MODEL 81

HEWLETT-PACKARD

OPERATING GUIDE

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Introduction

The HP-81 is already pre-programmed with many commonly-used financial tables and is ready to solve any of these business problems:

- All types of simple and compounded interest calculations
- Percentage calculations
- Statistical applications (mean and standard deviation)
- Present value, future value, and effective rate calculations
- Sum-of-the-digits amortization (finance charges, depreciation)
- Add-on interest to effective annual rate conversion
- Effective yield calculations
- Mortgage calculations
- Discounted cash-flow analysis
- Bond price and yield-to-maturity calculations
- Time interval and future date calculations
- Linear regression analysis (trend line forecasting)
- Square root and common log calculations

Also, these extended business functions are available for your use:

- Interest per period
- Discounted rate of return
- Declining-balance depreciation schedule
- Diminishing-balance depreciation schedule
- Sum-of-the-digits depreciation schedule
- Rule-of-78's prepayment
- Amortized loan schedule
- Odd-days interest
- Coupon-equivalent yield
- Percent of total

In addition to the many business-related functions, the HP-81 is fast, accurate, and convenient to use. It handles numbers up to 10^{100} (that's 1 followed by 100 zeros) and down to 10^{-99} (that's a decimal point followed by 98 zeros and a 1). It automatically places the decimal point (if you wish), allows you to round numbers to from zero to six decimal places, and provides you with a special alphanumeric, impact printer that produces an easy-to-read, permanent record. Of course, the HP-81 does everything a conventional four-function desk calculator does, too.

Using This Guide

Once you've unpacked the HP-81, take a few moments to read parts of this Guide to find out why your new calculator is different from all the rest. After making the simple checks on page 1, read the rest of Chapter 1 as you get acquainted with the HP-81's basic features. You'll need to know those Basic Instructions to get the most from your new calculator.

Next, use the Chapter Index to the right to find the HP-81 functions that will solve your business or financial problems. You are invited to try the example problem which accompanies each function.

After becoming acquainted with the HP-81, you may find that the accessory Quick Reference (look under the calculator's top-cover) is all that's needed when solving most problems. For your convenience the Quick Reference is organized, chapter-by-chapter, just like the Operating Guide.

CONTENTS

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PRT OFF   PAPER↑   DECIMAL   CLEAR   POWER
                             AUTO   OFF

n   TL   CE   CHS   STO   RCL   ÷   yˣ
        CAL   ÷K   √x̄

i   SOD   R↓   7   8   9   ×   x̄
YTM   CAL   ×K   Σ

PMT   DAY   x⇄y   4   5   6   −   Σ+
INT   DAT   LOG   Σ−

PV   %   S   1   2   3   ◇
BND   Δ%   A   PRM
                        V
FV   EXT( )   E   0   ·   +   ✳
        M( )   PRD
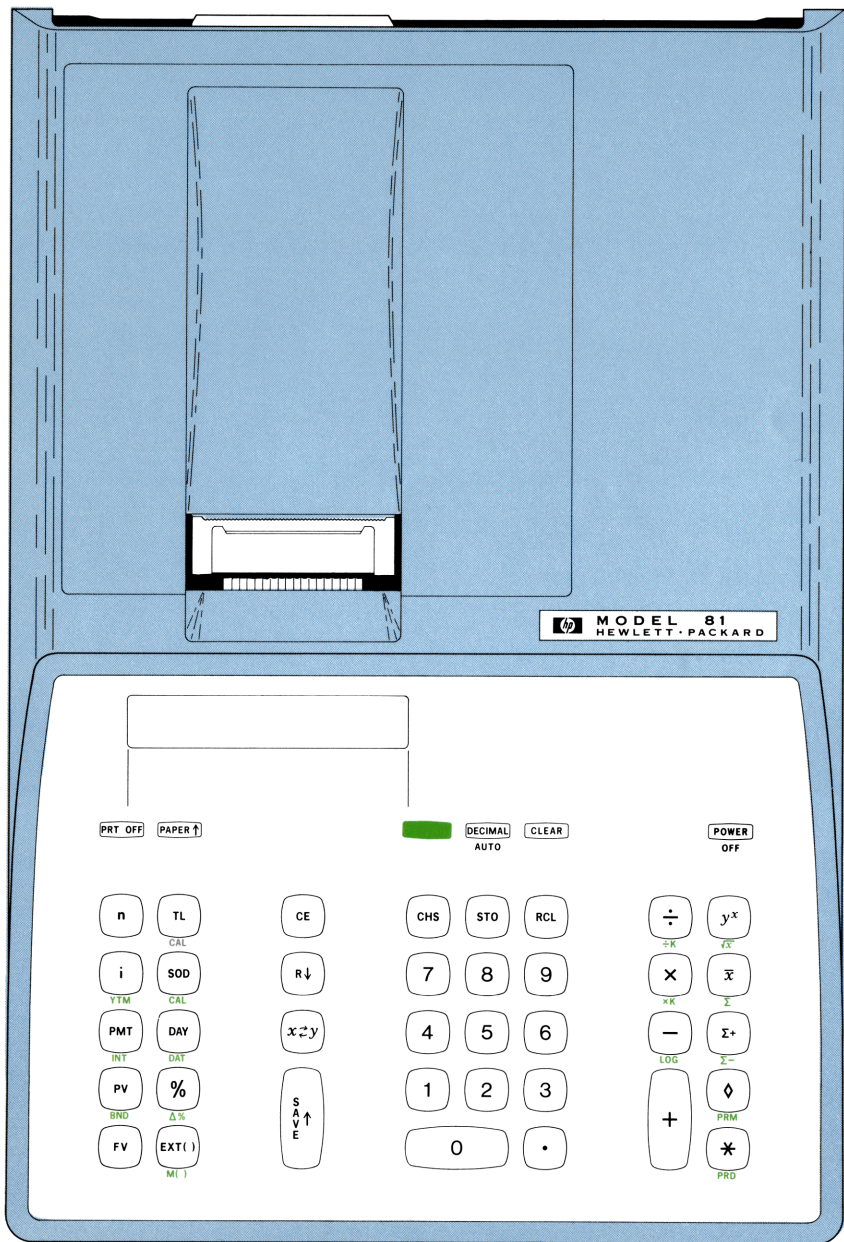
KEYBOARD LEGEND

| POWER OFF | Power switch. |

CLEAR — Erases the present calculation, the operational stack (see **SAVE↑** below), and the statistics storage registers (see page 6).
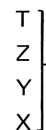
CE — Erases the number just keyed in.

DECIMAL AUTO — When switched *on* (up), automatically enters a decimal point with each number entry.

▬▬ — Use like a typewriter 'shift' key to perform the HP-81 alternate functions shown in green.

```
T ⎤
Z ⎪
Y ⎬
X ⎦
```
The HP-81 has four temporary storage locations (number lines) arranged as shown to the left.

SAVE↑ — All numbers go into the **X**-line first — the only line printed or displayed. Pressing **SAVE↑** copies the **X**-line number into the **Y**-line and moves the other line numbers up similarly. The original **T**-line number is lost.

CHS — Changes the sign (to positive or negative) of the number in the **X**-line.

STO — Stores an entry from the **X**-line into the designated storage register.

RCL — Recalls the number from the designated storage register back to the **X**-line.

R↓ — 'Rolls down' the numbers in the operational stack (the original **X**-line number is moved to the **T**-line).

x⇄y — Exchanges the contents of the **X**- and **Y**-lines.

◊ — Prints the **X**-line number (necessary for addition, subtraction, percent and percent difference calculations). It does not affect any calculation or the operational stack.

✳ — Prints the result of calculations and clears the operational stack.

PRT OFF — Switches the printer OFF.

PAPER↑ — Advances the printer paper.

CAUTION

THE HP-81 CAN BE SEVERELY DAMAGED IF IT
HAS NOT BEEN SET TO THE CORRECT VOLT-
AGE; IF IN DOUBT, PLEASE REFER TO
APPENDIX A.

Keyboard Fold-Out ➡

Switching On

Your HP-81 is shipped fully assembled and ready to operate, but first make these simple checks:

- If you have just received your HP-81, immediately inspect it and switch it ON by following the instructions in Appendix A. But if the HP-81 has been running in your area, read on:

- If the calculator is not plugged in, plug one end of the power cord into the rear panel of the calculator; plug the other end into a suitable power outlet.

- If the calculator is switched off, check to see that the [PRT OFF] switch is in the *up* position and the [DECIMAL] switch is in the *down* position (they will be explained soon). Now press and lock [POWER OFF] *down*; the word 'CLEAR' should be printed — if not, see Appendix C.

The Keyboard

The HP-81 keyboard layout and legend are shown on the facing page. Almost every key performs two distinct functions: the symbol for the primary function appears on the key-top; the symbol for the alternate function appears in green on the key-front.

To use the primary function, merely press the selected key. To use the alternate function, press the ▬▬ key immediately before pressing the selected key.

The Printer

The printer provides a written record of all calculations, using an easy-to-understand notation for each function. In addition, the HP-81 prints various messages. Some of these indicate calculator status, while others tell you of illegal operations, such as dividing by zero. You'll find a list of 'error messages' at the back of this Guide and under the calculator top-cover.

Display Option

With the display option installed, you should see a display of 0.00 when you switch the HP-81 ON. Numbers keyed in and the results of all calculations appear in the display. Press (◊) when you need to retain a particular result. And to conserve paper, press [PRT OFF] *down* to shut-off the printer.

Entering Numbers

Number keys are arranged conveniently as on an adding machine. Key in numbers from left to right and include the decimal point if it is a part of the number. For example, 94.125 would be keyed in as:

9 4 . 1 2 5

To check the number just keyed in, press ◊ . The small light in the display window simply indicates that the machine is doing an operation, in this case PRINT.

Before keying in a second number, save the first by pressing SAVE↑ . Now key in the next number.
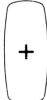
Clearing

If you find that you have made a mistake when keying in a number, erase the entire number by pressing CE . Then key in the number correctly. To ready the HP-81 for a new problem, press CLEAR . This is not always necessary, but it's reassuring! The operations that require initial 'clearing' are mentioned as they appear in this Guide.

If you wish to clear the entire calculator, including all stored data, switch the HP-81 OFF and then ON.

Arithmetic Operations

To add, subtract, multiply or divide:

1) Key in the first number, press **SAVE↑**

2) Key in the second number, press + , — , × , or ÷ .

The answer is calculated *and* printed (and displayed) for multiplication and division, but only calculated (and displayed) for addition and subtraction — this is to allow *chain calculations* where a series of numbers are entered and added to each other. To print addition and subtraction results, press ◊ .

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Examples:

A. Find 2 x 4

Enter:

2 [S A V E ↑↓] 4 ⊗

```
2.00      ↑
4.00      ×
8.00      ◇
```

B. Find 9600 ÷ 52

Enter:

9600 [S A V E ↑↓] 52 ⊙

```
9600.00    ↑
  52.00    ÷
 184.62    ◇
```

C. Find 42.3 + 11.9 + 29.1 + .07 − 6.30

Enter:

42.3 [S A V E ↑↓] 11.9 ⊕ 29.1 ⊕

.07 ⊕ 6.3 ⊖ ◇

```
42.30      ↑
11.90      +
29.10      +
  .07      +
 6.30      −
77.07      ◇
```

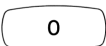# Negative Numbers

To enter a negative number, key in its value and press [CHS] .

To change the sign of the current answer, just press [CHS] .

All negative numbers are printed in red.

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Rounding Numbers

When the HP-81 is switched ON, printed (and displayed) numbers are automatically rounded to two decimal places. To change the rounding format, simply press ▭ and any number key from $\boxed{0}$ to $\boxed{6}$.

For example, when the HP-81 is in two-decimal-place format:

Entering 2.137 results in:

```
2.137      ↑
2.14       ◊
```

Entering 8.814 results in:

```
8.814      ↑
8.81       ◊
```

But entering 7.55 results in:

```
7.55       ↑
7.55       ◊
```

If ▭ $\boxed{7}$, ▭ $\boxed{8}$, or ▭ $\boxed{9}$ is pressed, numbers will be printed and displayed in *scientific notation*. This is a shorthand way of expressing very large or very small numbers. It uses a base number multiplied by 10 to a power.

For example:

$92{,}500 = 9.25 \times 10^4 =$

```
9.250000000+04◊
```

$.0025 = 2.5 \times 10^{-3} =$

```
2.500000000-03◊
```

The rounding format does not generally apply to the internal calculations, only to printed (and displayed) numbers.

In several calculations, however, the number and rounding format *does* affect the internal calculations. These include payment and depreciation schedules, rebate calculations, and accumulated interest calculation, where the periodic amounts must be payable in even monetary units.

Automatic Decimal Point

The DECIMAL key is used in conjunction with the rounding format so that a decimal point is entered automatically at the specified position. For example, when the HP-81 is in the two-decimal-place format and the DECIMAL key is *up* (on), a decimal point is entered automatically before the final two digits.

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When the [DECIMAL] key is *down* (off), the decimal point must be entered manually when needed. When the [DECIMAL] key is *up*, however, the decimal point may still be entered manually.

Storage Registers

There are 20 storage registers in the HP-81, numbered from 0 through 19. Registers 0 through 9 are accessed by pressing:

[STO] [0]

[RCL] [0]

. . .
. . .

[STO] [9]

[RCL] [9]
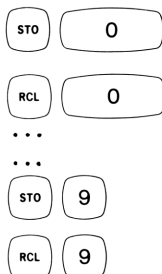
Registers 10 through 19 are accessed by pressing:

[STO] [.] [0]

[RCL] [.] [0]

. . .
. . .

[STO] [.] [9]

[RCL] [.] [9]
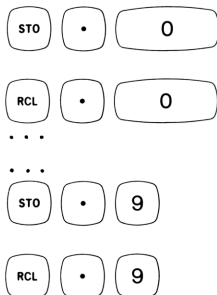
Register 0 is always reserved for your use (see page 13). Registers 1 through 9 are usually available for your use, while registers 10 through 19 are frequently required for one or more calculator routines (see the following table).

To list the contents of all storage registers, press [   ] [*] .
PRD

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The following table shows what the HP-81 stores in each register.

Register:	HP-81 Usage:
0	Constant storage (see page 11)
1	a) Length of time calculations — 1st time-period date
	b) Personal or corporate tax rate for After-tax Mode
2	a) Length of time calculations — 2nd time-period date
	b) Capital gains tax rate for After-tax Mode
3	
4	
5	
6	Cash-Flow Analysis
7	
8	
9	
10	a) Sum-of-the-squares for Summation
	b) Trend Line
11	a) Number of entries for Summation
	b) Trend Line
12	a) Sum of the numbers for Summation
	b) Trend Line
13	Trend Line
14	DAY
15	FV
16	i
17	PMT
18	PV
19	n

Only these registers are erased with [CLEAR].

The Operational Stack (a look inside the HP-81)

The operational stack in the HP-81 consists of four lines which are used for manipulating numbers. These lines are similar to writing long-hand arithmetic. For example:

$$\begin{array}{r} 312 \\ \times\ 14 \\ \hline 4368 \end{array}$$

That simple multiplication requires three lines on a piece of paper: two lines for the entries, and one for the answer.

To perform the same calculation with the HP-81, this is what happens (the four lines are labeled, from the bottom up, **X, Y, Z,** and **T**):

1. **Enter:** 312

T = (blank)
Z = (blank)
Y = (blank)
X = 312.

2. **Press:** [SAVE ↑]

T = (blank)
Z = (blank)
Y = 312.
X = 312.

3. **Enter:** 14

T = (blank)
Z = (blank)
Y = 312.
X = 14.

4. **Press:** [×]

T = (blank)
Z = (blank)
Y = (blank)
X = 4368.

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For most simple calculations, only the **X**- and **Y**-lines are used. However, the four lines of the operational stack allow numbers to interact for mixed, chain, and serial calculations.

The **X**-line is always seen (displayed or printed). To see the contents of any other line, use ⌈R↓⌉ to 'roll down' the group of numbers one at a time. This action is like rolling a drum one-quarter revolution each time ⌈R↓⌉ is pressed. After pressing ⌈R↓⌉ four times, the numbers are back to their original position.

⌈x⇄y⌉ exchanges the numbers in the **X**-line and the **Y**-line.

⌈SAVE↑⌉ pushes up the numbers in each line of the operational stack. That is, the number in the **X**-line is copied into the **Y**-line, the number in the **Y**-line is copied into the **Z**-line, the number in the **Z**-line is copied into the **T**-line, and the number in the **T**-line is lost.

To see how **SAVE↑** works, press: 1 ⌈SAVE↑⌉ 2 ⌈SAVE↑⌉ 3 ⌈SAVE↑⌉ 4

Now press ⌈R↓⌉ four times to see four lines of the operational stack:

	4.00	(X)
⌈R↓⌉	3.00 ↓	(Y)
⌈R↓⌉	2.00 ↓	(Z)
⌈R↓⌉	1.00 ↓	(T)
⌈R↓⌉	4.00 ↓	(X)

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To see how **SAVE↑** copies the **X**-line into the **Y**-line and pushes up the numbers in the other lines, press 8 [SAVE↑] .

Now press [R↓] four times to see the stack:

[R↓] . . . . 8.00 ↓ (Y)

[R↓] . . . . 4.00 ↓ (Z)

[R↓] . . . . 3.00 ↓ (T)

[R↓] . . . . 8.00 ↓ (X)

Certain routines in the HP-81 are performed on the line name shown on the key. For example, [yˣ] raises the number in the **Y**-line to the power in the **X**-line, and ▬▬ [yˣ] calculates the square root of the number in the **X**-line.

A good understanding of the operational stack will develop as you use the HP-81. This short explanation on how the stack works should help make it work for you.

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2

GENERAL FUNCTIONS

General Function Keys

The HP-81 general functions include special one-key functions and some specific operations which are necessary for understanding many routines described in the next chapters. A good knowledge of these functions allows greater flexibility and shortcutting when using your HP-81.

Constant Storage and Arithmetic

Register 0 is *always* reserved for storing a number (constant) for later use. Once stored, the constant (K) remains unchanged until either another number is stored or the HP-81 is switched OFF.

To **store a constant**, key in the number and press [STO] [0].

To **use the constant** in a problem, press [RCL] [0] instead of keying in the number.

To **multiply** by the stored constant, key in the number and press [ ] [×].

To **divide** by the stored constant, key in the number and press [ ] [÷].

Example: Multiply each of the following numbers by 3.1415.

28
85
76
32
19

13

Enter:

3.1415 [STO] [0]

28 ▬ [×] 85 ▬ [×]
×K   ×K

76 ▬ [×] 32 ▬ [×]
×K   ×K

19 ▬ [×]
×K

```
 3.1415    →0
 28.00     N  ×
 87.96     ◇  ·
 85.00     N  ×
267.03     ◇
 76.00     N  ×
238.75     ◇
 32.00     N  ×
100.53     ◇
 19.00     N  ×
 53.69     ◇
```

Percentage Calculations

A. To take a **percentage** of a number:

  1) Key in the base number, press **SAVE↑**

  2) Key in the percentage (as a %), press [%] [◇] .
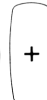
Example: Find 41% of 1598.

Enter:

1598 [SAVE↑] 41 [%] [◇]
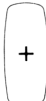
```
1598.00    ↑
  41.00    %
 655.18    ◇
```

B. To **add a percentage** amount to a number:

  1) Key in the base number, press **SAVE↑**

  2) Key in the percentage, press [%] [+] [◇] .

Example: Find the selling price of a £1550 sailing boat when a 10.5% value added tax (VAT) is added on.

