I_{J \text{ through } K} = (K - J - 1) PMT - (BAL_{J-1} - BAL_K)$

Add-On Interest Rate Loans

r = add-on rate as a decimal value

N = number of monthly payments

APR = 1200i

where i is the solution in the following equation:

$$\frac{\left(\frac{N}{12} \times PV \times r\right) + PV}{N} = \frac{i}{1 - (1 + i)^{-n}}$$
91

Compound Amount

$$FV = PV (1 + i)^n$$

Depreciation

L = assets' useful life expectancy

SBV = starting book value

SAL = salvage value

 DEP_{K} = depreciation for year K

 RBV_{K} = remaining book value at the end of year K

 RDV_{K} = remaining depreciable value at the end of year K

Straight-Line Depreciation

$$DEP_{K} = \frac{SBV - SAL}{L}$$

 $RDV_{K} = RDV_{K-1} - DEP_{K}$

Sum-of-the-Years'-Digits Depreciation

$$\text{DEP}_{K} = \frac{2(L - K + 1)}{L(L + 1)} (\text{SBV} - \text{SAL})$$

 $RDV_{K} = RDV_{K-1} - DEP_{K}$

• Declining Balance Depreciation

F = declining balance factor $DEP_{K} = RBV_{K-1} \times \frac{F}{L}$ $RBV_{K} = RBV_{K-1} - DEP_{K}$

Direct Reduction Loan (Ordinary Annuity) $PV = PMT \left[\frac{1 - (1 + i)^{-n}}{i} \right]$

Extracting Roots

$$x\sqrt{y} = y^{\frac{1}{x}}$$

Percentage

$$Percentage = \frac{Base \times Rate}{100}$$

Percent Difference =
$$\Delta\% = \left[\frac{\text{New Amount} - \text{Base}}{\text{Base}}\right] \times 100$$

Raising Numbers to Powers

$$y^x = e^{x \ln y}$$

where ln is the natural log and e is 2.718281828.

Rebate — Rule of 78's

FC = total Finance Change

n = total number of monthly payments

Rebate_K =
$$\frac{(n - K + 1)(n - K)/2}{(n + 1)n/2}$$
 FV

Rents, Leases (Annuity Due)

$$PV = PMT\left[\frac{1 - (1 + i)^{-n}}{i}\right](1 + i)^{n}$$

Savings (Annuity Due)

$$FV = PMT\left[\frac{(1+i)^n - 1}{1}\right](1+i)^n$$

Simple Interest

n = total number of days

- i = decimal interest rate on annual basis
- D = discount amount

Yield = decimal interest rate for discounted note

• Accrued Interest for Notes

$$I_{360} = \frac{n}{360} \times PV \times i$$

$$I_{365} = I_{360} \times \frac{360}{365}$$

Discounted Notes

$$D_{360} = \frac{n}{360} \times FV \times i$$
 $D_{365} = D_{360} \times \frac{360}{365}$

$$\text{Yield}_{360} = \frac{D_{360} \times 36000}{n (\text{FV} - \text{D}_{360})} \qquad \text{Yield}_{365} = \frac{D_{365} \times 36500}{n (\text{FV} - \text{D}_{365})}$$

Sinking Fund (Ordinary Annuity)

$$FV = PMT\left[\frac{(1+i)^n - 1}{i}\right]$$

Appendix D

Battery Operation

Use only the HP 82001A Rechargeable Battery Pack, which has been tested and is warranted for one year. The battery provides 3 to 5 hours of continuous operation. By turning off the power when the calculator is not in use, the HP-70 battery power will last easily throughout a normal working day. Battery power can be further lengthened by setting the display to zero decimal places (press OSP O) for calculations, and extending the display only when needed for results.

All decimal points light in the display when 2 to 5 minutes of operation time remain in the battery pack. Even when all decimal points are turned on, the true decimal position is known because an entire digit position is allocated to it.

Example:



Operating the calculator for more than 2 to 5 minutes after this low power indication first occurs may result in calculation errors. The battery pack must be recharged by connecting the HP-70 to the HP 82002A Battery Charger.

Recharging Procedure and AC Line Operation

Caution: To prevent damage to the calculator, the position of the line voltage select switch on the battery charger must be set to the proper line voltage.

- 1. Turn the HP-70 power switch to OFF.
- 2. Insert battery charger plug into the rear connector of the HP-70 and insert power plug of battery charger into an ac power outlet. The HP-70 will not operate when connected to the recharger unless the recharger is connected to a live power outlet.
- 3. Slide the power switch to ON, see that 0.00 is displayed.