Enter:

1550 [SAVE↑] 10.5 [%] [+] [◇]

```
1550.00    ↑
  10.50    %
 162.75    +
1712.75    ◇
```

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C. To **subtract a percentage** amount from a number:

1) Key in the base number, press SAVE↑

2) Key in the percentage (as a %), press (%) (−) (◊) .

Example: Find the net cost of a $5.95 item that includes a 25% retail profit mark-up.

Enter:

5.95 [SAVE↑] 25 (%) (−) (◊)

```
      5.95     ↑
     25.00     %
      1.49     −
      4.46     ◊
```

Percent Difference

To find the **percentage difference** between two numbers:

1) Key in the first number, press SAVE↑

2) Key in the second number, press ▬ (%) (◊) .

Examples:

A. Find the percent decrease from 110 to 89.

Enter:

110 [SAVE↑] 89 ▬ (%) (◊)

```
    110.00      ↑
     89.00   Δ  %
     19.09
```

B. A company grosses $1,234,567 in fiscal 1972 and $1,765,432 in fiscal 1973. The manager would like to calculate the percentage increase in gross sales.

Enter:

1234567 [SAVE↑]

1765432 ▬ (%) (◊)

```
  1234567.00      ↑
  1765432.00   Δ  %
       43.00      ◊
```

Total and Percentage

Calculates the total of a series of numbers and finds the percentage that each entry is of the total. A maximum of 18 entries may be made since 'n' is stored in register 19.

General Routine:

1) Key in total number of entries, press [n]

2) Key in first entry, press [STO] [1]

3) Key in second entry, press [STO] [2]

(continue)

4) Key in tenth entry, press [STO] [.] [0]

5) Key in eleventh entry, press [STO] [.] [1]

(continue)

6) After the last entry is stored, press [EXT( )] [9].

Example: An office supply store sold five different brands of pencils last year. The owner wishes to know the total number of pencils sold and the percentage of sales for each brand. Here are the figures:

Brand	Quantity Sold
A	1300
B	600
C	800
D	1700
X	2200

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Enter:

5 [n]

1300 [STO] [1]

600 [STO] [2]

800 [STO] [3]

1700 [STO] [4]

2200 [STO] [5]

[EXT( )] [9]

```
        5.00   → N
   1300.00   →1
    600.00   →2
    800.00   →3
   1700.00   →4
   2200.00   →5
1
   1300.00
      19.70   ⅞
2
    600.00
       9.09   ⅞
3
    800.00
      12.12   ⅞
4
   1700.00
      25.76   ⅞
5
   2200.00
      33.33   ⅞
Σ
   6600.00   *
    100.00   ⅞
```

Exponentiation

To raise a number to a positive power:

1) Key in the number and press **SAVE↑**

2) Key in the power and press [yˣ] .

Examples:

A. Find 2^9 $(2\times2\times2\times2\times2\times2\times2\times2\times2)$

Enter: 2 [SAVE↑] 9 [yˣ]

```
     2.00   ↑
     9.00   ⊿↑
   512.00   ◇
```

B. Now find $8^{2/3}$

Enter: 8 [SAVE↑] 2 [SAVE↑] 3 [÷]

[yˣ]

```
   8.00   ↑
   2.00   ↑
   3.00   ↟
    .67   ◇
          M↑
   4.00   ◇
```

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Now print the last result in scientific notation:

Press: ▬ 7 ◊   3.999999999+00◊

This shows an example of 'calculating error', which occurs because logarithms are used when calculating Y^x and the results are not always accurate to the last decimal place. In this case the error magnitude is only .000000001 (1 billionth)!

Square Root

To find the square root of a number, enter the base number and press ▬ y^x .

Example: Find $\sqrt{213.16}$

Enter:

213.16 ▬ y^x

213.16   √
14.60   ◊

Logarithms

To calculate the common log ($\log_{10}$) of a number, enter the base number and press ▬ − .

To calculate the antilog$_{10}$, that is, to convert a logarithm to its original number:

1) Key in 10, press **SAVE↑**

2) Key in the logarithm, press y^x .

Logarithms are frequently used to measure natural phenomenon, such as light, heat, and sound. For instance, the Richter scale, used by seismologists to measure the magnitude of earthquakes, operates on a logarithmic basis, so there is a 10-fold increase from one unit to the next.

For example, the 1906 San Francisco earthquake, with a magnitude of 8.25 on the Richter scale, is estimated to be about 105 times greater than the Nicaragua quake of 1972. What would be the magnitude of the later on the Richter scale?

Enter:

8.25 [S A V E ↑]

105 [━] [−] [−] [◊]
          LOG

```
    8.25      ↑
  105.00    L
    2.02    ◊
            ‾
    6.23    ◊
```

Calendar Functions

Enter dates for the following functions in a 'month-day-year' format (i.e., mm.ddyyyy). For example, May 7, 1965 would be entered as: 5.071965. The HP-81 calendar extends from January 1, 1901 (1.011901) through December 31, 2099 (12.312099). The calculator even automatically adds an extra day for each leap year, unless the 30-Day Month mode is set (see page 126).*
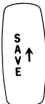
To **calculate the number of days between** two given dates:

1) Key in first date, press **SAVE↑**

2) Key in second date, press [DAY] .
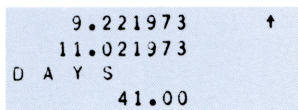
*The Actual-Day Month mode is automatically set when the HP-81 is switched ON.

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Example; If today is September 22, 1973 and your anniversary is November 2, how many days do you have to buy a gift for your spouse?

Enter:

9.221973 [SAVE↑]

```
    9.221973    ↑
   11.021973
D A Y S
      41.00
```

11.021973 [DAY]

To **calculate a date**, including the day of the week:

1) Set the required days-per-month mode* (see page 126).
2) Key in starting date, press **SAVE↑**
3) Key in number of days between, press ▬ [DAY] .

If the date to be found is in the past, enter a negative number of days between.
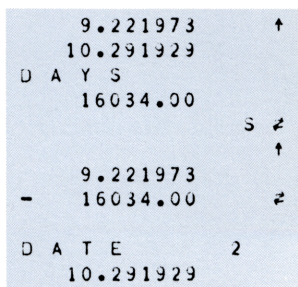
The day of the week is indicated by a single digit (1 = Monday, 2 = Tuesday, etc.).

Example: If today is still September 22, 1973, what day was it when the stock market crashed on October 29, 1929?

Enter:

9.221973 [SAVE↑] 10.291929 [DAY]

[CHS] [SAVE↑] 9.221973 [x⇄y] ▬ [DAY]

```
    9.221973    ↑
   10.291929
D A Y S
   16034.00
              S ⇄
                ↑
    9.221973
-  16034.00      ⇄
D A T E        2
   10.291929
```

The HP-81 confirms that the stock market crashed on Black Tuesday.

*The Actual-Day Month mode is automatically set when the HP-81 is switched ON.

Summation

The summation keys allow you to calculate a running summation of a series of numbers.

General Routine:

1) Press [CLEAR]

2) Key in a number, press [Σ+]

3) Continue entering numbers with [Σ+] for as much data as desired.

Each time a number is entered, the HP-81 automatically calculates the sum to that entry and the total number of entries. To find the number of entries at any time, press [x⇄y] ; then press [x⇄y] again to continue summing.

To print the current sum total without disturbing the routine, press

 [x̄] .
 ←Σ
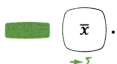
The summation routine uses storage registers 10, 11, and 12, so don't store any numbers in them while using this routine. Also, don't press [CLEAR], since it will erase the current sum-total.

To delete an entry and decrease the 'number of entries' counter by one, re-enter the wrong number and press [Σ+] .
 Σ−

Example: Find the total cost of these items after discounting them:

$3.00 (15% discount)
$6.50 (15% discount)
$35.00 (25% discount)

Enter:

[CLEAR] 3 [SAVE ↑] 15 [%] [−] [Σ+]

6.5 [SAVE ↑] 15 [%] [−] [Σ+]

35 [SAVE ↑] 25 [%] [−] [Σ+] [▬] [x̄]   Total cost

```
      CLEAR

   3.00        ↑
  15.00        %
    .45        −
   2.55       Σ+
   6.50        ↑
  15.00        %
    .98        −
   5.53       Σ+
  35.00        ↑
  25.00        %
   8.75        −
  26.25       Σ+
  34.33      →Σ
```

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3

INTEREST and REBATE

Charging and receiving interest has long involved a series of tables and a lot of calculations. Since the HP-81 easily computes these numbers for you, the drudgery is gone and a thinking man can take a more proper role.

In performing these calculations, the *interest rate* (i) must be entered as the rate per payment period. The *number of time or payment periods* (n) refers to the number of payments to be made, assuming that the interest charge will be computed at the end of each payment period. The *present value* (PV) refers to the original amount of principal, not including any interest charges. The *future value* (FV) refers to the amount of principal plus interest.

For all these calculations, any length payment period is acceptable, however, the terms 'month' and 'year' are generally used in the following explanations, since they are the most reasonable and likely time periods.

While the explanation for each routine should be clear, all of the terms used may not be. This short glossary may be of help.

Accrued Interest is the amount earned through interest but not collected. That is, neither added to the principal nor yet paid out.

Add-on Interest Rate is used to compute the interest charges which are 'added-on' to the principal amount when a loan is financed.

Balloon Payment is a large payment generally used to pay off a loan. In the HP-81 it must be the final payment, and the balloon payment amount entered must not include the regular monthly payment due at that time.

Compounding Interest is the action of adding the interest amount earned to the principal, thus increasing the amount of principal which will earn interest (e.g., a savings account).

Nominal Interest Rate is the stated interest rate. It assumes that only the principal will remain to draw interest — and allows no compounding or other factors which would affect the actual interest rate.

Effective Interest Rate or Annual Percentage Rate (APR) is the actual interest rate. It takes into account such factors as compounding of interest, odd-days charges, early payoff, a balloon payment, etc. This rate reflects the total cost of borrowing.

Odd Days is the number of days beyond 30 between the time a loan agreement is signed and the first payment is made. Interest is charged for each odd day.

Payment Amount includes part of the total principal and part of the total interest charge.

Pay Off is the total amount (principal plus interest) required to complete payment of a loan before it is due. It takes into account a rebate on interest charges.

Principal is the basic amount on which interest is charged or paid.

Rebate is a refund, generally of interest charges, due when a loan is paid off early.

Rule of 78's is a method of computing rebate of interest charges on loans where the sum of the numbers, representing the months of the year (1+2+3+...+12 = 78), is used to compute the rebate to any month in the year. By this method, the rebate in July for a 1-year loan made in January would be computed by:

a) 1+2+3+4+5+6+7 = 28

b) 78 — 28 = 50

c) 50 ÷ 78 = 64.1% (Percent amount of interest paid)

d) 28 ÷ 78 = 35.9% (Percent of interest charge rebate)

Compound Interest Calculations

This routine includes four variations of the [n] , [i] , [PV] , and [FV] keys to solve for:

- the number of time periods,
- the interest rate per time period,
- the present value, or
- the future value.

Any three values may be used to calculate the fourth. The three entries may be made in any order, and any or all of the entries may be updated and the problem re-solved without re-entering those values which do not change.

If you wish to use some of the entered values in a new problem (one that solves for a different unknown, simply [CLEAR] the old problem, then recall and reinitialize the carry-over values with [RCL] [Entry Keys] .

Note that the interest (i) must be expressed as a rate per time period (n).

To solve for n:

1) Key in interest rate per time period, press [i]
2) Key in present value, press [PV]
3) Key in future value, press [FV]
4) To find the number of time periods, press [n] .

To solve for i:

1) Key in number of time periods, press [n]
2) Key in present value, press [PV]
3) Key in future value, press [FV]
4) To find the interest rate per time period, press [i] .

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To solve for PV:

1) Key in number of time periods, press [n]

2) Key in interest rate per time period (as a %), press [i]

3) Key in future value amount, press [FV]

4) To calculate the present value, press [PV].

To solve for FV:

1) Key in number of time periods, press [n]

2) Key in interest rate per time period (as a %), press [i]

3) Key in present value amount, press [PV]

4) To calculate the future value, press [FV].

Examples:

A) If $500 is invested for 2 years at 5 ¾% annual interest, what is the future value when interest is compounded annually? Semi-annually? Monthly?

Enter:

[CLEAR] 2 [n]

5.75 [i]

500 [PV] [FV]

Enter:

[RCL] [n] 2 [×] [n]

[RCL] [i] 2 [÷] [i]

[FV]

```
          CLEAR

   2.00   → N
   5.75   → I
 500.00   →P
 F  V
   559.15

   2.00   ← N
   2.00     ×
   4.00    ◇
          → N
   5.75   ← I
   2.00    ÷
   2.88   ◇
          → I
 F  V
   560.03
```

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Enter:

[RCL] [n] 6 [×] [n]

[RCL] [i] 6 [÷] [i]

[FV]

```
        4.00   ← N
        6.00     ×
       24.00   ◇
               → N
        2.88   ← I
        6.00     ÷
         .48   ◇
               → I
   F   V
        560.78
```

B) How long will it take for $2,500 compounded monthly at 6.2% annual interest to double in value?

Enter:

[CLEAR] 6.2 [SAVE]

12 [÷] [i]

2500 [PV] 5000 [FV] [n]

```
         CLEAR

        6.20    ↑
       12.00    ÷
         .52   ◇
              → I
     2500.00  →P
     5000.00  → F
   N
      134.50
```

To find the time in years,

Enter:

[SAVE] 12 [÷]   time in years ⟶

```
      134.50    ↑
       12.00    ÷
       11.21   ◇
```

Accrued Interest

Calculates the interest earned, but not collected, for a given loan amount when the interest rate and either the number of elapsed days or the dates of the first and last days of the time period for accrual is known. The calculation is made for both a 365-Day Year and 360-Day Year bases. The mode setting determines which Day/Year basis answer is shown first.

General Routine:

1) Set the required days-per-year calculating mode* (see page 126).

2) *Either* key in the number of elapsed days and press [n] *or* key in the first date and press **SAVE↑** and then key in the last date and press [DAY] [n]

3) Key in the annual interest rate, press [i]

4) Key in the principal amount, press [PV]

5) Press ▬ [PMT/INT] to calculate the accrued interest. To see the interest calculated using the alternate days-per-year mode, press [R↓].

Example: How much interest will accrue on $2,600 between January 14, 1974 and February 11, 1974, at a 10½% annual interest rate for a 365-day year? A 360-day year?

Enter:

(in 365 day/year mode)

[CLEAR] ▬ [EXT( )/M( )] [5]   (365-Day Year Mode)

1.141974 [SAVE↑] 2.111974 [DAY] [n]

10.5 [i] 2600 [PV]

▬ [PMT/INT] [R↓]

365-day year basis ⟶
360-day year basis ⟶

```
            CLEAR

D A Y      365      5
         1.141974        ↑
         2.111974
D A Y S
          28.00
                      ← N
          10.50     ← I
        2600.00     ←P
I N T
          20.94
          21.23        ↓
```

*The 365-Day Year mode is automatically set when the HP-81 is switched ON.

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Accumulated Interest Paid Between Periods*

Calculates the amount of interest which is accumulated between two given payments, and the principal remaining after the latter payment. The rounding format affects this calculation.

General Routine:

1) Key in the beginning payment number, press [STO] [1]

2) Key in the last payment number, press [STO] [2]

3) Key in the interest rate per time period, press [i]

4) Key in the payment amount per period, press [PMT]

5) Key in the present value (principal), press [PV]

6) Press [Σ+] to calculate the remaining principal and interest accumulated.

Example: What is the accumulated interest and remaining principal from the 30th to the 35th payment of a 30-year mortgage (360 payments) with a principal amount of $25,000, an annual interest rate of 7½%, and payments of $174.80?

Enter:

[CLEAR] 30 [STO] [1]

35 [STO] [2] 7.5 [SAVE↑]

12 [÷] [i] 174.8 [PMT]

25000 [PV] [Σ+]

```
          CLEAR
     30.00      →1
     35.00      →2
      7.50        ↑
     12.00        ÷
       .63        ◊
              →  I
    174.80      →PT
  25000.00      →P
                Σ+
 P   V
    24276.77
 I  N  T
    913.37
```

The remaining principal is $24,276.77 and the accumulated interest is $913.37.

*Also see 'Amortized Loan Schedule', page 46.

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Effective Interest Rate

Calculates the interest rate per payment given the loan amount, the payment amount, and the number of payments.
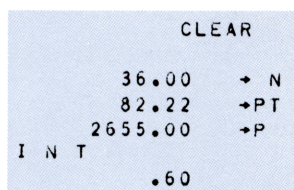
General Routine:

1) Key in total number of payments, press [n]

2) Key in the payment amount, press [PMT]

3) Key in the principal amount, press [PV]

4) Press [i] to calculate the interest rate per payment.

5) To find the annual interest rate, key in number of payments per year and press [x].

Example: What is the effective rate of interest per payment on a 36-month loan for $2,655.00 at a monthly payment of $82.22?

Enter:

[CLEAR] 36 [n]

82.22 [PMT]

2655 [PV] [i]

```
        CLEAR
    36.00    → N
    82.22    →PT
  2655.00    →P
I  N  T
        .60
```

The interest rate per payment is .6%.

Effective Annual Rate to Nominal Rate

Calculates the interest rate which, when compounded periodically, is equivalent to the stated annual rate. This routine illustrates that the effective periodic rate is not just the annual rate divided by the number of compounding periods per year.

To find the interest rate per period, given the effective annual rate:

1) Key in number of payments per year, press $\boxed{n}$

2) Key in the annual interest rate, press $\boxed{i}$;
then press $\boxed{\text{EXT( )}}$ $\boxed{0}$.

Example: What is the interest rate per period on a savings account which pays 6.55% annual interest compounded monthly?

Enter:

$\boxed{\text{CLEAR}}$ 12 $\boxed{n}$

6.55 $\boxed{i}$ $\boxed{\text{EXT( )}}$ $\boxed{0}$

```
              C L E A R

      1 2 . 0 0    →  N
          6 . 5 5  →  I
   I N T
          . 5 3
```

The monthly interest rate is .53%

'Add-on' Rate Converted to Annual Rate

Calculates the annual interest rate from a stated 'add-on' rate. The monthly payment can also be calculated with this routine, if the loan amount is entered.

General Routine:

1) Key in the number of months for loan, press $\boxed{n}$

2) Key in the 'add-on' rate (per annum), press $\boxed{i}$

3) Press $\boxed{i}$ again to calculate the annual rate.

Now you can find the monthly payment:

4) Press $\boxed{x \rightleftarrows y}$

5) Key in the principal amount, press $\boxed{\times}$.

33

Example: What is the annual interest rate (to three decimal places) for a 36-month loan at 8% Add-on?

Enter:

[CLEAR] ▭ 3

36 [n]

8 [i] [i]

```
          C L E A R
    3 6 . 0 0 0   →  N
        8 . 0 0 0   →  I
 I N T              A N %
        1 4 . 5 4 8
```

The annual interest rate is 14.548%.

Add-on (with odd days) to Annual Rate

Calculates the effective annual interest rate given the number of odd days, the add-on interest rate, and the number of payments to be made.

General Routine:

1) *Either* key in number of odd days and press [STO] [DAY] *or* key in date of first date and press **SAVE↑** and key in date of last odd day and press [DAY]

2) Key in number of payments, press [n]

3) Key in add-on rate, press [i]

4) To calculate the effective annual interest rate, press [EXT( )] [7] .

Example: What is the effective annual interest rate (to four decimal places) of a 24-month loan at 7½% add-on with 45 days until the first payment?

34

Enter:

`CLEAR` ▬ 4

45 [S A V E ↑] 30 `−` `STO` `DAY`

24 `n` 7.5 `i` `EXT( )` 7

```
        CLEAR

   45.0000      ↑
   30.0000      −
               →4＊
   24.0000    → N
    7.5000    → I
INT          AN ℀
   13.5076
```

The annual interest rate is 13.5076%.

Interest Rate for Loan with Balloon Payment

Calculates the periodic interest rate of a loan with a final balloon payment. The balloon payment is entered as an addition to the regular monthly payment. The monthly amount should not be included in the balloon payment amount. This routine uses the Bond Yield-to-Call routine.

General Routine:

1) Set Bond Mode[*] by pressing ▬ `EXT( )` 8

2) Set Annual Coupon Mode by pressing ▬ `EXT( )` 2

3) Key in balloon payment amount, press `FV`

4) Key in number of payments, press **SAVE↑** 365 `×` `STO` `DAY`

5) Key in monthly amount, press `PMT`

6) Key in principal amount, press `PV`

7) To calculate the interest rate per payment period, press ▬ `i` .

Now you can find the annual interest rate:

8) Key in the number of payments per year, press `×` .

*The Bond mode is automatically set when the HP-81 is switched ON.

Example: What is the monthly and annual percentage rate for a $4,000 loan with 36 payments of $95 each, including a final payment of $1,672.59?

Enter: [CLEAR] ▭ [EXT( )] [2] (Annual Coupon Mode)
　　　　　　　　　M( )

1672.59 [S/A/V/E ↑↑] 95 [—] [FV]

36 [S/A/V/E ↑↑] 365 [×] [STO] [DAY]

95 [PMT] 4000 [PV] ▭ [i]
　　　　　　　　　　　　YTM

```
C L E A R
        A N 2
1 6 7 2 . 5 9      ↑
    9 5 . 0 0      —
              → F
      3 6 . 0 0    ↑
    3 6 5 . 0 0    ×
1 3 1 4 0 . 0 0    ◇
              → 4 ✳
      9 5 . 0 0    → P T
  4 0 0 0 . 0 0    → P
    Y I E L D
    T O     C A L L
      . 9 6
```

The monthly interest rate is .96%.

Press: 12 [×]

```
1 2 . 0 0    ×
1 1 . 5 0    ◇
```

The annual interest rate is 11.5%.

Rebate by Rule of 78's

Calculates the rebate and amount of interest paid during the final payment for a loan paid off before it is due. Since this routine uses the Sum-of-the-Digits (SOD) depreciation method, the printout should be interpreted as: DEPR = Interest paid with final payment; PV = Rebate. Also, the current rounding format affects this routine.

General Routine:

1) Key in payment number at pay-off, press [STO] [1]
2) Key in total number of payments, press [STO] [2]
3) Key in total interest payable, press [PV]
4) Press ▭ [SOD].
　　　　　　CAL

Example: What is the interest amount included with the final payment and the interest charge rebate on a 24-month loan paid off after 14 months, when the total finance charge is $258.32?

Enter:

$\boxed{\text{CLEAR}}$ 14 $\boxed{\text{STO}}$ $\boxed{1}$

24 $\boxed{\text{STO}}$ $\boxed{2}$

258.32 $\boxed{\text{PV}}$ ▬ $\boxed{\substack{\text{SOD} \\ \text{CAL}}}$

```
          CLEAR

        14.00    →1
        24.00    →2
       258.32    →P
           DEPR
         9.47
   P    V
        47.37
```

The interest paid with the final payment is $9.47, and the interest-charge rebate is $47.37.

Rebate and Payoff by Rule of 78's

Calculates the pay-off and interest rebate for a loan which is prepaid.

General Routine:

1) Key in the payment number at payoff, press $\boxed{\text{STO}}$ $\boxed{1}$
2) Key in the total number of payments, press $\boxed{\text{STO}}$ $\boxed{2}$
3) Key in the payment amount, press $\boxed{\text{PMT}}$
4) Key in the total interest payable, press $\boxed{\text{PV}}$
5) Key in the principal amount, press $\boxed{\text{FV}}$
6) Press $\boxed{\text{EXT( )}}$ $\boxed{5}$ to calculate the interest rebate, the interest paid, and the total amount of payoff.

Example: What is the interest-charge rebate, the amount of interest paid, and the total pay-off after 17 months of a 36-month loan with a principal of $3,200, payments of 104.76 and a total finance charge of $571.36?

37

Enter:

CLEAR 17 STO 1

36 STO 2 104.76 PMT

571.36 PV 3200 FV

EXT( ) 5

```
                              C L E A R
                    17.00      ➜1
                    36.00      ➜2
                   104.76      ➜PT
                   571.36      ➜P
                  3200.00      ➜ F
          I  N  T           B A L
                   163.00
          I  N  T           A M T
                   408.36
                            B A L
                  1827.44
```

The rebate is $163.00, the amount of interest paid is $408.36 and the total pay-off is $1,827.44.

Nominal to Effective Rate

Calculates the effective annual interest rate, given the number of payments and nominal (stated) annual rate.

General Routine:

1) Key in the number of annual payments, press SAVE n

2) Key in the nominal annual interest rate, press x⇄y ÷ i

3) Key in 100, press PV FV ; then key in 100 and press − .

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

Enter:

CLEAR 4 SAVE n 12 x⇄y ÷ i

100 PV FV 100 − ◊

```
                              C L E A R
                    4.00       ↑
                               ➜ N
                   12.00
                    4.00       ⇄
                               ÷
                    3.00       ◊
                               ➜ I
                  100.00       ➜P
         F     V
                  112.55
                  100.00       −
                   12.55       ◊
```

The effective annual rate is 12.55%.

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4

ANNUITIES

An *annuity* is a series of equal payments made at equal intervals of time. The HP-81 assumes an *ordinary annuity*, where payments are made at the end of each payment period.

A *sinking fund* is a type of annuity created to pay off a debt which will come due at a certain date in the future. By this method, periodic payments are made into the fund at the payment level and interest rate necessary to reach the required sum by the future date.

The annuity routines use a combination of [n] , [i] , [PMT] , [PV] , and [FV] entries. Data may be entered in any order. Any of the entered values may be changed and the answer recalculated without re-entering the rest of the values.

Present Value of an Annuity

Calculates the present value of a series of equal payments compounded at a given interest rate over a set period of time.

To find the principal value of a loan:

1) Key in total number of payments, press [n]

2) Key in interest rate per payment period, press [i]

3) Key in the payment amount, press [PMT]

4) Press [PV] .

Example: What is the maximum price that you could finance for a new house, if you were able to make $200 monthly payments (principal and interest) on a 30 year loan with an 8% annual interest rate?

41

Enter:

[CLEAR] 360 [n]

8 [SAVE↑] 12 [÷] [i]

200 [PMT] [PV]

```
        CLEAR
    360.00   → N
      8.00     ↑
     12.00     +
       .67    ◇
             → I
    200.00   →PT
  P  V
    27256.70
```

You could afford a principal of $27,256.70.

Future Value of an Annuity

Calculates the future value of a series of equal payments when compounded at a given interest rate for a set period of time.

To find the amount of a sinking fund:

1) Key in the total number of payments, press [n]
2) Key in the interest rate per payment, press [i]
3) Key in the payment amount, press [PMT]
4) Press [FV].

Example: How much money would you have after depositing $100 per month for 5 years into a savings account that paid 5½% compounded monthly?

Enter:

[CLEAR]

12 [SAVE↑] 5 [×] [n]

5.5 [SAVE↑] 12 [÷] [i]

100 [PMT] [FV]

```
        CLEAR
     12.00     ↑
      5.00     ×
     60.00    ◇
             → N
      5.50     ↑
     12.00     +
       .46    ◇
             → I
    100.00   →PT
  F  V
    6888.08
```

After 5 years you'd have $6,888.08.

Payment Amount for an Annuity

Calculates the payment amount necessary to pay off a given sum being compounded at a given interest rate over a set period of time.

To find the payment amount for a sinking fund:

1) Key in total number of payments, press [n]

2) Key in interest rate per payment period, press [i]

3) Key in principal amount, press [PV]

4) Press [PMT].

Example: What would your monthly payment be on a $3,600 loan with a 14% annual interest rate, if you must pay off the loan in 36 months?

Enter:

[CLEAR] 36 [n]

14 [SAVE] 12 [÷] [i]

3600 [PV] [PMT]

```
CLEAR
36.00    → N
14.00     ↑
12.00     ÷
 1.17     ◇
         → I
3600.00  →P
          PMT
123.04
```

Your monthly payment would be $123.04.

Payments Required for a Sinking Fund

Calculates the number of payments necessary to reach a set future value. The interest rate and payment amount must be known.

General Routine:

1) Key in the payment amount, press [PMT]

2) Key in the interest per period, press [i]

3) Key in the future value, press [FV]

4) Press [n] to calculate the number of payments.

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Example: If you wish to save $7,500 for your child's college education, how many $30 monthly deposits must you make into a savings account which pays 5¾% compounded monthly?

Enter:

CLEAR 30 PMT

5.75 [SAVE↑] 12 ÷ i

7500 FV n

```
         CLEAR
    30.00    →PT
     5.75      ↑
    12.00      ÷
      .43      ◇
             →  I
  7500.00   →  F
 N
   164.74
```

You'll have to make 165 monthly deposits. How many $50 monthly deposits are required?

Enter:

50 PMT n

```
    50.00    →PT
 N
  113.30
```

Payment Amount for a Sinking Fund

Calculates the payment amount necessary to give a set future value. The number of payments and the interest rate must be known.

General Routine:

1) Key in the total number of payments, press n
2) Key in the interest rate per payment period, press i
3) Key in the future value, press FV
4) Press PMT to calculate the payment amount.

Example: If, in 9 years, you wish to take a $10,000 trip around the world, how much must you deposit per month in a savings account which pays 6% compounded monthly?

44

Enter:

[CLEAR] 9 [SAVE↑] 12 [×] [n]

6 [SAVE↑] 12 [÷] [i]

10000 [FV] [PMT]

```
        CLEAR

      9.00      ↑
     12.00      ×
    108.00      ◇
            →  N
      6.00      ↑
     12.00      ÷
       .50      ◇
            →  I
  10000.00   →  F
            P M T
     70.06
```

You will have to save $70.06 per month to make that trip.

Payments Required for a Loan

Calculates the number of equal and set payments possible from a given amount when compounded at a given interest rate.

General Routine:

1) Key in the interest rate, press [i]

2) Key in the present value, press [PV]

3) Key in the payment amount, press [PMT]

4) Press [n] to calculate the number of payments possible.

Example: How many $300 payments are required to pay off a $25,000 loan with 7¾% annual interest rate?

Enter:

[CLEAR]

7.75 [SAVE↑] 12 [÷] [i]

25000 [PV] 300 [PMT] [n]

```
        CLEAR

      7.75      ↑
     12.00      ÷
       .65      ◇
            →  I
  25000.00   → P
    300.00   → P T
  N
    120.02
```

You'll have to make 120 payments.

45

Required Interest Rate for a Sinking Fund

Calculates the interest rate per payment period necessary to give a set future amount when the future amount, the payment amount, and the tine period are known.

General Routine:

1) Key in total number of payments, press [n]
2) Key in the payment amount, press [PMT]
3) Key in the future value, press [FV]
4) Press [i] to calculate the necessary interest rate per payment period.

Example: If you are able to invest $100 per month in order to have $5,000 after 42 months, what yield must you obtain on your investment?

Enter:

[CLEAR] 42 [n]

100 [PMT] 5000 [FV]

[i]

```
          CLEAR
     42.00    →  N
    100.00   →PT
   5000.00    →  F
INT
        .83
```

Your investment goal requires a .83% monthly yield.

Amortized Loan Schedule

Calculates the interest paid, the principal paid, and the remaining balance for all payment periods specified. The loan amount, interest rate, and payment amount must be entered. The rounding format set affects this routine.

General Routine:

1) Key in the first payment number in question, press [STO] [1]

2) Key in the last payment number in question, press [STO] [2]

3) Key in the principal amount, press [PV]

4) Key in the interest per payment period, press [i]

5) Key in the payment amount, press [PMT]

6) Press [EXT( )] [6] to calculate and print the schedule. The interest paid for the scheduled periods is printed after the schedule.

Example: List the amortization schedule from the 13th through the 15th payment of an 8¾% mortgage for $42,000 with monthly payments of $345.30.

Enter:

[CLEAR] 13 [STO] [1]

15 [STO] [2] 8.75 [SAVE↑]

12 [÷] [i] 345.3 [PMT]

42000 [PV] [EXT( )] [6]

```
            CLEAR

        13.00    →1
        15.00    →2
         8.75     ↑
        12.00     +
          .73    ◊
                 → I
       345.30   →PT
     42000.00   →P
```
period no. ——→ 13
```
interest paid ——→  302.69
principal paid ——→   42.61
balance ——→    41469.54
     14
        302.38
         42.92
     41426.62
     15
        302.07
         43.23
     41383.39
    I N T
```
interest paid for scheduled periods ——→
```
         907.14
```

47

─────────────── NOTE ───────────────

If your HP-81 has Option 002 or 003 (buffered keyboard), keying in another operation causes the calculator to automatically halt the amortized loan schedule.

5
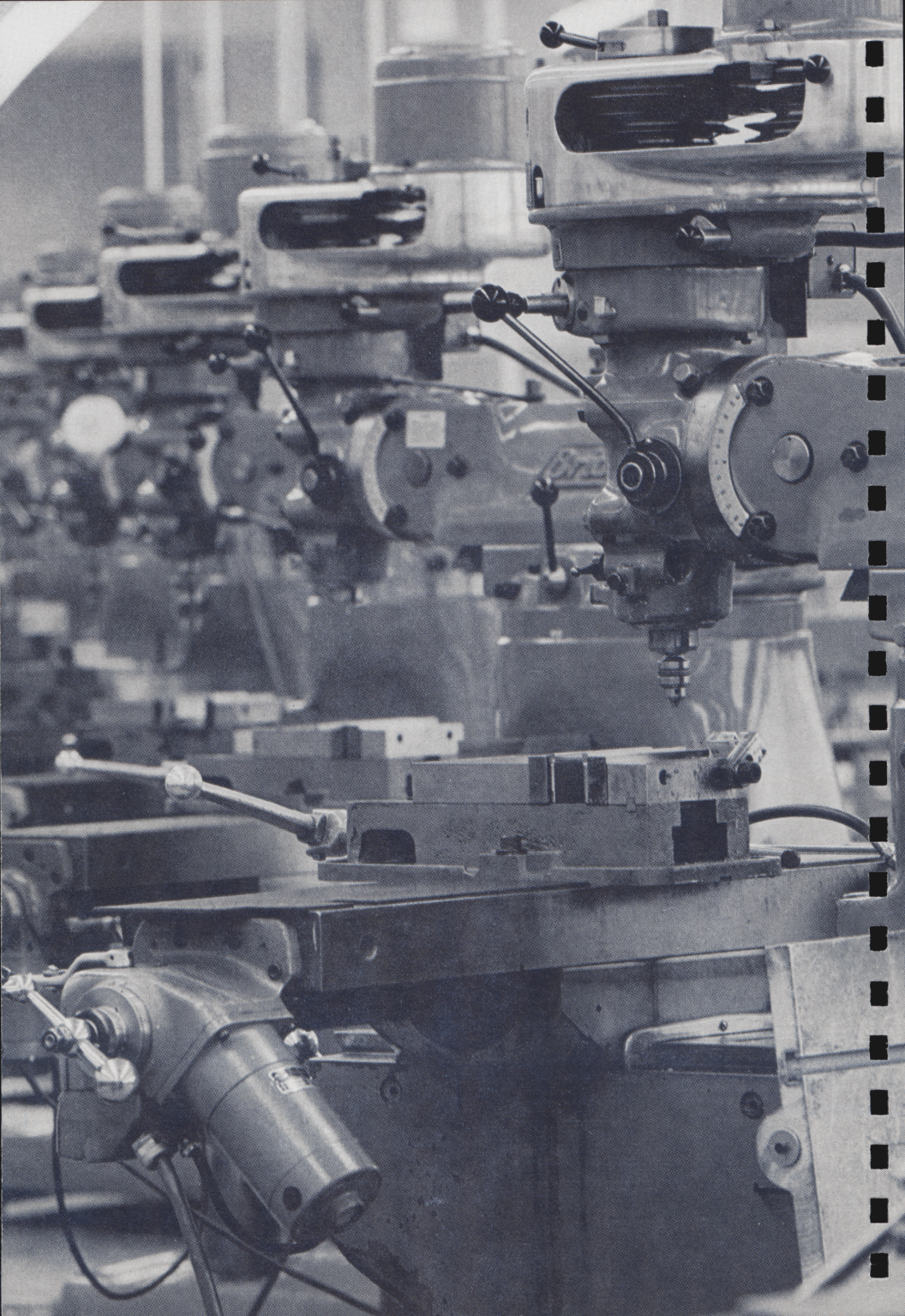
DEPRECIATION

Depreciation represents the loss in value of a physical asset through use and age over a time period.

Glossary

Depreciable life of a physical asset is the number of years (usually) from the time it is purchased until it is depreciated to its salvage value.

Salvage Value represents the amount at which the asset could be sold after its depreciable life has expired.

Depreciation Amount is the monetary amount which the asset will lose in value for any given year. This may be the same for each year in the life of the asset (as in *straight-line depreciation*).

Remaining book value of the asset is the real worth of the asset for any year after all depreciation to that point has been subtracted.

Here are the methods for computing depreciation which you can perform using the HP-81:

Straight-Line Depreciation where the asset declines in value by a set amount each year of it's depreciable life.

Sum-of-the-Digits Method (Sum-of-the-Years-Digits Method and Rule of 78's) This is a general term for methods of computing depreciation where the sum of the numbers, which represent the number of months or years left in the life of the asset, is used to compute the depreciation amount to any particular month or year. The *Rule of 78's* refers to the sum of the numbers representing the months of the year (12 + 11 + 10 1 . . . + 2 + 1 = 78). By this method, depreciation in July of an asset purchased in January, with a depreciable life of one year would be computed by:

1)   12 + 11 + 10 + 9 + 8 + 7 + 6 = 63

2)   63 ÷ 78 = 81% of the depreciable value is spent

3)   100% — 81% = 19% of the depreciable value is left.

The *Sum-of-the-Years-Digits Method* refers to the sum of the numbers representing the number of years left in an asset's depreciable life. For example, with a 10-year asset life, the base digit is 10 + 9 + 8 + 7 + . . . +1 = 55; depreciation after the 4th year would be computed by:

1)   10 + 9 + 8 + 7 = 34

2)   34 ÷ 55 = 62% of the total depreciation is spent

3)   100% — 62% = 38% of the depreciable value is left.

Declining-Balance Method uses a constant percentage (called the diminishing factor) which, when applied to the remaining book value, gives the depreciation amount for that year. This depreciation amount declines each year, since the book value to which the percentage applies also declines.

Depreciation to Salvage Value is used to compute depreciation down to an anticipated salvage value. In other methods of calculating depreciation, the final depreciable value is considered to be zero, since either the salvage amount is subtracted from the initial asset value before any depreciation is computed, or a negligible salvage value is assumed.

─────────────── NOTE ───────────────

The current rounding format affects *each* calculated de-
preciation amount.