96 Battery Operation

- Slide power switch to OFF if you don't want to use the calculator while it is charging. (The calculator can be operated on ac power during the charging cycle if desired.)
- 5. At the end of the charging period, you may continue using your HP-70 with ac power.
- For battery operation, slide the power switch to OFF, disconnect the battery charger from both the power receptacle and the HP-70.

The calculator may be operated continuously on ac power with or without the battery pack. There is no danger of overcharging the battery. For convenience, overnight charging is recommended; after 14 hours, a completely discharged battery will be fully charged. Shorter charge periods will cause reduced battery operating time.

If the calculator is used with the recharger for a week or more at a time, it is best to remove the battery pack during these intervals. Otherwise, temporary degradation-peculiar to nickel-cadmium batteries-may cause a decrease in the operating period of the battery pack. Should this happen turn the HP-70 on for at least 5 hours to discharge the batteries completely. Then put it on charge for at least 14 hours. This should correct the temporary degradation.

Note: It is normal for the battery charger to be warm to the touch when in use.

If the battery pack won't hold a charge, it may be defective. If the warranty is in effect, return the pack to Hewlett-Packard according to the instructions on page 101. If the battery pack is out of warranty, use the Accessory Order Card provided with you HP-70, to order a new battery pack. Remember, you can use your HP-70 on ac power until the replacement battery pack arrives.

Battery Pack Replacement

- 1. Set power switch to OFF and disconnect the battery charger.
- 2. Slide the two battery door latches (the top feet) toward middle of the calculator.

3. Let the battery door and battery pack fall into palm of the hand.





 See if the battery connector springs on the calculator have been inadvertently flattened inward. If so, bend them out and try the battery again.

5. Insert the battery pack so that its contacts face the calculator and contact is made with the battery connectors.





6. Insert the bottom of the battery door behind the retaining groove and close the door.

 Close the battery door by pressing it gently while sliding the two battery door latches outward.



Note: If you use your HP-70 extensively in field work or during travel, you may want to order the HP 82004A Reserve Power Pack, consisting of battery holder and spare battery pack. This enables you to charge one pack while using the other.

Warning: Do not try to burn old batteries. They may EXPLODE!

Appendix E

Service and Warranty

Servicing

Low Power

All decimal points light to warn you that you have 2 to 5 minutes of operating time left. You must then either:

- Operate from ac power.
- Charge the battery pack.
- Insert a fully charged battery pack.

Blank Display

If the display blanks out, turn the HP-70 off, then on. If 0.00 does not appear on the display, check the following:

- 1. If battery charger is attached to HP-70, make sure it is plugged into an ac outlet.
- 2. Examine battery pack to see if it is discharged or is not making contact.
- 3. If display is still blank, try operating the HP-70 from the ac line.
- If, after step 3, display is still blank, the HP-70 is defective. (Refer to Warranty paragraphs.)

Common Problems

If a top row key calculation starts executing while you are still keying in input values, you probably forgot to press **CLR** to clear the preceding parameter set. You will have to press **CLR** and key in all the new input values before continuing.

If you perform a calculation and the result is displayed as zero, it's probably because the magnitude of the result is too small for the display mode selected. For example, if you calculate 1/400 in DSP (2), the result is displayed as 0.00. But if you change the display mode to include more decimal places-say DSP (4)—the result is displayed as 0.0025.

Shipping List

The list below shows standard accessories included with the HP-70. All items were checked at our factory prior to shipment. Please notify Advanced Products Customer Service of any irregularities by returning a copy of the packing slip with your comments, or by telephoning (408) 996-0100. If outside the U.S., please contact the Hewlett-Packard Sales and Service Office nearest you.

Item	Model Part No.
Battery Pack	82001A
Battery Charger (115/230 Vac)	82002A
Zipper Carrying Case	82012A
HP-70 Owner's Handbook	00070-90001

Warranty

In-Warranty

The HP-70 is warranted against defect in materials and workmanship for one (1) year from date of delivery. During the warranty period, Hewlett-Packard will repair or, at its option, replace components that prove to be defective when the calculator is returned, shipping prepaid, to a Hewlett-Packard Customer Service Facility (refer to Shipping Instructions).

This warranty does not apply if the calculator has been damaged by accident, or misuse, or as a result of service or modification by other than an authorized Hewlett-Packard Customer Service Facility. No other warranty is expressed or implied. Hewlett-Packard is not liable for consequential damage.