Straight-Line Depreciation

Calculates the constant depreciation amount and the remaining depreciable value per year for an asset, given the depreciable asset value and the number of years of depreciation.

General Routine:

1) Key in the depreciable amount (purchase less salvage value), press **SAVE↑,SAVE↑**

2) Key in the asset life in years, press [÷]

3) To find the first year's remaining value, press [STO] [1] [−] [◊]

4) Press [RCL] [1] [−] [◊] for each year's remaining value.

Example: A parking lot is installed at a cost of $29,750.00. If the useful life of the paving is 20 years, what is the annual depreciation amount and remaining value for the first three years by the straight-line depreciation method?

Enter:

29750 [SAVE↑] [SAVE↑] 20 [÷]

[STO] [1] [−] [◊]

[RCL] [1] [−] [◊]

[RCL] [1] [−] [◊]

```
29750.00        ↑
                ↑
  20.00         ÷
1487.50         ◊
               →1
                −
28262.50        ◊
                ↑
1487.50        →1
                −
26775.00        ◊
                ↑
1487.50        →1
                −
25287.50        ◊
```

The depreciation amount is $1,487.50 and the remaining values for the three years are:

Year 1 = $28262.50
Year 2 = $26775.00
Year 3 = $25287.50

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Depreciation by Sum-of-the-Digits Method

Calculates the depreciation amount and the remaining book value of an asset, one year at a time. Only the depreciable value of the asset, its expected life, and the beginning year of depreciation need be entered. The depreciable value must be entered as the original cost minus the eventual salvage value.

General Routine:

1) Key in first year number of depreciation in question, press [STO] [1]

2) Key in expected life (in years) of asset, press [STO] [2]

3) Key in asset cost, press SAVE↑

4) Key in salvage value, press [−] [PV]

5) To find the beginning year's depreciation and remaining depreciable value, press [▬] [SOD]
   CAL

6) Repeat pressing [SOD] to see each successive year's depreciable amount and remaining depreciable value.

Now, to find the depreciation and remaining value for any particular year:

7) Key in the year number, press [STO] [1] and press [▬] [SOD]
   CAL

8) Repeat step 7 as needed.

Example: A tug boat was purchased for $132,000.00 thirteen years ago. After an expected life of 25 years, it will be sold for approximately $5,000. What is the boat's depreciation amount and remaining depreciable value for this year?

Enter:

13 [STO] [1] 25 [STO] [2]

132000 [SAVE↑] 5000 [−] [PV]

[____] [SOD]
      CAL

The depreciation amount is $5080.00, and the remaining value is $30,480.00.

Schedule by Sum-of-the-Years'-Digits Method

This routine calculates a schedule which includes the depreciation amount and remaining book value of an asset over a given number of years. Only the value of the asset, it's expected life, and the beginning year of the schedule must be entered. The depreciable amount must be entered as the initial value of the asset *minus* the eventual salvage value.

General Routine:

1) Key in the first-year number of the schedule, press [STO] [1]

2) Key in life (in years) of asset, press [STO] [2]

3) Key in cost of asset, press **SAVE↑**

4) Key in salvage value, press [−] [PV]

5) Press [EXT( )] [4] to calculate and print the schedule.*

Example: A company will purchase office equipment costing $4,857.00. The trade-in value after 4 years should be $1800. What will be the depreciation amount and remaining value for each year?

*See the NOTE on page 58.

Enter:

1 [STO] 1 4 [STO] 2

4857 [SAVE ↑] 1800 [−] [PV]

[EXT( )] 4

```
                    1.00   →1
                    4.00   →2
                 4857.00     ↑
                 1800.00     −
                            →P
        S    Y    D
        1
                 1222.80
                 1834.20
        2
                  917.10
                  917.10
        3
                  611.40
                  305.70
        4
                  305.70
                    .00
```

Schedule by Declining-Balance Method

Calculates a depreciation schedule of the depreciation amount and the remaining book value of an asset over a given number of years. For this method of calculating depreciation, a negligible salvage value is assumed.

General Routine:

1) Key in first-year number of schedule, press [STO] 1

2) Key in life (in years) of asset, press [STO] 2

3) Key in initial cost of asset, press [PV]

4) Key in 'diminishing factor', press [i]

5) Press [EXT( )] 2 to calculate and print the depreciation schedule.*

Example: A piece of construction equipment is purchased for $25000.00. It has a useful life of 10 years and will have a negligible salvage value at that time. Calculate a depreciation schedule for the last six years, assuming a 200% depreciation rate (double declining-balance method).

*See the NOTE on page 58.

Enter:

5 [STO] [1] 10 [STO] [2]

25000 [PV] 2 [i]

[EXT( )] [2]

```
          5.00   →1
         10.00   →2
      25000.00   →P
          2.00   →  I
          DCL
  FACTR
          2.00
  5
       2048.00
       8192.00
  6
       1638.40
       6553.60
  7
       1310.72
       5242.88
  8
       1048.58
       4194.30
  9
        838.86
       3355.44
  10
        671.09
       2684.35
```

Depreciation to a Stated Salvage Value

This routine calculates a 'diminishing factor' and prints the depreciation schedule. The schedule includes the year number, the depreciation amount and the remaining book value of the asset. The salvage amount which is entered must be a reasonable amount in relation to the original cost and expected life of the asset, so that the diminishing factor and depreciation schedule will also be reasonable and useful.

To find the 'diminishing factor' and print the Declining-Balance Depreciation Schedule:

1) Key in the first-year number of the schedule, press [STO] [1]
2) Key in the life (in years) of the asset, press [STO] [2]
3) Key in the initial asset value, press [PV]
4) Key in the salvage value, press [FV]
5) Press [EXT( )] [3].

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Example: A professional gardener bought five lawnmowers for a total of $489.75. After seven years the machines will be sold for scrap for $50. What is the diminishing factor (depreciation rate) and annual depreciation amount?

Enter:

1 [STO] 1 7 [STO] 2

489.75 [PV] 50 [FV]

[EXT( )] 3

```
                    1.00    →1
                    7.00    →2
                  489.75    →P
                   50.00    →  F
         DMN
          FACTR
                    1.95
        1
                  136.24
                  353.51
        2
                   98.34
                  255.17
        3
                   70.98
                  184.19
        4
                   51.24
                  132.95
        5
                   36.98
                   95.97
        6
                   26.70
                   69.27
        7
                   13.27
                   50.00
```

───────────── NOTE ─────────────

If your HP-81 has Option 002 or 003 (buffered keyboard), keying in another operation will cause the calculator to automatically halt the depreciation schedule.

6

INVESTMENT ANALYSIS

The cash-flow analyses available with the HP-81 are highly-flexible methods of determining the value of an investment, based on an anticipated or actual return of cash.

The cash-flow routines are useful for determining, for example, the interest rate that could be paid on a loan to purchase new machinery — based on the profits which should be returned from the use of that machinery. They are also good investment guides for comparing two or more possible investments to see which is best, based on the probable return from each investment.

Glossary

The *internal rate of return* of a cash flow refers to the average yield per year (per cash-flow period) over the total investment period. This rate of return is based on the amount invested and amount returned.

The *discounted cash flow* approach allows the user to specify the anticipated yield of the cash flow and find out quickly if that rate of return will be achieved. The result is the dollar amount which will be realized *beyond* the anticipated yield (the net gain or loss). This method may be used as a quick trial-and-error way of determining the actual yield of a cash flow, or to compare cash flow yield to the cost (interest rate) of borrowed capital.

Discounted Cash Flow

Calculates the net gain or loss *beyond an expected yield* for a cash-flow investment. If the result is zero, the cash-flow yield is exactly as expected.

The entries must be made in the order shown. Also, the original investment must be entered as a negative number, since it represents a cash outlay.

To find the net gain or loss *beyond an expected yield* for a cash-flow investment:

1) Press [CLEAR]

2) Key in expected yield (in %) per period, press [i]

3) Key in amount of original investment, press [CHS] [PV]

4) Key in first cash-flow amount, press [Σ+]

5) Repeat step 4 for each successive cash flow. The last number printed is the final net gain or loss.

Example: An investor bought a share of the Sitzmark Ski Company for $10,000.00. He borrowed money for the investment at 11% annual interest and expected to get his money back in 5 years. Based on the following cash flows, was it a profitable investment?

Year 1: $3800.00

Year 2: $4125.00

Year 3: $4350.00

Year 4: $3654.00

Year 5: $2775.00

Enter:

[CLEAR] 11 [i] 10000 [CHS] [PV]

3800 [Σ+] 4125 [Σ+]

4350 [Σ+] 3654 [Σ+]

2775 [Σ+]

```
        CLEAR

     11.00    → I
-  10000.00   →P
    3800.00    Σ+
-   6576.58    ◇
    4125.00    Σ+
-   3228.63    ◇
    4350.00    Σ+
-     47.95    ◇
    3654.00    Σ+
    2359.05    ◇
    2775.00    Σ+
    4005.88    ◇
```

Yes, the investment was profitable, since he made his 11% and $4005.88 more.

Rate of Return For Uneven Cash Flow

This routine calculates the internal rate of return (yield) of a series of periodic cash flows from an initial investment. A maximum of nine cash-flow entries may be made.

If both cash inflows and outlays have occurred during a time period, they should be expressed together as a *net* cash flow for that period (outlays must be entered as negative numbers). Cash outlays must be entered at the beginning of the cash-flow listing (i.e., cash outflows must not be intermixed with cash inflows). The rate of return is expressed as a percent per cash-flow time-period.

To find the internal rate of return (yield, in %) of a series of cash flows:

1) Key in the initial investment, press [CHS] [PV]
2) Key in total number of cash flows, press [n]
3) Key in first cash-flow amount, press [STO] [1]
4) Key in second cash-flow amount, press [STO] [2]
5) Continue storing each successive cash flow in its corresponding storage register. The ninth (last) cash flow will be stored in register 9.
6) Press [EXT( )] [1] to find the rate of return (the calculation may take up to two minutes).

Example: A recent blackmailer spent $12,500.00 in suitcases, phone-calls, a car, and lawyer's fees. Based on the following flow of pay-offs, was his investment profitable?

Year 1: $1200
Year 2: $1800
Year 3: $5000
Year 4: $1100
Year 5: $ 900
Year 6: $ 750

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Enter:

12500 [CHS] [PV] 6 [n]

1200 [STO] [1] 1800 [STO] [2]

5000 [STO] [3] 1100 [STO] [4]

900 [STO] [5] 750 [STO] [6]

[EXT( )] [1]

```
 -    12500.00    →P
          6.00    → N
       1200.00    →1
       1800.00    →2
       5000.00    →3
       1100.00    →4
        900.00    →5
        750.00    →6
        DISC ROR
 -       4.71
```

The rate of return was −4.71%. No, crime still does not pay.

Rate of Return For Even Cash Flows

Calculates the rate of return (yield) of a series of equal periodic cash flows. Any number of cash flows may be used. The entry sequence for this routine differs from that of the Uneven Cash-Flow Analysis routine previously explained, because a different approach is used.

General Routine:

1) Press [CLEAR]

2) Key in the total number of cash flows, press [n]

3) Key in the amount of initial investment, press [PV]

4) Key in the cash-flow amount, press [PMT]

5) Press [i] to find the rate of return.

Example: A woman wishes to buy a boarding house but she must get a mortgage at 11.5% interest. If she could collect $3,600 a year in rent and could have a 15-year mortgage on the $32,500 house, would the venture be profitable?

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Enter: [CLEAR]

15 [n] 32500 [PV]

3600 [PMT] [i]

```
        C L E A R
     1 5 . 0 0    →  N
  3 2 5 0 0 . 0 0   →P
     3 6 0 0 . 0 0   →P T
 I  N  T
      7 . 1 4
```

At a 7.14% rate, the return is not equal to the mortgage interest rate.

If she raises the rent to $4,800 a year, would the investment be profitable?

Enter:

4800 [PMT] [i]

```
    4 8 0 0 . 0 0   →P T
 I  N  T
     1 2 . 1 1
```

At a 12.11% rate of return, the investment would be profitable, since that rate is greater than the mortgage interest rate.

7

STATISTICS

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Month	No. of Units Sold
1	47
2	59
3	57
4	63
5	62
6	58

PROJECTED SALES

ACTUAL SALES

CLEAR

47.00
59.00
57.00
63.00
62.00
58.00

T
T
T
T
T
T

FACTR

T   L

.43

2.00

50.67
7.00

N

64.67

66.67

68.67

70.67

72.67

74.67

S

y

y

y

y

y

80

60

40

20

SALES (IN UNITS)

0   2   4   6   8   10   12

MONTH
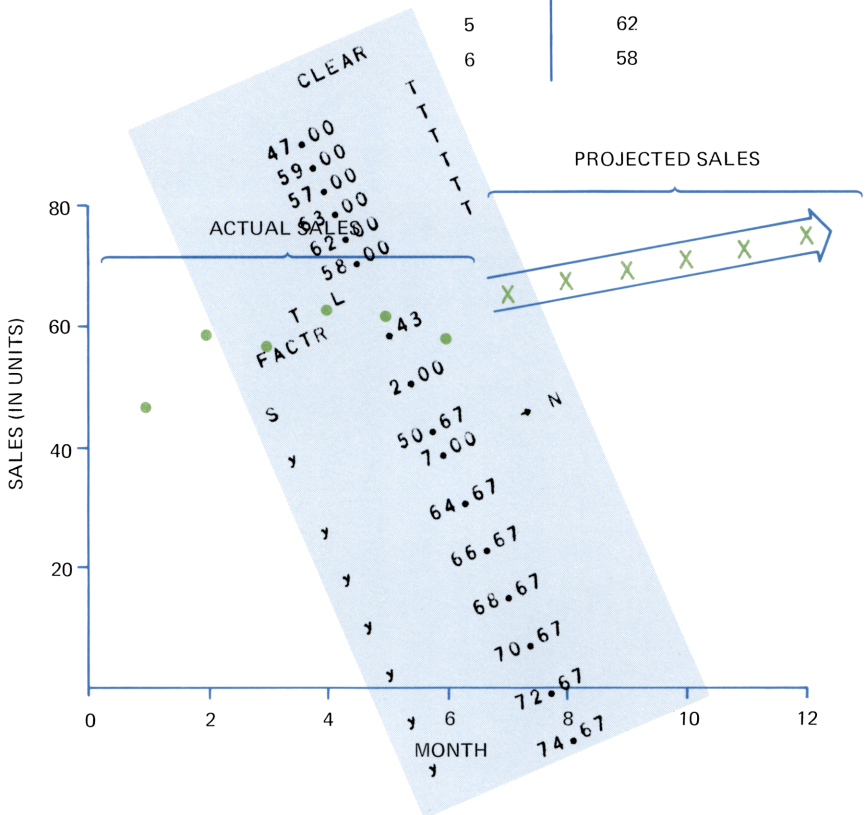
This section includes four statistics routines useful in business.

Glossary *

The *mean* of a set of numbers is the arithmetic average found by adding all the entries and dividing the sum by the number of entries.

The *standard deviation* of a set of a numbers expresses the average difference between the data values and the mean of those values.

A *trend line* is a method of analyzing a series of data values for a trend pattern. It is particularly useful for predicting future values, assuming that the trend will continue.

Least-squares linear regression is the statistical name for the method which the HP-81 uses to find the best possible trend line through the various data values.

The *determination coefficient* tells how well the trend line fits the data values, where a factor of '1' indicates a perfect fit and a factor of '0' indicates no fit at all (i.e., random values). Since the trend line is a straight line, it may not always be the best method for prediction when the entry values go up and down periodically; however the determination coefficient will tell the user how useful the trend line is for any particular set of data values.

The *log trend line* is useful when percent changes rather than value changes are important, as for growth analysis. The steeper the slope of the trend line, the greater the growth.

The *slope* and *Y-axis intercept* of the trend line are essential for calculating the actual equation of that line. The equation is:

$$Y = \text{'Y-axis intercept'} + \text{'slope'} * X$$

*See Appendix D for all statistics equations.

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That equation may be used to make a chart of the trend line. Note that semi-log graph paper must be used to plot the Log Trend Line.

Mean and Standard Deviation

To calculate the arithmetic mean and standard deviation* from that mean of a group of numerical entries:

1) Press [CLEAR]

2) Key in first number, press [Σ+]

3) Repeat step 2 for each number entry;

4) Press [x̄] .

―――――――――――― NOTE ――――――――――――

To correct a wrong entry, key in the number again and press ▬▬ [Σ+] .
                                    Σ−

Example: In a recent survey to determine the average age of the 10 wealthiest people in the U.S., the following data was obtained:

62 84 47 58 68 60 62 59 71 73

Of the ages given, what is the mean and the standard deviation?

Enter: [CLEAR]

62 [Σ+] 84 [Σ+] 47 [Σ+]

58 [Σ+] 68 [Σ+] 60 [Σ+]

62 [Σ+] 59 [Σ+] 71 [Σ+]

73 [Σ+] [x̄]

CLEAR	
62.00	Σ+
84.00	Σ+
47.00	Σ+
58.00	Σ+
68.00	Σ+
60.00	Σ+
62.00	Σ+
59.00	Σ+
71.00	Σ+
73.00	Σ+
σ 10.10	
N 10.00	
x̄ 64.40	

*The formula used for standard deviation is: $\sqrt{\dfrac{\Sigma x^2 - 1/n\ (\Sigma x)^2}{n-1}}$

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Now, delete the highest and lowest ages and find the new mean and standard deviation:

Enter:

84 ▭ Σ+ 47 ▭ Σ+ x̄
     Σ–   Σ–

```
8 4 . 0 0    Σ-
4 7 . 0 0    Σ-
σ    5 . 7 4
N    8 . 0 0
x̄   6 4 . 1 3
```

Trend Line Analysis

This routine calculates the linear regression of a series of equally spaced data points.

The determination coefficient expresses the 'goodness of fit' of the trend line through the data values, where a factor of 1 means a perfect fit, and a factor of 0 means a random pattern of data values and no correlation to the trend line.

General Routine:

1) Press [CLEAR]

2) Key in the first data value, press [TL]

3) Repeat step 2 for each data value to be entered;

4) Press ▭ [TL] to find the coefficient, slope, and Y-axis
        [CAL]
intercept point.

To find an unknown point on the trend line:

5) Key in the appropriate time-period number (X-value), press [n]

6) Press [TL] to print the predicted Y-value.

Example: The Hunt-n-Peck Typewriter Co. wishes to quickly analyze the sales rate of their newest product, so that its future sales rate can be predicted. Here are the sales results for the product's first six-month period:

Month	No. of Units Sold
1	47
2	59
3	57
4	63
5	62
6	58

To find the sales trend for the first six-month period:

Enter: [CLEAR]

47 [TL] 59 [TL] 57 [TL]

63 [TL] 62 [TL] 58 [TL]

■■ [TL]
CAL

```
                                  CLEAR
                       47.00         T
                       59.00         T
                       57.00         T
                       63.00         T
                       62.00         T
                       58.00         T
                          T    L
                    FACTR
Determ. coeff. ──→              .43
                     S
        slope ──→              2.00
                     y
    intercept ──→            50.67
```

Based on the previous six-month interval, find the product sales for each of the next six months:

Enter:

7 [n] [TL]

```
                       7.00    ─→ N
                     y
                     64.67
                     y
                     65.67
                     y
                     68.67
                     y
                     70.67
                     y
                     72.67
                     y
                     74.67
```

Repeat pressing [TL] for each successive month (the HP-81 automatically increments n).

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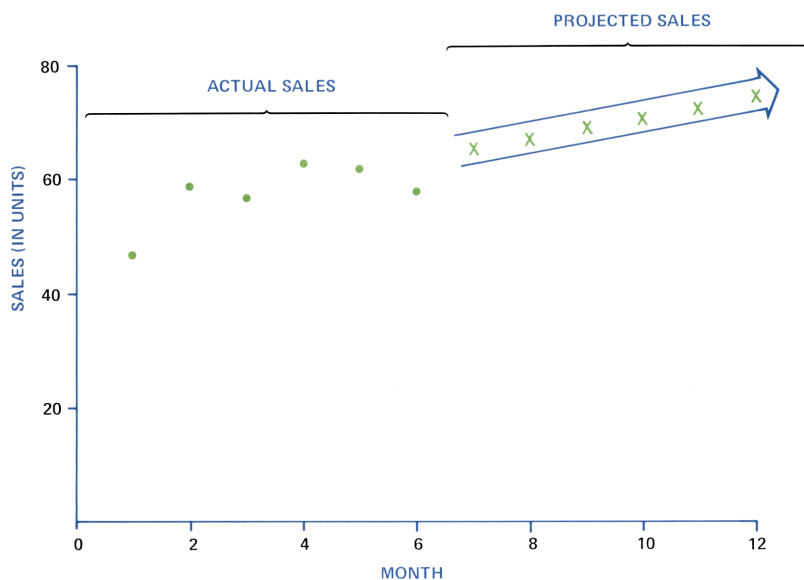The actual sales and projected sales are shown in the following graph.

If the sales trend continues as projected, what will be the percent growth for the year?

Enter:

47 [S A V E ↑] 74.67 ▬▬ [%] [◊]
       Δ%

% growth for year

```
47.00      ↑
74.67   Δ  ✗
58.87      ◊
```

Expanded Trend Line

Calculates a two-variable trend line (by the least-squares linear regression method), including the determination coefficient, slope, and Y-axis intercept. The equation of the trend line is:

$$Y = \text{'Y-axis intercept'} + \text{'Slope'} * X$$

This routine allows the user to enter both X and Y values, as is necessary when the data points are not equally spaced. The X value is the independent variable (e.g., number of years, months, hours, etc.) and the Y value is the dependent variable (e.g., asset value by year, cost of living per month, production per hour, etc.).

The determination coefficient expresses the 'goodness of fit' of the trend line through the data values. A factor of 1 means a perfect fit, and a factor of 0 means a random pattern of data values and no correlation to the trend line.

The data can be entered in any order, except that the first X-value must not be zero.

General Routine:

1) Press [CLEAR]

2) Key in first X value, press [STO] [TL]
   Key in corresponding Y value, press [TL]

3) Repeat step 2 for each data pair.

4) Press [▬▬] [TL] to print the coefficient, slope, and Y-axis
   intercept point.
   [CAL]

To find an unknown point on the trend line:

5) Key in the corresponding X value, press [n]

6) Press [TL] to print the predicted Y value.

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Example: The Customer Service Dept. for the Hunt-n-Peck Typewriter Co. wishes to predict the future repair costs for its newest product, based on these incomplete records:

Month (X-variable)	Repair Costs (Y-variable)
1	$750
2	?
3	$810
4	$730
5	?
6	$590

To calculate a trend line from the above values,

Enter:

CLEAR 1 STO TL 750 TL

3 STO TL 810 TL

4 STO TL 730 TL

6 STO TL 590 TL

[CAL] TL

```
        CLEAR
    1.00    →3*
  750.00      T
    3.00    →3*
  810.00      T
    4.00    →3*
  730.00      T
    6.00    →3*
  590.00      T
      T   L
  FACTR
            .57
  S
  -      33.85
  y
      838.46
```

Now, to find the next six-month's repair costs, based on the current trend,

Enter:

7 n TL 12 n TL

```
      7.00    →  N
  y
  601.54
      12.00   →  N
  y
      432.31
```
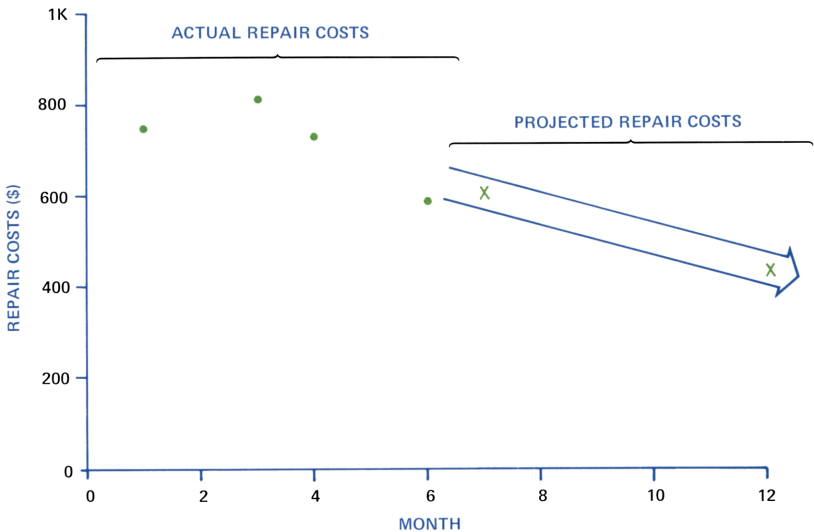
75

The results are shown in the following graph.

Log Trend Line

Calculates a logarithmic trend line (by the least-squares linear regression method) including the determination coefficient, slope, and Y-axis intercept. This routine is a combination of the special LOG key and either the Trend Line or the Expanded Trend Line routine.
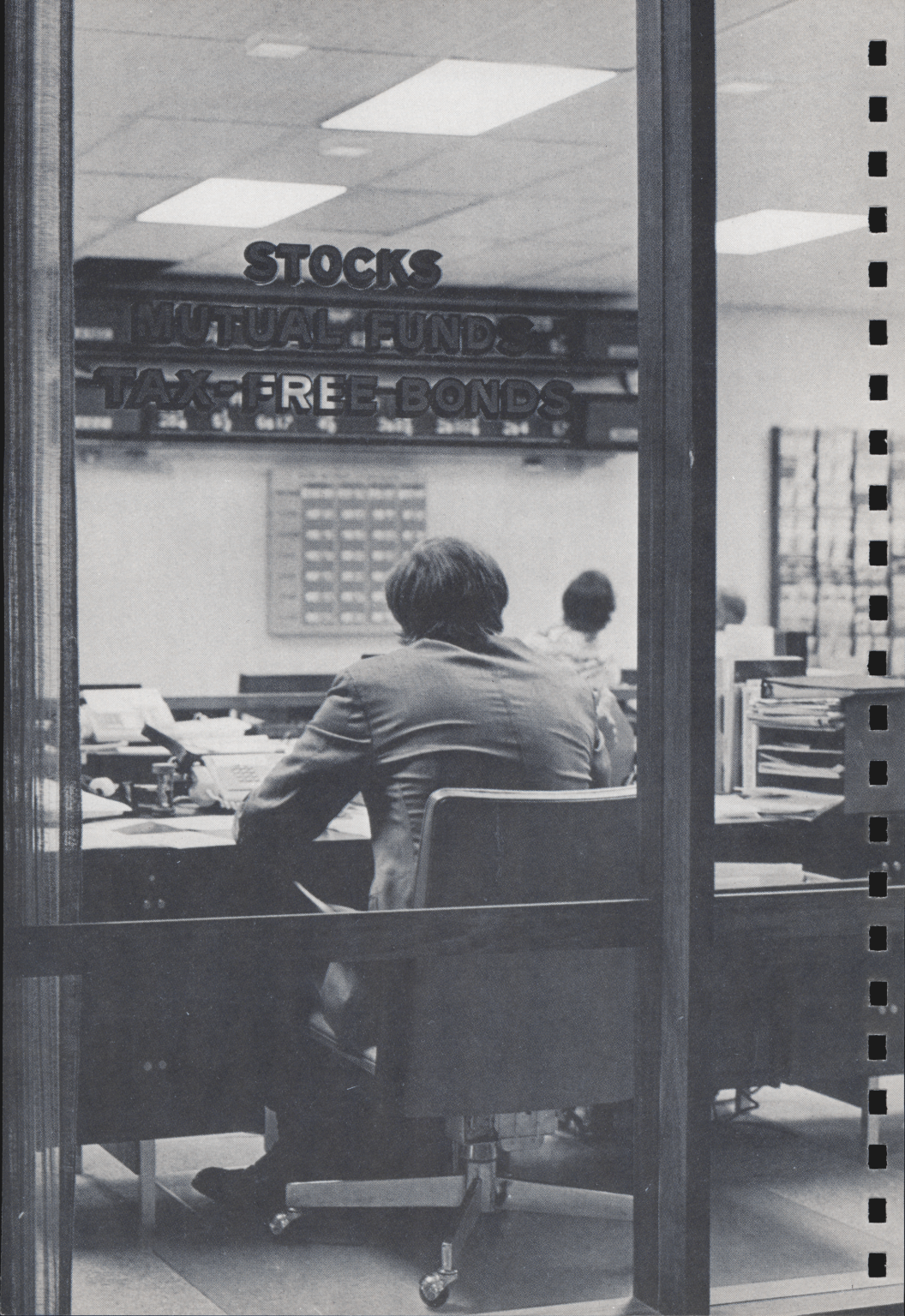
General Routine:

1) Find the log of each Y-value by keying in the value and pressing ▬ $\boxed{-}$ (LOG). *All Y_{log} values must be calculated before starting the trend line routine.*

2) Now use those Y_{log} values to perform either trend line routine.

3) To convert each result back to a natural number,

   a) Press 10 **SAVE↑**

   b) Key in the log result, press $\boxed{y^x}$.

8

BONDS and NOTES ANALYSIS

Glossary

A *bond* is a written agreement to pay a sum of money, called the face value or redemption value, plus periodic interest payments, called *coupons*, over the life of the bond.

A bond may be purchased at its face value (at *par*), below the face value (at a *discount*) or above the face value (at a *premium*). An investor's willingness to buy a bond at other than face value depends largely on the interest rate (and thus the effective yield) that the bond should bring. The value of a bond is almost invariably expressed in multiples of $100.

The *yield* of a bond is computed as a combination of the percentage of interest paid and the difference (if any) between the purchase price and the redemption price. For example, if a 5-year bond for $100 is purchased for $95 and has a coupon rate of 5%, the effective annual yield will be approximately 6% since the extra $5 realized at redemption adds an extra 1% per year to the yield.

A *callable bond* is one which may be redeemed on a specified date before maturity (the *call date*) at a specified price (the *call price*).

The *settlement price* of a bond or note is its value on the day before the issue is traded. This date is the *settlement date*.

A *note* is a written agreement to pay a sum of money plus interest at a certain rate. Notes do not have periodic coupons, since all interest is paid at maturity. They may be purchased at par, at a discount, or at a premium.

For after-tax computations, the interest or coupon payments are considered income, while the difference between bond or note face value and its purchase price is considered capital gains.

Entering Days

The entries for the number of days (to maturity, to call, etc.) may be made in either of two ways:

- If the actual number of days is known, it may be entered.

- If the transaction dates are known, they may be entered in the month-day-year format (mm.ddyyyy), to permit the HP-81 to calculate the number of days between the two dates.

Data-Entry Keys

The bond and note routines use these keys:

Number of days ➜ [STO] [DAY] and/or [n]

Yield ➜ [i]

Interest or Coupon Rate ➜ [PMT]

Note or Bond Price ➜ [PV]

Call Price ➜ [FV]

─────────────── NOTE ───────────────

Press [CLEAR] before starting each Bond or Note calculation. Also, you may list the modes currently set by pressing [   ] [◊] .

PRM

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Bond Price

To calculate the price of a bond given the settlement date, maturity date, effective yield to maturity, and the coupon rate:

1) Press [CLEAR]

2) See page 125 to set desired modes (Bond mode *must* be set).

3) Key in settlement date*, press **SAVE↑**

4) Key in maturity date*, press [DAY]

5) Key in yield to maturity (as a %), press [i]

6) Key in coupon rate (as a %), press [PMT]

7) To find the bond price, press 🟩 [PV].
   BND

Example: Find the price of a bond maturing on September 15, 1984 which has a yield of 6¼% and a coupon rate of 5%. The settlement date is November 2, 1973. (Use the Pre-tax mode, Semiannual Coupon mode, Actual-Day Month mode, and 365-Day Year mode).

Since all the required modes are automatically set when the HP-81 is switched ON,

Enter: [CLEAR]

11.021973 [SAVE↑] 9.151984 [DAY]

6.25 [i] 5 [PMT] 🟩 [PV]
                     BND

```
              C L E A R
      11.021973        ↑
       9.151984
   D A Y S
       3970.00
          5.25    → I
          5.00    →PT
   P R I C E
       T O      M A T
       90.24
```

---

*If the number of days (in the proper days/month and days/year mode) from settlement to maturity is known, that may be entered with [STO] [DAY].

Bond Yield-to-Maturity

To calculate the yield of a bond given the settlement date, maturity date, bond price, and coupon rate:

1) Press [CLEAR]

2) See page 125 to set desired modes (Bond Mode *must* be set).

3) Key in settlement date*, press **SAVE↑**

4) Key in maturity date*, press [DAY]

5) Key in coupon rate (as a %), press [PMT]

6) Key in bond price, press [PV]

7) To find the bond yield, press ▬ [i].
   YTM

Example: Find the yield of a bond that matures on December 14, 1990 and has a price of 98.875 and a coupon rate of 4¾%. The settlement date is January 5, 1974. (Use the After-tax mode, Semiannual Coupon mode, Actual-day Month mode, and 365-day Year mode.)

To set the After-tax mode,

Enter:

[CLEAR] ▬ [EXT( )] [1]
         M( )

To store an income tax rate of 48% and a capital gains rate of 30%,

Enter:

48 [STO] [1] 30 [STO] [2]

Now Enter:

1.051974 [S↑AVE] 12.141990 [DAY]

4.75 [PMT] 98.875 [PV] ▬ [i]
                            YTM

```
              CLEAR

AFT                  TX1

        48.00     →1
        30.00     →2


        1.051974         ↑
       12.141990
D A Y S
        6187.00
             4.75    →PT
           98.875    →P
       YIELD
       TO        MAT
            2.54
```

*If the number of days (in the proper day/month and day/year mode) from settlement to maturity is known, that may be entered with [STO] [DAY].

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Bond Price-to-Call

To calculate the current price-to-call of a bond, assuming a certain future call date and call price:

1) Press CLEAR

2) See page 125 to set desired modes (Bond mode *must* be set).

3) Key in the settlement date*, press SAVE↑

4) Key in the call date*, press DAY

5) Key in the yield-to-call rate (as a %), press i

6) Key in the coupon rate (as a %), press PMT

7) Key in the call price, press FV

8) To find the price-to-call, press ▬▬ PV .
BND

Example: Find the price-to-call of a bond with a call price of 105.75 and a call date of May 20, 1978. The bond yield-to-call rate is 5½% and coupon rate is 5¼%. The settlement date is November 16, 1973. (Use the modes automatically set.)

Enter: CLEAR

11.161973 [SAVE↑] 5.201978 DAY

5.5 i 5.25 PMT

105.75 FV ▬▬ PV
BND

```
          CLEAR
  11.161973       ↑
  5.201978
D A Y S
    1646.00
      5.50    → I
      5.25    →PT
    105.75    → F
P R I C E
    T O        C A L L
  103.52
```

---

*If the number of days (in the proper day/month and day/year mode) from settlement to call is known, this may be entered with STO DAY .

Bond Yield-to-Call

To calculate the yield-to-call of a bond, given the settlement date, call date, coupon rate, bond price, and call price:

1) Press [CLEAR]

2) See page 125 to set desired modes (Bond mode *must* be set).

3) Key in settlement date*, press **SAVE↑**

4) Key in call date*, press [DAY].

5) Key in coupon rate (as a %), press [PMT]

6) Key in bond price, press [PV]

7) Key in call price, press [FV]

8) To find the yield-to-call rate, press ▬ [i].
       YTM

Example: Find the yield-to-call of a bond with a price of 104.125, a call date of July 10, 1981, a coupon rate of 7¼%, and a call price of 103. The settlement date is November 19, 1973. (Use the calculating modes automatically set.)

Enter: [CLEAR]

11.191973 [SAVE↑] 7.101981 [DAY]

7.25 [PMT] 104.125 [PV] 103 [FV]

▬ [i]
   YTM

```
        CLEAR
  11.191973      ↑
   7.101981
D A Y S
    2790.00
       7.25    →PT
   104.125     →P
   103.00    →  F
  YIELD
    TO      CALL
      6.85
```

---

*If the number of days (in the proper day/month and day/year mode) from settlement to call is known, it may be entered with [STO] [DAY].

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Note Price

To calculate the settlement price of a note (be sure to enter dates in this order):

1) Press [CLEAR]

2) See page125 to set desired modes (Note mode *must* be set)

3) Key in issue date*, press **SAVE↑**

4) Key in maturity date*, press [DAY] and [n]

5) Key in settlement date†, press **SAVE↑**

6) Key in maturity date†, again press [DAY]

7) Key in yield to maturity (as a %), press [i]

8) Key in interest rate (as a %), press [PMT]

9) To find the price, press [■] [PV] .

Example: Find the settlement price of a note with a 5¼% interest rate and a 6% yield to maturity. The issue date is January 5, 1972, maturity date is January 30, 1978 and settlement date is December 20, 1973. (Use all modes automatically set except Note mode.)

Enter:

[CLEAR] [■] [EXT( )] [9] (Note mode)

1.051972 [SAVE↑] 1.301978 [DAY] [n]

12.201973 [SAVE↑] 1.301978 [DAY]

6 [i] 5.25 [PMT] [■] [PV]

```
            C L E A R
N O T E              9
      1.051972      ↑
      1.301978
D A Y  S
       2217.00
                  → N
   12.201973       ↑
    1.301978
D A Y  S
     1502.00
        6.00   → I
        5.25   →PT
  P R I C E
      T O      M A T
      95.49
```

*If the number of days from issue to maturity is known, it may be entered with [n] .

†If the number of days from settlement to maturity is known, it may be entered with [STO] [DAY] .

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Note Yield-before-Maturity

To calculate the yield of a note (be sure to enter dates in this order):

1) Press CLEAR

2) See page 125 to set desired modes (Note mode *must* be set).

3) Key in issue date*, press **SAVE↑**

4) Key in maturity date*, press DAY and n

5) Key in settlement date†, press **SAVE↑**

6) Key in maturity date again†, press DAY

7) Key in interest rate (as a %), press PMT

8) Key in settlement price, press PV

9) To find the note yield, press ▆▆ i
                                     YTM

Example: Find the yield of a 90-day note having a settlement price of $100, and an interest rate of 7%. The maturity date is February 20, 1974, and settlement date is January 21, 1974. (Use all modes automatically set except the Note mode.)

Enter: CLEAR

▆▆ EXT( ) 9   (Note mode)
   M( )

90 n

1.211974 SAVE↑ 2.201974 DAY

7 PMT 100 PV ▆▆ i
                 YTM

```
          CLEAR
N O T E            9
        9 0 . 0 0    → N
   1 . 2 1 1 9 7 4     ↑
   2 . 2 0 1 9 7 4
D A Y S
        3 0 . 0 0
         7 . 0 0    →P T
       1 0 0 . 0 0  →P
   Y I E L D
     T O       M A T
         6 . 9 2
```

*If the number of days from issue to maturity is known, it may be entered with n .