Out-of-Warranty

Beyond the one (1) year warranty period, calculators will be repaired for a moderate charge. *All* repair work performed beyond the warranty period is warranted for a ninety (90) day period.

Obligation to Make Changes

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

Shipping Instructions

Whether the unit is in warranty or out of warranty, it is the customer's responsibility to pay charges for shipping to the applicable service facility listed on the *Service Card*. During warranty, the service facility will, in turn, ship the unit back to the customer prepaid, via the fastest economical means.

On out-of-warranty repairs, the customer will pay shipping charges both ways. The service facility will ship units back to the customer C.O.D., unless the customer contacts them in advance and prepays the shipping and repair charges.

Malfunctions traced to the calculator or battery charger require that you return the following to us:

- Calculator with all standard accessories.
- Completed Service Card.

If a battery pack is defective and within warranty, return the following to us:

- Defective battery pack only.
- Completed Service Card.

Send returned items safely packaged to the address shown on the Service Card

Under normal conditions, calculators will be repaired and reshipped within five (5) days of receipt at any Hewlett-Packard Service Facility listed on the *Service Card*.

Should other problems or questions arise regarding service, please call the applicable service telephone number on the *Service Card*, or call Advanced Products Division, Customer Service, at (408) 996-0100.

Appendix F

Accessories

Standard and optional accessories for the HP-70 can be ordered by completing and mailing the *Accessory Order Card* provided. We will send you additional order cards as new optional accessories are added to our product line.

Standard Accessories	Model/Part No.
Battery Pack	82001A
Battery Charger (115/230 Vac)	82002A*
Zipper Carrying Case	82012A
Owner's Handbook	00070-90001
Optional Accessories	Model No.
Reserve Power Pack	82004A
Security Cradle and Cable	82007A
Hard Field Case	82006A

^{*}If outside the U.S. you may require a different version of the battery charger. Please contact the nearest Hewlett-Packard Sales Office for the appropriate model number.

Applications Directory

This directory is your alphabetic guide to the applications casebook. Headings in the applications casebook are shown below in dark type. Financial calculation formulas associated with these applications may be found in appendix C.

Accrued Interest-360-Day Basis, 42 Accrued Interest-365-Day Basis, 43 Accumulated Interest Paid for Loan see Accumulated Interest with Remaining Balance (Ordinary Annuity), 54 Accumulated Interest Paid for Ordinary Annuity see Accumulated Interest with Remaining Balance (Ordinary Annuity), 54 Accumulated Interest Paid for Simple Mortgage see Accumulated Interest with Remaining Balance (Ordinary Annuity), 54 Accumulated Interest with Remaining Balance (Ordinary Annuity), 54 Add-on Interest-to-APR Conversion: Finding Monthly Payment, 61 Add-on Interest Conversion see APR-to-Add-on Interest Conversion. 62 Amortization Schedule (Ordinary Annuity), 53 Annual Percentage Rate Conversion see Add-on Interest-to-APR Conversion: Finding Monthly Payment, 61 Annual Rate of Return for Discounted Mortgage (Simple) see also Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Annual Rate of Return for Investment with Even Payment Stream, 7; see also Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Annual Rate of Return for Investment with Uneven Payment Stream, Basis for see Discounted Cash Flow Analysis, 72 Annual Rate of Return for Leases and Rents (Without Residual) see Interest Rate for Payments in Advance (Annuity Due), 67 Annual Rate of Return for Lump Sum Investment, 33, 36; see also Rate of Interest for Compounded Amount, 47 Annual Rate to Effective Annual Rate Conversion see Nominal Rate Converted to Effective Annual Rate, 49