†If the number of days from settlement to maturity is known, it may be entered with

STO DAY .

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Discounted Note

To calculate a note's discount amount (interest) and effective annual yield:

1) Press [CLEAR]

2) Set the desired days-per-year mode (see page 125)

3) Key in the issue date*, press SAVE↑

4) Key in the maturity date*, press [DAY] and [n]

5) Key in the annual interest rate (as a %), press [i]

6) Key in the note par value, press [FV]

7) Press [▬] [PMT] .
                 INT

To find the results in the alternate days-per-year mode:

8) Press [R↓] [R↓] for the discount amount

9) Press [R↓] again for the effective annual yield.

Example: What is the discount amount on a $1000 note (par value is 100) having 37 days until maturity and a 6% interest rate? What is the effective annual yield?

Enter:

[CLEAR] [▬] [EXT( )] [7]   (365-day Year mode)
              MI)

37 [n] 100 [FV] 6 [i]

[▬] [PMT]
       INT

```
           CLEAR
 B  A        365      7

             37.00   → N
           100.00   → F
             6.00   → I
 EF   YIELD
             6.04
           DISC   AMT
             .61
```

*If the number of days from issue to maturity is known, it may be entered with [n] .

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Coupon-Equivalent Yield

This routine is useful for comparing discounted notes with bonds. The purchase price must be accurate to 4 decimal places, to insure that the answer is usable.

To calculate the yield of a discounted note as if it were a bond selling at par with semiannual coupons:

1) Set the rounding format by pressing ▬ 4

2) Key in the settlement date*, press **SAVE↑**

3) Key in the maturity date*, press DAY

4) Key in the note purchase price, press PV

5) To find the note's coupon-equivalent yield, press EXT( ) 8 .

Example: What is the coupon-equivalent yield of a U.S. Treasury bill which has 230 days to maturity and a price of 95.815?

Enter:

▬ 4

230 STO DAY 95.815 PV

EXT( ) 8

```
          230.0000    →4→
           95.8150    →P
          YIELD
            6.8826
```

---

*If the number of days from settlement to maturity is known, it may be entered with STO DAY .

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MARKETING FUNCTIONS

The basic function keys on the HP-81 are used to perform many otherwise long and tedious calculations. The Marketing routines are good examples of the use of the ⌐%⌐ key (also see 'Percentage Calculations' on page 14).

The following term may need some explanation.

A *chain discount* is the trade term for a series of discount percentages applied to the retail price to determine the discount price. The first percentage is applied to the retail price, the second percentage is applied to this result, and the third percentage is applied to the second result to give the final discount price. Note that, for example, a chain discount of 20%/10%/5% results in a different discount price than a regular discount of 35%.
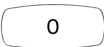
Retail Price

The retail price of an item is calculated on a cost-plus-profit basis. The gross profit (or margin) is usually computed as a percentage of the retail price, rather than a percentage of the cost.

To find the price of an item:

1) Press ⌐1⌐ SAVE↑

2) Key in the profit margin (as a decimal fraction), press ⌐−⌐ ⌐STO⌐ ⌐0⌐

3) Key in item cost, press ▭ ⌐÷⌐ .

4) Repeat step 3 to find the cost of other items with the same profit margin.

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Example: Find the retail price of items costing $10.50, $14.25 and $4.50, with a required profit margin of 35%.

Enter:

1 [SAVE↑] .35 [−] [STO] [0]

10.5 [━] [÷]
⠀⠀⠀⠀÷K

14.25 [━] [÷]
⠀⠀⠀⠀÷K

4.5 [━] [÷]
⠀⠀÷K

```
          1.00      ↑
           .35      −
                   →0
         10.50   N  +
         16.15   ◊
         14.25   N  +
         21.92   ◊
          4.50   N  +
          6.92   ◊
```

The selling prices are:

$16.15
$21.92
$ 6.92

Regular Discount

To find the discount amount and selling price of an item:

1) Key in original price of item, press **SAVE↑**
2) Key in discount rate (as a %), press [%]
3) To print the discount selling price, press [−][◊].

Example: What is the selling price of an item costing $44.95 at a 35% discount?

Enter:

44.95 [SAVE↑] 35 [%] [−] [◊]

```
         44.95     ↑
         35.00     %
         15.73     −
         29.22     ◊
```

The discount amount is $15.73 and the selling price is $29.22.

Chain Discount

To find the selling price, based on a chain discount rate:

1) Key in the original price of item, press **SAVE↑**

2) Key in first discount rate (as a %), press [%] [—]

3) Repeat step 2 for each successive discount rate.

4) To print the discount selling price, press [◊].

Example: What is the discount price of an item with a retail price of $324.85, at a chain discount of 20%/10%/5%?

Enter:

324.85 [SAVE↑] 20 [%] [—]

10 [%] [—] 5 [%] [—] [◊]

```
324.85      ↑
 20.00      %
 64.97      —
 10.00      %
 25.99      —
  5.00      %
 11.69      —
222.20      ◊
```

The discount price is $222.20.

**Appendices**

INSPECTION AND TURN-ON PROCEDURES

Please check to see that all the accessories listed below are present when unpacking your HP-81. Also, inspect the calculator for damage which may have occurred during shipment. If you find any damage or if any accessories listed are missing, you should file a claim with the carrier and contact the nearest -hp- Sales and Service Office listed on pages 112 — 113.

Accessories

Each HP-81 is furnished with these basic accessories:

DESCRIPTION	-hp- PART NUMBER
Operating Guide	00081-90000
Pocket Reference Guide	00081-90001
Printer Paper (2 rolls)	9281-0415
Printer ribbon	9282-0511
Power Cord	(See Below)
Dust Cover	4040-0528
Spare Fuse (one supplied):	
½A, slo-blo (120v operation)	2110-0202
¼A, slo-blo (240v operation)	2110-0201
Travel Case	5061-0707

Power cords with different plugs are available for the calculator. Each plug, together with the part number of the power cord which has that plug, is shown below. The cord packaged with each calculator depends upon where that calculator is to be delivered. If your calculator has the wrong power cord for your area, please contact the nearest -hp- Sales and Service Office.

Standard

8120-1351   8120-1369   8120-1689   8120-1348   8120-0698 *
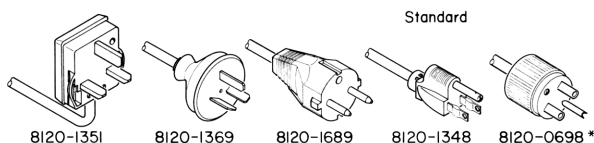
*Approved by U.L. for either 220V or 240V operation in the United States.

Turn-on Procedure

1. Before connecting the power cord to the back of your calculator check the setting of the voltage selector card in the power module (see the following photographs). The number visible indicates which voltage is set. The HP-81 operates on power line frequency of between 48 and 66 Hz. If the card is set to the available power line voltage, you may skip the next step and go to step 3.
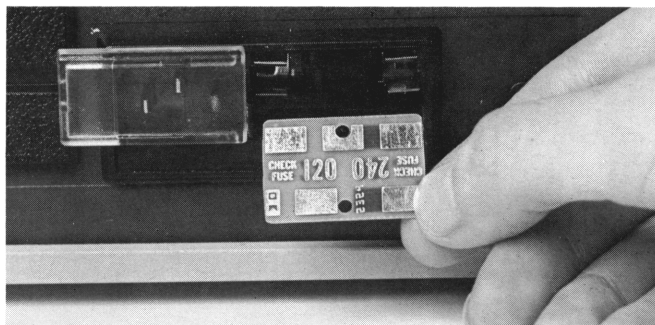
──────────── **CAUTION** ────────────

THE HP-81 CAN BE DAMAGED IF IT IS SWITCHED ON WHEN NOT SET TO THE CORRECT LINE VOLTAGE.

2. To reset the voltage selector card:

a. Slide the plastic window on the power module completely to the left; then remove the fuse by moving the FUSE PULL lever to the left.

b. Pry the voltage selector card out (use a pointed tool such as a ball-point pen) and re-insert it so that the number representing the available line voltage is readable.
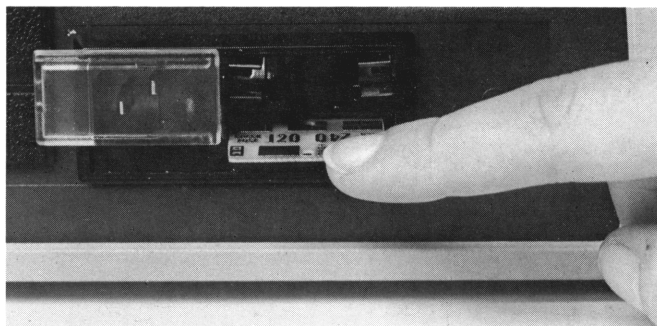
c. Move the FUSE PULL lever to the right and insert the correct fuse for the new line voltage setting. Then slide the plastic window back to the right.

————————— NOTE —————————

For 100 or 120V ac operation, use a ½A. fuse.

For 220 or 240V ac operation, use a ¼A. fuse.

3. Plug the power cord into the back of the calculator and into a suitable power outlet. The calculator requires a maximum of 40 voltamps.

4. Turn your calculator ON by pressing the ⌜POWER⌝ switch. Each time the HP-81 is switched-on, the word 'CLEAR' is printed (provided ⌜PRT OFF⌝ is released). To switch-off the calculator, merely press ⌜POWER⌝ again.

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Your calculator meets current NEMA (National Electrical Manufac-
turers' Association) grounding standards provided that a 3-conductor
power cord is used to supply power to the calculator from a suitably
grounded outlet.

If your calculator does not operate as described above when switched
on, see 'Service' (Appendix C).

APPENDIX B

OPERATING LIMITS

Calculator Range

The HP-81 handles numbers up to 10^{100}. Calculations or data entries exceeding that range are indicated by 'NOTE 1' (and displayed as $9.999999999\ 99$). The calculator also handles numbers as small as 10^{-99}. Calculations or data entries exceeding that range are printed (and displayed) as zero.

Accuracy

The accuracy of the HP-81 varies according to the operation being performed. Arithmetic operations and simple functions (+, −, X, ÷, %, △%, Σ+, Σ−, ÷K, xK) are accurate to within ±1 count in the 10th (least significant) digit.

Special functions (LOG, Y^x, $\sqrt{X}$, $\bar{x}$) are always accurate to not less than 7 digits — the accuracy is due to rounding error and depends upon the individual problem.

Special routines solved through an iterative method (bond yields, effective annual yield, rate conversion problems, etc.) are accurate to not less than 5 digits.

Operating Errors

Improper number entries, key sequences, and calculations are indicated by printed 'NOTES' and a flashing display (if installed). A list of operating notes is at the back of this guide, and under the calculator top-cover.

Temperature Range

Operating and Storage: 0° to 45°C (32° to 113°F)

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SERVICE and MAINTENANCE

Checkout Procedure

If the calculator fails to turn ON properly, check these possible causes:

1. Is the calculator set to operate on the correct line voltage?

2. Is the fuse burned out? (Look for a broken filament inside the fuse.) Follow steps 2a and 2c of the 'Turn-on Procedure' when checking or replacing the fuse.

Should the calculator print anything but 'CLEAR' when it is switched ON, carefully press the following sequence of keys and compare the results with those shown.

A. Preliminary Checkout

1. Switch [PRT OFF] UP and [DECIMAL AUTO] DOWN.
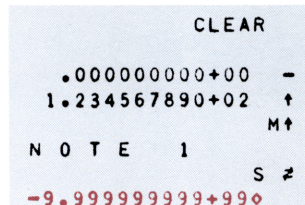
2. Press: [CLEAR]   *0.00*

3. Press: ▭ [9] [−]   *0.000000000 00*

4. Press: 123.456789 [S A V E ↑]   *1.234567890 02*

5. Press: [yˣ]   *9.999999999 99*
   (flashing)

6. Press: [CHS] [◊]   *−9.999999999 99*

```
            CLEAR
    .000000000+00    —
  1.234567890+02    ↑
                      M↑
  N O T E   1
                      S ⇄
  −9.999999999+99◊
```

If, after repeated attempts, your results fail to duplicate those shown, return your calculator according to the Shipping Instructions on page 107.

If you suspect the operation of a particular routine, perform any of the following checkouts related to that routine. Carefully go through each key sequence and compare your printout with the sample shown.

B. General Functions and Statistics

1. Press: [CLEAR] ▬ [2]

2. Press: [6] [SAVE] [×] [9] [÷]

3. Press: [STO] [3] [5] [Σ+]

4. Press: [RCL] [3] [Σ+] [x̄]

5. Press: [x⇄y] [yˣ] ▬ [yˣ]

6. Press: [CHS] [✳] [◊]

```
        CLEAR

     6.00        ↑
                 ×
    36.00        ◊
     9.00        ↑
     4.00        ◊
                →3
     5.00        Σ+
                 ↑
     4.00       →3
     4.00        Σ+
σ
      .71
N
     2.00
x̄
     4.50
      .71        ⇄
                M↑
     2.90        ◊
                 √
     1.70        ◊
                S ⇄
 —   1.70        ✳

      .00        ◊
```

C. Calendar Functions

1. Press: [CLEAR]

2. Press: [1] [.] [0] [1]

   [1] [9] [8] [0] [SAVE]

3. Press: [3] [6] [5] ▬ [DAY]

```
        CLEAR
    1.011980      ↑
      365.00
 DATE           3
   12.311980
```

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D. Trend Line

1. Press: `CLEAR`

2. Press: `1` `STO` `TL` `1` `TL`

3. Press: `5` `STO` `TL` `3` `TL`

4. Press: ▬ `TL` (CAL)

```
                    CLEAR
            1.00    →3*
            1.00      T
            5.00    →3*
            3.00      T
      T  L
   FACTR
            1.00
  S
              .50
  y
              .50
```

E. Accrued Interest

1. Press: `CLEAR`

2. Press: `9` `n` `6` `i`

3. Press: `1` `0` `0`

4. Press: `PV` ▬ `PMT` (INT)

```
                    CLEAR
            9.00    →  N
            6.00    →  I
          100.00    →P
   I N T
              .15
```

F. Bonds and Notes

1. Press: `CLEAR`

2. Press: `1` `SAVE↑` `5` `i`

3. Press: `5` `PMT` ▬ `PV` (BND)

```
                    CLEAR
            1.00       ↑
            5.00    →  I
            5.00    →PT
   P  R  I  C  E
        T O        M A T
          100.00
```

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G. Annuities

1. Press: `CLEAR`
2. Press: `9` `n`
3. Press: `9` `PMT`
4. Press: `1` `0` `0`
5. Press: `FV` `i`

```
                CLEAR
       9.00    →  N
       9.00    →PT
     100.00    →  F
 I N T
       5.19
```

H. Accumulated Interest and Cash-Flow Analysis

1. Press: `CLEAR`
2. Press: `1` `STO` `1`
3. Press: `2` `STO` `2` `4` `i`
4. Press: `3` `PMT` `5` `0`
5. Press: `PV` `Σ+`

```
                CLEAR
       1.00    → 1
       2.00    → 2
       4.00    →  I
       3.00    →PT
      50.00    →P
               Σ+
  P   V
      47.96
 I N T
       3.96
```

If your printout results do not duplicate the sample, or if the calculator has a problem not checked by the above procedures (for example, if the `POWER` `OFF` switch does not lock in place), return the calculator according to the following instructions.

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Warranty

The HP-81 is warranted against defects in materials and workmanship, as described by the HP-81 Technical Data Sheet. During the warranty period, we will repair or replace components that prove to be defective, provided that the HP-81 is returned to HP according to the following Shipping Instructions.

Beyond the stated warranty period, your calculator will be repaired for a moderate charge. Again, return the calculator according to the Shipping Instructions.

With regard to the HP-81 pre-programmed routines, we make no express or implied warranty of any kind, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. HP shall not be liable for incidental or consequential damages in connection with or arising out of the furnishing, performance, or use of those routines.

Shipping Instructions

Please be sure that all items are protectively packed to avoid damage while in transit. Such damage would not be covered by warranty. Also, you should insure your shipment.

When returning your calculator for service:

1. Remove the roll of printer paper and the spindle.

2. Include a completed Service Card with the calculator. The card is kept in the reference-book pocket (look under the calculator top-cover). When filling out the Service Card, be sure to indicate the checkout sequences you have completed and briefly describe the calculator problem.

3. Pack the calculator in the travel case.

4. Carefully pack the travel case in a larger cardboard box.

5. Return your calculator to the nearest service location listed on pages 112-113 and mark it, **Attention: Customer Service.**

If you prefer, you can return the calculator to the factory, by sending it to this address:

Hewlett-Packard
815 14th Street S.W.
Loveland, Colorado 80537
**Attn: Calculator Service**

If you have any questions or problems regarding calculator service, please call the nearest -hp- Sales and Service Office.

Replacing Printer Paper

Your HP-81 is furnished with two rolls of printer paper. If you wish to purchase paper other than that supplied by -hp-, many replacement products are available — just be sure to specify 2¼" wide, adding machine paper.

When replacing the printer paper:

1. Be sure to remove any remaining old paper before loading the new roll.

2. Insert the free end of the new paper as shown below, press the [PAPER↑] key, and guide the advancing paper under the paper tear-off bracket.
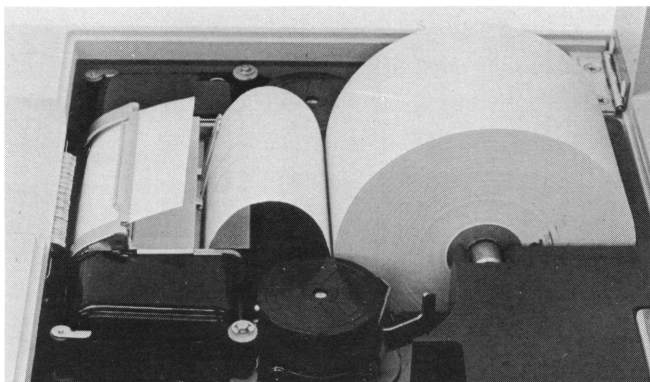
Replacing the Ribbon

The printer ribbon supplied should give many months of reliable service, but when the printout becomes light or intermittent, the ribbon needs replacing. Any adding machine ribbon equivalent to the ribbon supplied with the calculator or either of the products listed below can be used as a replacement.

General Ribbon Co., type E200, black and red intense ribbon.

Columbia Ribbon Co., type 43, black-red record, double-spool ribbon.

When replacing the printer ribbon:

1. Notice the path of the old ribbon before removing it (see drawing below).

2. Be sure the black portion of the new ribbon is *up* when installed.

3. Press [PAPER↑] to draw the ribbon taut before closing the calculator top-cover.
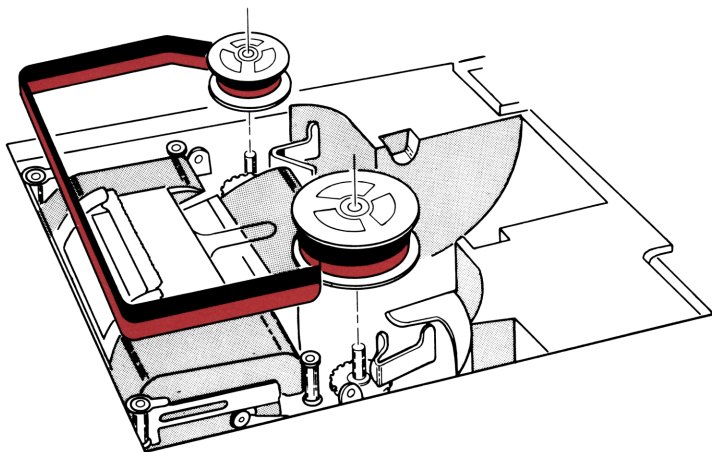
Cleaning the Printer

To ensure clear printouts, we recommend that the printer be cleaned at least every 3 months. The only equipment needed to clean the printer is a brush (any small, stiff-bristled brush will do) and a small amount of denatured (isopropyl) alcohol.

To clean the printer:

1. Remove the printer paper; then lift up the paper tear-off bracket and lift off the small, metal cover plate (see photo below).

2. Remove the ribbon and inspect it for wear; if it looks frayed or perforated — install a new one later.

3. Slide a strip of printer paper (about 6″ long) under and around the metal print drum as shown in the photograph. This paper will catch any particles brushed from the print drum.

4. Use the stiff-bristled brush and a small amount of alcohol to clean each character on the print drum.

BE SURE NOT TO SPILL ALCOHOL ON ANY OF THE OTHER COMPONENTS.

5. After you've cleaned the drum, fold the paper as shown and slowly pull the paper back out from under the drum. Now blow any dust or remaining ribbon particles out of the printer.

6. Replace the small cover plate; snap the paper tear-off bracket back into place, replace the ribbon and the printer paper.

Cleaning the Calculator

Your HP-81 can be cleaned with a soft cloth dampened either in clean water or in water containing a mild detergent. Do not use an excessively wet cloth nor allow water to penetrate inside the calculator. Also, do not use any abrasive cleaners, especially on the display window.

SALES & SERVICE OFFICES

UNITED STATES

CALIFORNIA
1430 East Orangethorpe Ave.
Fullerton 92631
Tel: (714) 870-1000

CUSTOMER SERVICE CENTER
333 Logue Avenue
Mountain View, California 94040

GEORGIA
P.O. Box 28234
450 Interstate North
Atlanta 30328
Tel: (404) 436-6181
TWX: 810-766-4890

ILLINOIS
5500 Howard Street
Skokie 60076
Tel: (312) 677-0400
TWX: 910-223-3613

NEW JERSEY
W. 120 Century Road
Paramus 07652
Tel: (201) 265-5000
TWX: 710-990-4951

TEXAS
P.O. Box 1270
201 E. Arapaho Rd.
Richardson 75080
Tel: (214) 231-6101
TWX: 910-867-4723

CANADA

QUEBEC
Hewlett-Packard (Canada) Ltd.
275 Hymus Boulevard
Pointe Claire
Tel: (514) 697-4232
TWX: 610-422-3022
Telex: 01-20607

AFRICA, ASIA, AUSTRALIA

ANGOLA
Telectra Empresa Técnia
de Equipamentos Eléctricos
SAR
Rua de Barbosa Rodrigues
42.1°
Box 6487
Luanda
Cable: TELECTRA Luanda

AUSTRALIA
Hewlett-Packard Australia
Pty. Ltd.
22-26 Weir Street
Glen Iris, 3146
Victoria
Tel: 20-1371 (6 lines)
Cable: HEWPARD Melbourne
Telex: 31 024

Hewlett-Packard Australia
Pty. Ltd.
Corner Bridge & West Streets
Pymble, New South Wales, 2073
Tel: 449 6566
Cable: HEWPARD Sydney
Telex: 21561

Hewlett-Packard Australia
Pty. Ltd.
97 Churchill Road
Prospect 5082
South Australia
Tel: 65-2366
Cable: HEWPARD Adelaide

Hewlett-Packard Australia
Pty. Ltd.
2nd Floor, Suite 13
Casablanca Buildings
196 Adelaide Terrace
Perth, W.A. 6000
Tel: 25-6800
Cable: HEWPARD Perth

Hewlett-Packard Australia
Pty. Ltd.
10 Woolley Street
P.O. Box 191
Dickson A.C.T. 2602
Tel: 49-8194
Cable: HEWPARD Canberra ACT

Hewlett-Packard Australia
Pty. Ltd.
2nd Floor, 49 Gregory Terrace
Brisbane, Queensland, 4000
Tel: 29 1544

CEYLON
United Electricals Ltd.
P.O. Box 681
60, Park St.
Colombo 2
Tel: 26696
Cable: HOTPOINT Colombo

CYPRUS
Kypronics
19 Gregorios & Xenopoulos Road
P.O. Box 1152
CY-Nicosia
Tel: 45628/29
Cable: KYPRONKS PANDEHIS

ETHIOPIA
African Salespower & Agency
Private Ltd., Co.
P.O. Box 718
58/59 Cunningham St.
Addis Ababa
Tel: 12285
Cable: ASACO Addisababa

HONG KONG
Schmidt & Co. (Hong Kong) Ltd.
P.O. Box 297
1511, Prince's Building 15th Floor
10, Chater Road

Hong Kong
Tel: 240168, 232735
Cable: SCHMIDTCO Hong Kong

INDIA
Blue Star Ltd.
Kasturi Buildings
Jamshedji Tata Rd.
Bombay 400 020
Tel: 29 50 21
Telex: 3751
Cable: BLUEFROST

Blue Star Ltd.
Band Box House
Prabhadevi
Bombay 400 025
Tel: 45 73 01
Telex: 3751
Cable: BLUESTAR

Blue Star Ltd.
14/40 Civil Lines
Kampur 208 001
Tel: 6 88 82
Cable: BLUESTAR

Blue Star, Ltd.
7 Hare Street
P.O. Box 506
Calcutta 700 001
Tel: 23-0131
Telex: 655
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House.
34 Ring Road
Lajpat Nagar
New Delhi 110 024
Tel: 62 32 76
Telex: 463
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House
11/11A Magarath Road
Bangalore 560 025
Tel: 51473
Telex: 430
Cable: BLUESTAR

Blue Star, Ltd.
1-1-117/1
Sarojini Devi Road
Secunderabad 500 003
Tel: 7 63 91, 7 73 93
Cable: BLUEFROST
Telex: 459

Blue Star, Ltd.
23 24 Second Line Beach
Madras 600 001
Tel: 2 39 55
Telex: 379
Cable: BLUESTAR

Blue Star, Ltd.
1B Kaiser Bungalow
Dindli Road
Jamshedpur 831 001
Tel: 38 04
Cable: BLUESTAR
Telex: 240

INDONESIA
Bah Bolon Trading Coy. N.V.
Djalah Merdeka 29
Bandung
Tel: 4915; 51560
Cable: ILMU
Telex: 08-809

IRAN
Multicorp International Ltd.
Avenue Soraya 130
P.O. Box 1212
IR-Teheran
Tel: 83 10 35-39
Cable: MULTICORP Tehran
Telex: 2893 MCI TN

ISRAEL
Electronics & Engineering
Div. of Motorola Israel Ltd.
17 Aminadav Street
Tel-Aviv
Tel: 36941 (3 lines)
Cable: BASTEL Tel-Aviv
Telex: 33569

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
1-59-1 Yoyogi
Shibuya-ku, Tokyo
Tel: 03-370-2281/92
Telex: 232-2024YHP
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Nisei Ibaragi Bldg.
2-2-8 Kasuga
Ibaragi-Shi
Osaka
Tel: (0726) 23-1641
Telex: 5332-385 YHP OSAKA

Yokogawa-Hewlett-Packard Ltd.
Nakamo Building
No. 24 Kamisasazima-cho
Nakamura-ku, Nagoya City
Tel: (052) 571-5171

Yokogawa-Hewlett-Packard Ltd.
Nitto Bldg.
2-4-2 Shinohara-Kita
Kohoku-ku
Yokohama 222
Tel: 045-432-1504
Telex: 382-3204 YHP YOK

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg.,
Rm. 603 3,
2-Chome
IZUMI-CHO,
Mito, 310
Tel: 0292-25-7470

KENYA
Kenya Kinetics
P.O. Box 18311
Nairobi, Kenya
Tel: 57726
Cable: PROTON

KOREA
Amtraco Corporation
Industrial Products Div.
Seoul P.O. Box 1103
8th floor, DaeKyung Bldg.
107 Sejong Ro
Chongro-Ku, Seoul
Tel: 73-8924-7
Cable: AMTRACO Seoul

LEBANON
Constantin E. Macridis
P.O. Box 7213
RL-Beirut
Tel: 220846
Cable: ELECTRONUCLEAR Beirut

MALAYSIA
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya, Selangor
Cable: MECOMB Kuala Lumpur

MOZAMBIQUE
A. N. Goncalves, LDA.
4.1 Apt. 14 Av. D. Luis
P.O. Box 107
Lourenco Marques
Telex: 6-203 NEGON MO
Cable: NEGON

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
94-96 Dixson St.
P.O. Box 9443
Courtenay Place
Wellington, N.Z.
Tel: 56-559
Telex: 6-203 NEGON MU
Cable: HEWPACK Wellington

Hewlett-Packard (N.Z.) Ltd.
Box 51092
Pukuranga
Tel: 56-9837
Cable: HEWPACK, Auckland

NIGERIA
Teil (MesaCom Division)
25 Moronll St, Suru-Lere,
P.O. Box 5705
Lagos
Cable: THETEIL LAGOS

PAKISTAN
Mushko & Company, Ltd.
Oosman Chambers
Abdullah Haroon Road
Karachi 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi

Mushko & Company, Ltd.
38B, Satellite Town
Rawalpindi
Tel: 41924
Cable: FEMUS Rawalpindi

PHILIPPINES
Electromex Inc.
5th Floor, Architects
Center Bldg.
Ayala Ave., Makati, Rizal
C.C.P.O. Box 1028
Makati, Rizal
Tel: 86-18-87, 87-76-77
Cable: ELEMEX Manila

SINGAPORE
Mechanical and Combustion
Engineering Company Ltd.
9, Jalan Kilang
Red Hill Industrial Estate
Singapore, 3
Tel: 642361-3; 632611
Cable: MECOMB Singapore

Hewlett-Packard Far East
Area Office
P.O. Box 87
Alexandra Post Office
Singapore 3
Tel: 633022
Cable: HEWPACK SINGAPORE

SOUTH AFRICA
Hewlett-Packard South Africa
(Pty.), Ltd.
P.O. Box 31716
Braamfontein Transvaal
Milnerton
30 De Beer Street
Johannesburg
Tel: 725-2080, 725-2030
Telex: 0226 JH
Cable: HEWPACK Johannesburg

Hewlett Packard South Africa
(Pty.), Ltd.
Breccastle House
Bree Street
Cape Town
Tel: 3-6019, 3-6545
Cable: HEWPACK Cape Town
Telex: 5-0006

Hewlett Packard South Africa
(Pty.), Ltd.
641 Ridge Road, Durban
P.O. Box 99
Overport, Natal
Tel: 88-6102
Telex: 567954
Cable: HEWPACK

TAIWAN
Hewlett Packard Taiwan
39 Chung Shiao West Road
Sec. 1
Overseas Insurance
Corp. Bldg. 7th Floor
Taipei
Tel: 389160,1,2, 375121,
Ext. 240-249
Telex: TP824 HEWPACK
Cable: HEWPACK Taipei

THAILAND
UNIMESA Co., Ltd.
Chongkoinee Building
56 Suriwongse Road
Bangkok
Tel: 37956, 31300, 31307,
37540
Cable: UNIMESA Bangkok

UGANDA
Uganda Tele-Electric Co., Ltd.
P.O. Box 4449
Kampala
Tel: 57279
Cable: COMCO Kampala

VIETNAM
Peninsular Trading Inc.
P.O. Box H-3
216 Hien-Vuong
Saigon
Tel: 20-805, 93398
Cable: PENTRA, SAIGON 242

ZAMBIA
R. J. Tilbury (Zambia) Ltd.
P.O. Box 2792
Lusaka
Zambia, Central Africa
Tel: 73793
Cable: ARJAYTEE, Lusaka

**MEDITERRANEAN AND
MIDDLE EAST COUNTRIES
NOT SHOWN PLEASE
CONTACT:**
Hewlett-Packard
Co-ordination Office for
Mediterranean and Middle
East Operations
Via Marocco, 7
I-00144 Rome-Eur, Italy
Tel: (6) 59 40 29
Cable: HEWPACKIT Rome
Telex: 61514

**OTHER AREAS NOT
LISTED, CONTACT:**
Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 326-7000
(Feb. 71 493-1501)
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

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CENTRAL AND SOUTH AMERICA

ARGENTINA
Hewlett-Packard Argentina
S.A.C.e.I
Lavalle 1171 - 3°
Buenos Aires
Tel: 35-0436, 35-0627, 35-0341
Telex: 012-1009
Cable: HEWPACK ARG

BRAZIL
Hewlett-Packard Do Brasil
I.E.C. LTDA.
Rua Frei Caneca 1119
01307-**Sao Paulo** - 3, SP
Tel: 288-7111, 287-5858
Cable: HEWPACK Sao Paulo

Hewlett-Packard Do Brasil
I.E.C. LTDA.
Praca Dom Feliciano 78
Salas 806/808
9000-Porto Alegre RS
Rio Grande do Sul (RS)-Brasil
Tel: 25-8470
Cable: HEWPACK Porto Alegre

Hewlett-Packard Do Brasil
I.E.C. LTDA.
Rua da Matriz 29
2000-**Rio de Janeiro,** GB
Tel: 266-2643
Cable: HEWPACK Rio de Janeiro

BOLIVIA
Stambuk & Mark (Bolivia) LTDA.
Av. Mariscal, Santa Cruz 1342

La Paz
Tel: 40626, 53163, 52421
Telex: 3560014
Cable: BUKMAR

CHILE
Héctor Calcagni y Cia, Ltda.
Casilla 16.475
Santiago
Tel: 423 96
Cable: CALCAGNI Santiago

COLOMBIA
Instrumentación
Henrik A. Langebaek & Kier S.A.
Carrera 7 No. 48-59
Apartado Aéreo 6287
Bogota, 1 D.E.
Tel: 45-78-06, 45-55-46
Cable: AARIS Bogota
Telex: 44400INSTCO

COSTA RICA
Lic. Alfredo Gallegos Gurdián
Apartado 10159
San José
Tel: 21-86-13
Cable: GALGUR San José

ECUADOR
Laboratorios de Radio-Ingenieria
Calle Guayaquil 1246
Post Office Box 3199
Quito
Tel: 212-496; 219-185
Cable: HORVATH Quito

EL SALVADOR
Electronic Associates
Apartado Postal 1682
Centro Comercial Gigante
San Salvador, El Salvador C.A.
Tel: 23-44-60, 23-32-37
Cable: ELECAS

GUATEMALA
IPESA
5a via 2-01, Zona 4
Guatemala City
Tel: 63-6-27 & 64-7-86
Telex: 4192 TELTRO GU

MEXICO
Hewlett-Packard Mexicana, S.A.
de C.V.
Adolfo Prieto 622
Col. del Valle
Mexico 12, D.F.
Tel: 543-4232; 523-1874
Telex: 017-74-507

NICARAGUA
Roberto Terán G.
Apartado Postal 689
Edificio Terán
Managua
Tel: 3451, 3452
Cable: ROTERAN Managua

PANAMA
Electrónico Balboa, S.A.
P.O. Box 4929
Ave. Manuel Espinosa No. 13-50
Bldg. Alina
Panama City
Tel: 230833
Telex: 3481003, Curundu,
Canal Zone
Cable: ELECTRON Panama City

PARAGUAY
Z.J. Melamed S.R.L.
Division: Aparatos y Equipos
Médicos
Salón de Exposición y Escritorio
Chile 482
Edificio Victoria—Planta Baja
Asuncion, Paraguay
Tel: 4-5069, 4-6272
Cable: RAMEL

PERU
Compañia Electro Médica S.A.
Ave. Enrique Canaual 312
San Isidro
Casilla 1030
Lima
Tel: 22-3900
Cable: ELMED Lima

PUERTO RICO
San Juan Electronics, Inc.
P.O. Box 5167
Ponce de Leon 154
Pda. 3-PTA de Tierra

San Juan 00906
Tel: (809) 725-3342, 722-3342
Cable: SATRONICS San Juan
Telex: SATRON 3450 332

URUGUAY
Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel: 40-3102
Cable: RADIUM Montevideo

VENEZUELA
Hewlett-Packard De Venezuela
C.A.
Apartado 50933
Caracas
Tel: 71.88.05, 71.88.69, 71.99.30
Cable: HEWPACK Caracas
Telex: 21146 HEWPACK

FOR AREAS NOT LISTED,
CONTACT:
Hewlett-Packard
Inter-Americas
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

EUROPE

AUSTRIA
Hewlett-Packard Ges.m.b.H
Handelska 52/3
P.O. Box 7
A-1205 **Vienna**
Tel: (0222) 33 66 06 to 09
Cable: HEWPAK Vienna
Telex: 75923 hewpak a

BELGIUM
Hewlett-Packard Benelux
S.A./N.V.
Avenue du Col-Vert, 1
B-1170 **Brussels**
Tel: (02) 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494 paloben bru

DENMARK
Hewlett-Packard A/S
Datavej 38
DK-3460 **Birkerod**
Tel: (01) 81 66 40
Cable: HEWPACK AS
Telex: 166 40 hp as

Hewlett-Packard A/S
Torvet 9
DK-8600 **Silkeborg**
Tel: (06) 82-71-66
Telex: 166 40 hp as
Cable: HEWPACK AS

FINLAND
Hewlett-Packard Oy
Bulevardi 26
P.O. Box 12185
SF-00120 **Helsinki** 12
Tel: (90) 13730
Cable: HEWPACKOY Helsinki
Telex: 12-15363 hel

FRANCE
Hewlett-Packard France
Quartier de Courtaboeuf
Boite Postale No. 6
F-91401 **Orsay**
Tel: (1) 907 78 25
Cable: HEWPACK Orsay
Telex: 60048

Hewlett-Packard France
4 Quai des Etroits
F-69321 **Lyon Cedex** 1
Tel: (78) 42 63 45
Cable: HEWPACK Lyon
Telex: 31617

Hewlett-Packard France
29 rue de la Gare
F-31700 **Blagnac**
Tel: (61) 85 82 29
Telex: 51957

GERMAN FEDERAL
REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernerstrasse 117
Postfach 560 140
D-6000 **Frankfurt** 56
Tel: (0611) 50 04-1
Cable: HEWPACKSA Frankfurt
Telex: 41 32 49 fra

Hewlett-Packard GmbH
Vertriebsbüro Böblingen
Herrenbergerstrasse 110
D-7030 **Böblingen,** Wurttemberg
Tel: (07031) 66 72 87
Cable: HEPAK Boblingen
Telex: 72 65 739 bbn

Hewlett-Packard GmbH
Vertriebsbüro Düsseldorf
Vogelsanger Weg 38
D-4000 **Düsseldorf**
Tel: (0211) 63 80 31-35
Telex: 85/86 533 hpdd d

Hewlett-Packard GmbH
Vertriebsbüro Hamburg
Wendenstr. 23
D-2000 **Hamburg** 1
Tel: (0411) 24 05 51/52
Cable: HEWPACKSA Hamburg
Telex: 21 63 032 hphh d

Hewlett-Packard GmbH
Vertriebsbüro München
Unterhachinger Strasse 28
ISAR Center
D-8012 **Ottobrunn**
Tel: (0811) 601 30 61/7
Telex: 52 49 85
Cable: HEWPACKSA München

(West Berlin)
Hewlett-Packard GmbH
Vertriebsbüro Berlin
Wilmersdorfer Strasse 113/114
D-1000 **Berlin W.** 12
Tel: (0311) 3137046
Telex: 18 34 05 hpbln d