106 Applications Directory

Annual Yield for Investment with Uneven Payment Stream, Basis for see Discounted Cash Flow Analysis, 72 Annual Yield for Discounted Mortgage (Simple) see Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Annual Yield for Discounted Notes see Discounted Notes, 44 Annual Yield for Investment with Even Payment Stream, 7; see also Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51: Rate of Interest for Sinking Fund (Ordinary Annuity), 59; Rate of Interest for Savings Calculation (Annuity Due), 64 Annual Yield for Leases and Rents (Without Residual) see Interest Rate for Payments in Advance (Annuity Due), 67 Annual Yield for Lump Sum Investment, 33, 36; see also Rate of Interest for Compounded Amount, 47 Annual Yield for Savings see Rate of Interest for Savings Calculation (Annuity Due), 64 Annuity Due Calculations see Savings Calculations, 63; Leases and Rents (Payments in Advance), 66 Anticipation Discounts see Cash Discounts. 75 Appreciation Rate see Rate of Interest for Compounded Amount, 47 APR-to-Add-on Interest Conversion, 62 Balance Due on Prepaid Consumer Loan see Rule-of-78 Rebate, 63 **Balloon Payment Calculation** see Payment Amount for Mortgage with Balloon Payment (Ordinary Annuity), 57 Cash Discounts, 75 Cash Flow Analysis, Uneven Cash Flows see Discounted Cash Flow Analysis, Net Present Value, 72 Chain Discounts see Cost and Price (Markup, Chain Discounts), 74 Common Logarithms, 41 **Compound** Interest see Compounded Amounts (Compound Interest), 45 **Compounded Amount and Interest Earned**, 48 **Compounded Amounts (Compound Interest)**, 45

Consumer Finance, 61 Cost and Price (Markup, Chain Discounts), 74 Cube Root. 27 Dealer Discount Ratio see Cost and Price (Markup, Chain Discounts), 74 **Declining Balance Depreciation**, 70 Denominate Number Conversion, 76 Deposit Amount for Savings see Payment Amount Required for Some Future Value-Savings Calculation (Annuity Due), 65 Depreciation, 69 Direct Reduction Loans, 50 Discount Amount see Discounted Notes, 44 **Discounted Cash Flow Analysis-Net Present Value**, 72 **Discounted Notes**, 44 Effective Annual Rate Conversion see Nominal Rate Converted to Effective Annual Rate, 49 Effective Annual Rate Converted to Nominal Rate, 50 Exponentiation see Powers of Numbers-Exponentiation, 26 Foreign-to-U.S. Currency Conversion, 77 Future Value of Compounded Amount, 45 Future Value of Lump Sum Investment, 36, 38, 39; see also Future Value of Compounded Amount, 45 Future Value of a Series of Deposits (Annuity Due), 65 Future Value of a Series of Payments see Future Value of a Series of Deposits (Annuity Due), 65 Future Value of Sinking Fund (Ordinary Annuity), 58 Future Worth of Compounded Amount see Future Value of Compounded Amount, 45 Future Worth of Lump Sum Investment, 36, 38, 39; see also Future Value of Compounded Amount, 45 Future Worth of Sinking Fund see Future Value of Sinking Fund (Ordinary Annuity), 58 Future Worth of a Series of Payments see Future Value of a Series of Deposits (Annuity Due), 65 Interest Amount on Lump Sum Investment, 39; see also Compounded Amount and Interest Earned, 48 Interest Earned on Lump Sum Investment see Compounded Amount and Interest Earned, 48

Interest Rate for Compounded Amount, 36: see also Rate of Interest for Compounded Amount, 47 Interest Rate for Leases and Rents (Without Residual) see Interest Rate for Payments in Advance (Annuity Due), 67 Interest Rate for Loan see Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Interest Rate for Lump Sum, 36; see also Rate of Interest for Compounded Amount, 47 Interest Rate for Simple Mortgage see Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Interest Rate for Payments in Advance (Annuity Due), 67 Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Interest Rate for Savings see Rate of Interest for Savings Calculation (Annuity Due), 64 Interest Rate for Sinking Fund see Rate of Interest for Sinking Fund (Ordinary Annuity), 59 Internal Rate of Return for Investment with Even Payment Stream, 7; see also Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Internal Rate of Return for Investment with Uneven Payment Stream, Basis for see Discounted Cash Flow Analysis, 72 Internal Rate of Return for Leases and Rents (Without Residual) see Interest Rate for Payments in Advance (Annuity Due), 67 Internal Rate of Return for Lump Sum Investment, 33: see also Rate of Interest for Compounded Amount, 47 Lease Payment Amount see Periodic Payment Amount for Payments in Advance (Annuity Due), 68 Leases and Rents (Payments in Advance), 66 Loan Amortization Schedule see Amortization Schedule (Ordinary Annuity), 53 Loan Amount (Present Value of Ordinary Annuity), 52 Loan Payment Amount see Periodic Payment Amount (Ordinary Annuity), 50; Payment Amount for Mortgage with Balloon Payment (Ordinary Annuity), 57 Lump Sum Calculations see Compounded Amounts (Compounded Interest), 45