GREECE
Kostas Karayannis
18, Ermou Street
GR-**Athens** 126
Tel: 3230-303
Cable: RAKAR Athens
Telex: 21 59 62 rkar gr

IRELAND
Hewlett-Packard Ltd.
224 Bath Road
GB-**Slough,** SL1 4 DS, Bucks
Tel: Slough (0753) 33341
Cable: HEWPIE Slough
Telex: 84413

Hewlett-Packard Ltd.
The Graftons
Stamford New Road
Altrincham, Cheshire, England
Tel: (061) 928.8626
Telex: 668068

ITALY
Hewlett-Packard Italiana S.p.A.
Via Amerigo Vespucci 2
I-20124 **Milan**
Tel: (2) 6251 (10 lines)
Cable: HEWPACKIT Milan
Telex: 32046

Hewlett-Packard Italiana S.p.A.
Piazza Marconi
I-00144 **Rome** - Eur
Tel: (6) 5912544/5, 5915947
Cable: HEWPACKIT Rome
Telex: 61524

Hewlett-Packard Italiana S.p.A.
Vicolo Pastori, 3
I-35100 **Padova**
Tel: (49) 66.40.62
Telex: 32046 via Milan

Hewlett-Packard Italiana S.p.A.
Via Colli, 24
I-10129 **Turin**
Tel: (11) 53 82 64
Telex: 32046 via Milan

LUXEMBURG
Hewlett-Packard Benelux
S.A. N.V.
Avenue du Col-Vert, 1
B-1170 **Brussels**
Tel: (03.02) 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494

NETHERLANDS
Hewlett-Packard Benelux N.V.
Weerdestein 117
P.O. Box 7825
NL **Amsterdam,** Z 11
Tel: (020) 42 77 77
Cable: PALOBEN Amsterdam
Telex: 13 216 hepa nl

NORWAY
Hewlett-Packard Norge A/S
Nesveien 13
Box 149
N-1344 Haslum
Tel: (02) 53 83 60
Telex: 16621 hpnas n

PORTUGAL
Telectra-Empresa Técnica de
Eléctricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-**Lisbon** 1
Tel: (19) 68 60 72
Cable: TELECTRA Lisbon
Telex: 1598

SPAIN
Hewlett-Packard Española, S.A.
Jerez No 8
E-**Madrid** 16
Tel: 458 26 00
Telex: 23515 hpe

Hewlett-Packard Españoia, S.A.
Milanesado 21-23
E-**Barcelona** 17
Tel: (3) 203 62 00
Telex: 52603 hpbe e

SWEDEN
Hewlett-Packard Sverige AB
Enighetsvägen 1-3
Fack
S-161 20 **Bromma** 20
Tel: (08) 98 12 50
Cable: MEASUREMENTS
Stockholm
Telex: 10721

Hewlett-Packard Sverige AB
Hagakersgatan 9C
S-431 41 **Mölndal**
Tel: (031) 27 68 00/01
Telex: 21 312 hpmndl s

SWITZERLAND
Hewlett-Packard (Schweiz) AG
Zürcherstrasse 20
P.O. Box 64
CH-8952 Schlieren **Zurich**
Tel: (01) 98 18 21/24
Cable: HPAG CH
Telex: 53933 hpag ch

Hewlett-Packard (Schweiz) AG
9, Chemin Louis-Pictet
CH-1214 Vernier—**Geneva**
Tel: (022) 41 4950
Cable: HEWPACKSA Geneva
Telex: 27 333 hpsa ch

TURKEY
Telekom Engineering Bureau
Saglik Sok No. 15/1
Ayaspasa-Beyoglu
P.O. Box 437 Beyoglu
TR-**Istanbul**
Tel: 49 40 40
Cable: TELEMATION Istanbul

UNITED KINGDOM
Hewlett-Packard Ltd.
224 Bath Road
GB-**Slough,** SL1 4 DS, Bucks
Tel: Slough (0753) 33341
Cable: HEWPIE Slough
Telex: 84413

Hewlett-Packard Ltd.
'The Graftons''
Stamford New Road
GB-**Altrincham,** Cheshire
Tel: (061) 928-8626
Telex: 668068

Hewlett-Packard Ltd's registered
address for V.A.T. purposes
only:
70, Finsbury Pavement
London, EC2A1SX
Registered No: 69057

SOCIALIST COUNTRIES
PLEASE CONTACT:
Hewlett-Packard Ges.m.b.H.
Handelskai 52/3
P.O. Box 7
A-1205 **Vienna**
Ph: (0222) 33 66 06 to 09
Cable: HEWPACK Vienna
Telex: 75923 hewpak a

ALL OTHER EUROPEAN
COUNTRIES CONTACT:
Hewlett-Packard S.A.
Rue du Bois-du-Lan 7
P.O. Box 85
CH-1217 Meyrin 2 **Geneva**
Switzerland
Tel: (022) 41 54 00
Cable: HEWPACKSA Geneva
Telex: 2 24 86

EQUATIONS

Compounded Amount

Future Value

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

when: $I \neq 0$

Present Value

$$PV = FV (1 + I)^{-n}$$

when: $I \neq 0$

Number of Periods

$$N = \frac{\ln \left(\frac{FV}{PV}\right)}{\ln (1+I)}$$

when: $I \neq 0$

Rate of Interest

$$I = 100 \left[\left(\frac{FV}{PV}\right)^{\frac{1}{n}} - 1 \right]$$

APR Odd-Days Interest

This routine uses the same iterative process as for Rate of Interest for an Annuity, except that an odd days factor is entered via this equation:

$$P = \frac{N}{1 + \frac{N+n}{12} * \frac{AIR}{100}}$$

Where:

N = Number of monthly payments

n = (Number of odd days) $\times \dfrac{12}{365}$

AIR = Add-on interest rate, in percent.

Annuities

$$N = \frac{-\log\left(1 - \frac{PV \cdot I}{PMT}\right)}{\log(1+I)} \qquad\qquad N = \frac{\ln\left(\frac{FV \cdot I}{PMT} + 1\right)}{\ln(1+I)}$$

Future Value

$$FV = PMT\,\frac{(1+I)^N - 1}{I} \qquad\qquad FV = N(PMT)$$

when: $I \neq 0$ $\qquad\qquad\qquad\qquad\qquad$ when: $I = 0$

Present Value of an Annuity

$$PV = PMT\,\frac{1 - (1+I)^{-N}}{I} \qquad\qquad PV = N(PMT)$$

when: $I \neq 0$ $\qquad\qquad\qquad\qquad\qquad$ when: $I = 0$

Payment Amount of a Sinking Fund

$$PMT = FV\,\frac{I}{(1+I)^N - 1} \qquad\qquad PMT = \frac{FV}{N}$$

when: $I \neq 0$ $\qquad\qquad\qquad\qquad\qquad$ when: $I = 0$

Payment Amount of an Annuity

$$PMT = PV\,\frac{I}{1 - (1+I)^{-N}} \qquad\qquad PMT = \frac{PV}{N}$$

when: $I \neq 0$ $\qquad\qquad\qquad\qquad\qquad$ when: $I = 0$

Rate of Interest of an Annuity

This problem uses an iterative routine based on:

$$X_{K+1} = X_K\left[1 + \frac{1 - \dfrac{(X_K-1)P}{(1 - X_K^{-N})}}{\dfrac{N}{1 + X_K^N} + \dfrac{X_K}{X_K - 1}} \right]$$

when solving for FV: P = PV/PMT
when solving for PV: P = -FV/PMT , N = -N

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Amortized Loan Schedule

For each payment period:

$$INT_\ell = \frac{PV_\ell \ (I)}{100}$$

$$PRIN_\ell = PMT - INT_\ell$$

$$PV_{\ell+1} = PV_\ell - PRIN_\ell$$

$$INT_T = \sum_{\ell = J}^{K} INT_\ell$$

Where:

J   = First payment of schedule

K   = Last payment of schedule

I   = Interest Rate of loan (in percent)

PMT   = Payment amount

INT_ℓ = Interest paid in the ℓ th payment

$PRIN_\ell$ = Principal paid in the ℓ th payment

PV_ℓ = Remaining priciple at the ℓ th payment

INT_T = Total interest accumulated between first and last periods of schedule

Sum-of-the-Digits Method

This problem uses an iterative routine based on these equations:

$$PV_{K+1} = PV_K - DEPR_K$$

$$DEPR_K = \frac{[N - K + 1]}{N \ (N+1)/2} \ PV_0$$

Where:

PV_K is the remaining book value after the Kth depreciation period.

N is the number of depreciation periods in the life of the asset.

PV_0 = Principle amount of loan

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Declining-Balance Depreciation (iterative solution)

$$PV_{K+1} = PV_K - DEPR_K$$

$$DEPR_K = M(PV_K)$$

$$M = \frac{DCL\ FCTR}{N}$$

Where:

PV_K is the remaining book value after the Kth depreciation period.

$DEPR_K$ is the amount of depreciation in the Kth period.

M is the multiplier

DCL FCTR is the declining factor.

N is the number of periods in the life of the asset.

Depreciation

This routine has the same solution as the Declining-Balance Depreciation routine except that the DCL factor must be calculated from the data given.

$$M = \frac{DCL\ FCTR}{N}$$

$$DCL\ FCTR = -N\left[\left(\frac{FV}{PV}\right)^{1/N} - 1\right]$$

FV = salvage value of asset

PV = initial value of asset

N = number of depreciation periods in life of asset.

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Cash-Flow Analysis

Annual Interest Rate to Nominal Rate

$$I = 100 \; [(1+I)^{1/N} - 1]$$

Discounted Rate of Return

This routine uses an iterative technique to solve for IRR. The basic defining equation is:

$$0 = -I + \sum_{j=1}^{n} C_j(1+i)^{-j}$$

Where:

n is the number of cash flows.

C_j is the jth cash flow.

$-I$ is the initial investment.

i is the discounted rate of return.

After e^r (r = continuous rate of return) is substituted for $1 + i$, the final equation for Discounted ROR is:

$$I = \sum_{j=1}^{n} C_j e^{-jr}$$

Statistics

Mean and Standard Deviation

$$\overline{X} = \frac{\Sigma x}{N}$$

where:

n = number of X values

$$S_x = \sqrt{\frac{1}{n-1}(\Sigma x^2 - n\overline{x}^2)}$$

Trend Line

$$\text{Slope} = \frac{UXY}{UX^2}$$

$$\text{Intercept} = \frac{\Sigma Y - (\text{slope})\Sigma X}{N}$$

$$r^2 = \frac{(UXY)^2}{(UY^2)(UX^2)}$$

where: N = number of data points.

$$UXY = \Sigma XY - \frac{(\Sigma x)(\Sigma y)}{N}$$

$$UX^2 = \Sigma X^2 - \frac{(\Sigma X)^2}{N}$$

$$UY^2 = \Sigma Y^2 - \frac{(\Sigma Y)^2}{N}$$

Bonds

Definitions

P = bond price
i = bond yield
c = coupon rate, in percent
j = 1 — fractional part of $(\frac{an}{b})$
n = life of bond in days
a = 1 (annual coupon)
   2 (semiannual coupon)
b = 360 (360-day basis)
   365 (365-day basis)

Bond Price

1) When the life of the bond is greater than the coupon period:

$$PV = 100\left(1+i/a\right)^{-an/b} + \frac{C}{(FV/100)i}\left[(1+i/a)^{j} - (1+i/a)^{-an/b}\right] - \frac{cj}{a(FV/100)}$$

$$P = PV\left(\frac{FV}{100}\right)$$

2) When the life of the bond is less than the coupon period:

$$PV = \frac{\left[100 - \frac{100NC}{aFV}\right] - N\frac{i}{a}\left[\frac{c100}{aFV}\right](1-N)}{1 + \frac{Ni}{a}}$$

$$P = PV\left(\frac{FV}{100}\right)$$

Bond Yield

Bond Yield is found by using the above equations to solve for i.

Notes

Definitions

P = note price

R = note yield

$N = (\dfrac{\text{settlement to maturity}}{\text{basis}})$

$M = (\dfrac{\text{issue to maturity}}{\text{basis}})$

c = interest rate of note.

Note Price

$PV = \dfrac{100 + NC - NRC\ (M\text{-}N)}{1 + NR}$

$P = PV\ (\dfrac{100}{100})$

Note Yield-to-Maturity

$R = \dfrac{1}{N}\ \left[\dfrac{\dfrac{100}{p} + \dfrac{MC}{P}}{1 + \dfrac{C}{P}(M\text{-}N)} - 1\right]$

Coupon-Equivalent Yield

1) When less than 6 months to maturity:

$CEY = (\ \dfrac{100}{P} - 1)\ \dfrac{200}{N}$

2) When more than 6 months to maturity:

$CEY = \left[\left((N/2)^2 + (1\text{-}N)(1\text{-}100/P)\right)^{1/2} - (N/2)\right]\ 200/N\text{-}1$

Where: $N = \dfrac{n}{182.5}$

n = no. of days to maturity

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After-Tax Calculations

The After-tax mode only applies to bond and note calulations. The two taxes of concern are the personal tax rate (p%) and the corporate tax rate (C%). C% and p% are decimal numbers, i.e., 30% = .30 .

In the bond price equation, the following changes are made:

when $n < \dfrac{b}{a}$

$C(1 - P\%) \to C$

$$P_{new} = \dfrac{P_{old} - FV(C\%)(1 - ni/b)}{1 - (C\%)(1 - ni/b)}$$

when $n \geqslant \dfrac{b}{a}$:

$C(1 - P\%) \to C$

$$P_{new} = \dfrac{P_{old} - FV(C\%)(1 + i/a)^{-na/b}}{1 - (C\%)(1+i/a)^{-na/b}}$$

Discounted Note

For 360-day Year basis:

$$DISC_{360} = \dfrac{NI(FV)}{36000}$$

$$Yield_{360} = \dfrac{DISC_{360}(36000)}{n(FV - DISC_{360})}$$

$$DISC_{365} = DISC_{360} \dfrac{360}{365}$$

For 365-day Year basis:

$$Yield_{365} = \dfrac{DISC_{365}(36500)}{n(FV - DISC_{365})}$$

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CALCULATING MODES

The HP-81 calculating modes offer considerable flexibility when using some routines. The required mode settings are listed at the beginning of each of those routines.

Each mode must be set before the routine is started; although, in most cases, the result can be recalculated by simply changing the mode setting and pressing the final key-sequence again.

To print a list of the calculating modes currently set, press ⬛ ◊ .

Pre-tax* or After-tax Mode

The mode set determines whether answers for several bond routines are calculated on a Pre-tax or After-tax basis.

For the After-tax mode, two tax rates must be stored:

1. Key in the individual or corporate income tax rate (as a %), press STO 1

2. Key in the capital gains tax rate (as a %), press STO 2 .

The HP-81 assumes long-term capital gains. If the bond is purchased above par, the capital gains rate should be entered as 0.

Annual or Semiannual* Coupon Mode

The mode set determines whether a bond calculation includes an annual or semiannual coupon rate.

*This mode is automatically set when the HP-81 is switched ON.

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30-day or Actual-day * Month Mode

When the time-period is greater than one month and the final date is the 31st of a month:

To have results conform to the 30-day convention which assumes that a final date of the 31st of a month and the 1st of the next month are the same day, you should either add one day to the specified final date or add one day to the calculated number of days.

Here is the formula used to calculate the number of days when the 30-day month mode is used:

$$n = (Y2-Y1)*360+(M2-M1)*30+(D2-D1)$$

where: n = number of days
D1 = day of first date
D2 = day of second date
M1 = month of first date
M2 = month of second date
Y1 = year of first date
Y2 = year of second date

360-day or 365-day * Year Mode

The mode set specifies either a 360-day year or 365-day year for bond, note, and interest calculations. This mode setting does not affect Calendar functions (see page 19).

Bond * or Note Mode

The mode set specifies the proper instrument of exchange for the appropriate calculations. The Bond Mode assumes that periodic payments (coupon payments) are made, while the Note mode assumes that only a final payment is made.

*This mode is automatically set when the HP-81 is switched ON.

Here is how to set each mode (setting one of each pair resets the other):

To set this mode:	Press:	Printout:
Pre-tax*	■ EXT( ) M( ) [0]	P R E T X 0
After-tax†	■ EXT( ) M( ) [1]	A F T T X 1
Annual Coupon	■ EXT( ) M( ) [2]	A N 2
Semiannual Coupon*	■ EXT( ) M( ) [3]	S E M A N 3
30-day Month	■ EXT( ) M( ) [4]	D A Y 3 6 0 4
Actual-day Month*	■ EXT( ) M( ) [5]	D A Y 3 6 5 5
360-day Year	■ EXT( ) M( ) [6]	B A 3 6 0 6
365-day Year*	■ EXT( ) M( ) [7]	B A 3 6 5 7
Bond*	■ EXT( ) M( ) [8]	B O N 8
Note	■ EXT( ) M( ) [9]	N O T E 9

*These modes are automatically set when the HP-81 is switched ON.

†When using the After-tax mode, the income tax rate must be stored in register 1 and the capital gains rate must be stored in register 2.

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Alphabetic Index

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ERRATA

Page 97. Please change the references to the U.L. listed power cords to this:

125V—6A*   250V—6A*

8120-1351   8120-1369   8120-1689   8120-1348   8120-0698
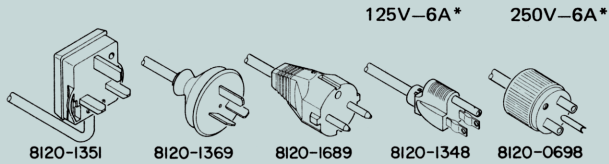
*UL listed for use in the United States of America.

Page 116. Replace the two equations at the top of the page with these:

$$N = \frac{-\log\ [1 - (PV{\cdot}I)/PMT]}{\log\ (1 + I)}$$

$$N = \frac{\ln\ [(FV{\cdot}I)/PMT + 1]}{\ln\ (1 + I)}$$

Changes

HP 81 OPERATING GUIDE
Part No. 00081-90000

Page 112:
Please add a note indicating that the California and Texas offices are not available for HP 81 service.

ERROR NOTES

When an error is encountered, the display (if installed) will blink continuously. Press either $\boxed{\text{CE}}$ or $\boxed{\text{CLEAR}}$ before correcting the error.

NOTE 1   Number beyond the range of the calculator.

NOTE 2   Insufficient or unusable data for these routines:
  a. Compound Interest routines
  b. Bond Yield to Maturity
  c. Discounted Note
  d. Accrued Interest

NOTE 3   DAY or DATE error:
  a. outside the calendar range (January 1, 1901 — December 31, 2099)
  b. an incorrect format
  c. an improper 360-day year calendar date

NOTE 4   Length of time-period error (with $\boxed{\text{STO}}$ $\boxed{1}$ and $\boxed{\text{STO}}$ $\boxed{2}$), where the starting period of the schedule is $\leqslant 0$.

NOTE 5   Math error:
  a. division by zero
  b. $\log_{10} X$ where X is less than or equal to zero
  c. Y^X where Y is less than or equal to zero
  d. $\sqrt{X}$ where X is less than or equal to zero.

NOTE 6   Cash Flow Analysis error:
  a. positive initial investment
  b. more than nine cash flow entries, or none at all
  c. outlays mixed in with inflows
  d. more than 100 individual calculations required.

NOTE 7   Math error associated with Bond, Yield-to-Maturity, or Interest calculations.

NOTE 8   More than 19 entries for the Total and Percentage routine.

NOTE 9   Horizontal trend line.