Markup see Cost and Price (Markup, Chain Discounts), 74 Merchandising, Purchasing, 74 Mortgage Amortization Schedule (Simple Mortgage) see Amortization Schedule (Ordinary Annuity), 53 Mortgage Amount (Simple) see Loan Amount (Present Value of Ordinary Annuity), 52 Mortgage Amount, Discounted see Loan Amount (Present Value of Ordinary Annuity), 52 Mortgage Payment Amount see Periodic Payment Amount (Ordinary Annuity), 50; Payment Amount for Mortgage with Balloon Payment (Ordinary Annuity), 57 Net Amount see Percentage and Net Amount, 24 Net Present Value of Future Cash Flows see Discounted Cash Flow Analysis-Net Present Value, 72 Nominal Rate Conversion see Effective Annual Rate Converted to Nominal Rate, 50 Nominal Rate Converted to Effective Annual Rate, 49 Number of Deposits for Savings see Number of Time Periods for Savings Calculation (Annuity Due), 63; Number of Time Periods for Sinking Fund (Ordinary Annuity), 60 Number of Payments for Ordinary Annuity see Number of Periods Required to Amortize Loan (Ordinary Annuity), 52 Number of Payments in Advance (Annuity Due), 66 Number of Periods for Compounded Amount, 48 Number of Periods for Leases and Rents (Without Residual) see Number of Payments in Advance (Annuity Due), 66 Number of Periods for Loan see Number of Periods Required to Amortize Loan (Ordinary Annuity), 52 Number of Periods for Lump Sum Investment see Number of Periods for Compounded Amount, 48 Number of Periods for Mortgage (Simple) see Number of Periods Required to Amortize Loan (Ordinary Annuity), 52 Number of Periods for Payments in Advance see Number of Payments in Advance (Annuity Due), 66 Number of Periods Required to Amortize Loan (Ordinary Annuity), 52

Number of Periods for Sinking Fund (Ordinary Annuity), 60 Number of Time Periods for Savings Calculation (Annuity Due), 63 Ordinary Annuity Amortization Schedule see Amortization Schedule (Ordinary Annuity), 53 Ordinary Annuity Calculations see Direct Reduction Loans. 50: Sinking Funds, 58 Ordinary Annuity Payment see Periodic Payment Amount (Ordinary Annuity), 50; Payment Amount for Sinking Fund (Ordinary Annuity), 59 Payment Amount for Leases and Rents (Without Residual) see Periodic Payment Amount for Payments in Advance (Annuity Due), 68 Payment Amount for Loan with Balloon Payment see Payment Amount for Mortgage with Balloon Payment (Ordinary Annuity), 57 Payment Amount for Mortgage with Balloon Payment (Ordinary Annuity), 57 Payment Amount (Annuity Due), Periodic see Payment Amount Required for Some Future Value-Savings Calculation (Annuity Due), 65 Payment Amount (Ordinary Annuity), Periodic, 39 see also Add-on-Interest-to-APR Conversion, Finding Monthly Payment, 61; Periodic Payment Amount (Ordinary Annuity), 50; Payment Amount for Sinking Fund (Ordinary Annuity), 59 Payment Amount Required for Some Future Value-Savings Calculation (Annuity Due), 65 Payment Amount for Sinking Fund (Ordinary Annuity), 59 Payments in Advance Calculations see Savings Calculations, 63; Leases and Rents (Payments in Advance), 66 Payments in Arrears Calculations see Direct Reduction Loans. 50: Sinking Funds, 58 Percent Difference Between Two Numbers, 25 Percent Increase/Decrease see Percent Difference Between Two Numbers, 25 Percentage Amount and Net Amount, 24 Percentage Problems, 24

Periodic Payment Amount see Add-on Interest-to-APR Conversion; Finding Monthly Payment, 61; Payment Amount Required for Some Future Value-Savings Calculation (Annuity Due), 65 Periodic Payment Amount for Leases and Rents (Without Residual) see Periodic Payment Amount for Payments in Advance (Annuity Due). 68 Periodic Payment Amount (Ordinary Annuity), 39, 50; see also Payment Amount for Mortgage with Balloon Payment (Ordinary Annuity), 57; Payment Amount for Sinking Fund (Ordinary Annuity), 59 Periodic Payment Amount for Payments in Advance (Annuity Due), 68 Powers of Numbers-Exponentiation, 26 Present Value of Compounded Amount, 46 Present Value of Future Cash Flows see Discounted Cash Flow Analysis-Net Present Value, 72 Present Value of Investment with Even Payment Stream see Remaining Balance Only (Ordinary Annuity), 56; Present Value of Payments in Advance (Annuity Due), 68 Present Value of Investment with Uneven Payment Stream see Discounted Cash Flow Analysis-Net Present Value, 72 Present Value of Lease and Rental Payments (Without Residual) see Present Value of Payments in Advance (Annuity Due), 68 Present Value of Loan see Loan Amount (Present Value of Ordinary Annuity), 52 Present Value of Lump Sum Investment see Present Value of Compounded Amount, 46 Present Value of Mortgage (Simple) see Loan Amount (Present Value of Ordinary Annuity), 52 Present Value of Ordinary Annuity see Loan Amount (Present Value of Ordinary Annuity), 52 Present Value of Payments in Advance (Annuity Due), 68 Price of Mortgage (Simple) see Loan Amount-Present Value of Ordinary Annuity), 52 Price of Discounted Mortgage (Simple) see Loan Amount-Present Value of Ordinary Annuity), 52 Pricing see Cost and Price (Markup, Chain Discounts), 74 Principal Amount of Loan see Loan Amount (Present Value of Ordinary Annuity), 52

Principal Amount of Lump Sum Investment see Present Value of Compounded Amount, 46 Principal Amount of Mortgage (Simple) see Loan Amount (Present Value of Ordinary Annuity), 52 Principal Amount of Ordinary Annuity see Loan Amount (Present Value of Ordinary Annuity), 52 **Proportion of Numbers**, 25 Purchasing see Merchandising, Purchasing, 74 Rate of Appreciation see Rate of Interest for Compounded Amount, 47 Rate of Interest for Compounded Amount, 36, 47 Rate of Interest for Leases and Rents (Without Residual) see Interest Rate for Payments in Advance (Annuity Due), 67 Rate of Interest for Loans see Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Rate of Interest for Lump Sum, 33, 36; see also Rate of Interest for Compounded Amount, 47 Rate of Interest on Simple Mortgage see Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Rate of Interest for Savings Calculation (Annuity Due), 64 Rate of Interest for Sinking Fund (Ordinary Annuity), 59 Rate of Return for Investment with Uneven Payment Stream. Basis for see Discounted Cash Flow Analysis, 72 Rate of Return for Discounted Mortgage (Simple) see Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Rate of Return for Investment with Even Payment Stream, 7; see also Interest Rate per Period, Annual Interest Rate (Ordinary Annuity), 51 Rate of Return for Leases and Rents (Without Residual) see Interest Rate for Payments in Advance (Annuity Due), 67 Rate of Return for Lump Sum Investment, 33, 36; see also Rate of Interest for Compounded Amount, 47 Rate of Return for Savings see Rate of Interest for Savings Calculation (Annuity Due), 64 Rebates see Rule-of-78 Rebate, 63 Reciprocals, 27

Remaining Balance of Loan see Accumulated Interest with Remaining Balance (Ordinary Annuity), 54; Remaining Balance Only (Ordinary Annuity), 56 Remaining Balance on Prepaid Consumer Loan see Rule-of-78 Rebate, 63 Remaining Balance for Ordinary Annuity see Accumulated Interest with Remaining Balance (Ordinary Annuity), 54; Remaining Balance Only (Ordinary Annuity), 56 Remaining Balance for Simple Mortgage see Accumulated Interest with Remaining Balance (Ordinary Annuity), 54; Remaining Balance Only (Ordinary Annuity), 56 Remaining Balance Only (Ordinary Annuity), 56 Remaining Book Value see Declining Balance Depreciation. 70 Remaining Depreciable Amount/Value see Straight-line Depreciation Schedule, 69; Sum-of-the-years'-Digits Depreciation, 71 Rental Payment Amount see Periodic Payment Amount for Payments in Advance (Annuity Due), 68 Roots of Numbers, 27 Rule-of-78 Rebate, 63 **Running Totals and Subtotals**, 30 Savings Calculations, 63 Simple Interest Amount, 42 Simple Interest Amount-360-Day Basis see Accrued Interest-360-Day Basis, 42 Simple Interest Amount-365-Day Basis see Accrued Interest-365-Day Basis, 43 Sinking Funds, 58 Square Root, 27 Straight-Line Depreciation Schedule, 69 Sum-of-the-Years'-Digits Depreciation, 71

Term of Investment with Even Payment Stream, 40: see also Number of Periods Required to Amortize Loan (Ordinary Annuity), 52; Number of Periods for Sinking Fund (Ordinary Annuity), 60; Number of Time Periods for Savings Calculation (Annuity Due), 63 Term for Leases and Rents (Without Residual) see Number of Payments in Advance (Annuity Due), 66 Term for Loan with Even Payment Stream see Number of Periods Required to Amortize Loan (Ordinary Annuity), 52 Term of Lump Sum Investment see Number of Periods for Compounded Amount, 48 Term of Sinking Fund, 40; see also Number of Periods for Sinking Fund (Ordinary Annuity), 60 Trade Discounts see Cost and Price (Markup, Chain Discounts), 74 U.S.-to-Foreign Currency Conversion, 76 Yield see Annual Yield

General Index

Note: For your convenience, applications have been indexed separately in the Applications Directory immediately preceding this index.

ac line operation, 95 Accessories, 103 Accrued interest for notes, formula for, 94 Accumulated interest and remaining balance, formula for, 91 Accumulation. 29 Accumulation, two-dimensional (see *Two-total Accumulation*) Addition. 14 Add-on interest. 61 Add-on interest rate, formula for, 91 Adjusted final payment amount, 38 Algorithm, 87 Annual depreciation, straight-line depreciation method, 70 Annual interest rate, 37 Annual percentage rate (APR), 61 Annuity due problems, 37 Applications directory, 105 Arithmetic: chained, 16; combined, 16; mixed, 19; serial, 16; simple, 14 Balloon payment problems, 37 Battery: conservation of, 95; duration of power, 95; operations, 10, 95; Battery pack replacement, 96 Blank display, 99 Blinking display, 10, 80 Book value, 69, 70 Calculating range, 79 Calculation errors, 95 Capital budgeting, 72 Cash flow schedule, 72 Chained calculations, 16

Changing input/output values in financial functions, 39

Changing sign, 20, 29

Clearing: calculator, 14; display, 13, 14; financial functions, 14, 41, 42, 99; memory registers, general purpose, 14, 28, 37; stack, 14

Common logarithms, 41

Common problems, **99** Compound amount, formula for, **92**

Compound interest: formula for, 41; keys, 34

116 General Index

Compounding period calculations, **36**, Consequential damage, Constants, **27**, **29**, **34**, **37**, Conversion constant in K-register, Converting percents to decimal equivalents, Cost of capital, Counter, setting of, Cube root,

Daily compounding, 47 Data storage (see Storing and Recalling Numbers) Dealer discount rate, 74 Dealer discount ratio, 74 Declining balance depreciation, formula for, 92 Defective battery pack, 96 Decimal point entry and display, 12 Declining factor, 71 Default value in K-register, 29, 37, 42 Depreciable value, 69 Depreciation: allowance, 72; multiplier, declining balance method, 70 Direct reduction loan, formula for, 92 Discount rate, 44, 72 Discounted note, formula for, 94 Discounted notes, 41, 44 Display: blank, 99; blinking, 10, 80; description of, 12; modes, 20; rounding, 20 Display characters, 20 Display format, overflow, 80 Division. 15 Double declining balance depreciation, 70

e, **93**

Entering numbers, 12 Equals key, 16 Errors: correction of, 13, 23; in financial functions, 41; range, 79; signal, 80 Execution time, 79 Exponents, 20, 80 Exponentiation, 20 Exponentiation, 26 Extended applications, 42 Extracting roots, 27 Face value of discounted note, 44 Finance charge, 63 Financial function: keys, 34; registers, 38 Financial functions: changing input values of, 39; changing output values of, 39; compounding period conversions in, 36; description of, 33; formatting, 34; payment calculations in, 37; recalling and displaying input values in, 38 Financial problem formulas, 91 Fixed decimal notation, 21 Flashing display, 26 Formatting financial functions, 34 Formulas for financial problems, 91 Fundamental operations, 10 General purpose memory: operations, 82; registers, 37 Improper operations, 10, 80 Input: parameters, 35, 39, 41, 42, 46, 79; values in financial functions, 38, 39, 41, 79, 80 Interest compounding process, 34 Interest rate limitation, 79 Interest rate per period, 37 Keyboard, 10, 11 Kevboard summary, 120 Keying in numbers, 12 K-register, 29, 37, 42 Loading stack, 82 Line voltage select switch, 95 Logarithms, 41 Low battery indicator, 95 Low power, 99 Mathematical expressions, 87 Memory: locations, 81; registers, general purpose, 14 Mixed calculations, 19 M-register, 28 Multiplication, 15

Natural log, **93** Negative accumulation, **29** Negative numbers, **20** Net amount in accrued interest problem, 42 Notes, discounted, 41, 44 Numbers: entering, 12; keying in, 12; negative, 20; powers of, 26 Obligation to make changes, 101 Operating characteristics, 79 Operational stack: description of, 10; manipulation of, 82; operation of, 12-20, 22-29, 31, 32, 38, 42, 44, 81-89; solution method model, 87; summary of operations, 84; theory of, 81 Operations: fundamental, 10; improper, 80 Optional accessories, 103 Ordinary annuity problems, 37 Output: parameters, 35, 39, 41; values in financial functions, 39, 41 Overflow, 79, 80 Parameters: description of, 34; set of, 35 Payment amount, rounding or truncating, 38 Payment: calculations, 37: periods, 36 Percent difference, formula for, 93 Percentage, formula for, 93 Percentage problems, 24 Periodic payments, 36 Periods, 36 Positive/negative power, 26 Power: degradation, 96; low, 99; outlet, 95 Powers: negative numbers, 26; numbers, 22, 26 Preprogrammed functions, 34, 42 Products of sums, 19 Profit margin, 74 Raising numbers to powers, formula for, 93 Range: calculating, 79; temperature, 80 Range errors, 79, 80 Rebate-rule-of-78, formula for, 93 Recalling: accumulated sums, 30; numbers from memory, 27 Recalling and displaying input values in financial functions, 38 Recharging procedure, 95 Reciprocals, 27 Registers, operational stack, 81 Rents, leases, formula for, 93 Repositioning numbers, 22

Retail pricing, 74 Reverse Polish notation, 81, 87 Reversing operand order, 23 Reviewing/verifying numbers entered, 22 Root extraction, formula for, 93 Roots. 27 Rounding display, 20 Roundoff error, 79 Running totals (see Accumulation) Salvage value, 69, 70, 71 Savings calculation, formula for, 93 Scientific notation, 22, 80 Serial calculations, 16 Servicing. 99 Shipping instructions, 101 Shipping list, 100 Sign, changing of, 20 Simple interest: amount, 41, 42; key, 34 Sinking fund, formula for, 94 Square root, 27 Stack, operational (see *Operational Stack*) Standard accessories, 100 Stated annual interest rate, 49 Storing: input parameters, 38; numbers, 27 Straight-line depreciation, formula for, 92 Subtraction, 14 Sum of products, 17 Sum-of-the-years'-digits depreciation, formula for, 92 Temperature range, 80 Terms, 25 Time and money calculations, 33 Time periods, 36 Top row keys, 34 Truth in lending law, 61 Two-total accumulation, 30 Underflow, 79 Unit conversions, 76 Variables, 34 Warranty, 100 Working storage area, 10 Zero display error, 99

Keyboard Summary and Index

Keys are listed in alphabetical order; symbols are listed following the alphabetic listing. Page numbers indicate where key usage is described.

Key	Function/Operation	Page
CHS	Change sign	20, 26, 29
CLR	Clear operational stack; n, i, PMT, PV, FV registers 13, 14, 33, 35, 37, 38, 40,	11 12 00
CLX	Clear X-register (display) $\dots \dots \dots$	
	Display mode selectory (with $0 - 9$ or $\mathbf{\bullet}$),	57, 80, 82
DSP	Recall values from n, i, PMT, PV, FV 21,	22, 38, 99
ENTER+	Copy x into Y-register . 10, 12, 13, 17, 19, 23, 24, 25, 26,	27 81 82
FV	Future value	, ,
i	Interest rate/period	
	Simple interest amount	
INT	1	
K	Recall value in K-register (initially set to 12) .	
М	Recall value in M-register	28, 29, 30
M+	Accumulate in M-register (use CHS M+ for minus)	29,30
n	Number of periods 33, 34, 35, 36, 37, 38,	
PMT	Payment amount	
PV	Present value	38, 41, 79
R+	Roll down stack	22, 23, 82
TO K	Store value in K-register	29
то м	Store value in M-register	28, 30
x <y< td=""><td>Exchange contents of X and Y-registers \ldots.</td><td> 23,82</td></y<>	Exchange contents of X and Y-registers \ldots .	23,82
yx	y to the power x	70.00.00
107-701000	(exponentiation, roots)	
%	Percent (x percent of y)	
∆%	Percent difference	
-	Subtract	, ,
+	Add 10, 14, 16, 17,	
×	Multiply	, ,
÷	Divide	27, 80, 81
0-9.•	Numeric entry key set	12, 21, 22

ST

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