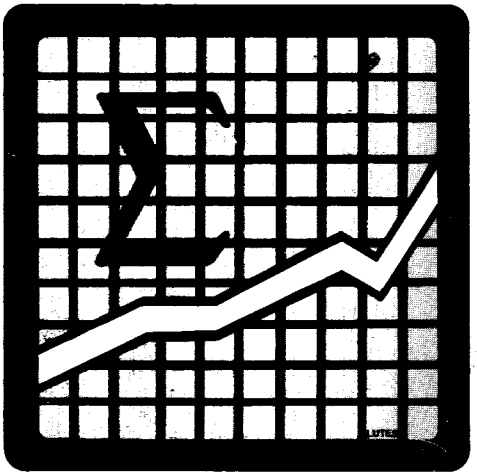
Micro-Statistician



User's Handbook Models 340/342

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Contents

Here is a quick, easy guide that will show you how the Compucorp 345 Statistician makes short work of laborious statistical calculations. It will take you through the powerful statistical key functions, the convenient arithmetic operations, the 10 storage and accumulator registers, and programming if you have the programmable model.

BEFORE YOU START

1. The ON-OFF switch is in back and is labeled "POWER ON OFF." When switched on, all registers are cleared, and the decimal point is set to two places. If the display shows E----, either when turned on or during your calculations, touch [RESET] or [CLEAR ENTRY]. When switched off, data and program steps you may have stored are lost.
2. The Micro Statistician runs on batteries, or through an AC adapter which is supplied for use with normal house current and plugs into the socket on the back of the machine. Be sure to set the adapter for your line voltage. Important information on battery and AC operation is included on page 33.
3. The examples you'll find here are all done with the decimal point set to 3 places. To set 3 places, touch [SET DP] [3]. You may use any number from 0 through 9. Just touch [SET DP] and the number of places you wish.
4. Your Micro Statistician is a precision electronic instrument, designed for portable operation. It will help you with your calculations wherever and whenever they come up.

STATISTICAL FUNCTIONS

The Micro Statistician includes a number of common statistical functions which eliminate the tedium of everyday statistical analyses. These key functions are the following:

- Standard Deviation and Mean — Ungrouped Data
- Standard Deviation and Mean — Grouped Data
- Linear Regression
  - Coefficient of Correlation
  - Slope
  - Intercept
  - Estimated Values of Dependent Variable
- t Test of Dependent or Correlated Data
- t Test of Independent Data
- Z Score

There are also a number of keys for basic mathematical functions which you will find valuable:

- Add, subtract, multiply, divide, reciprocal
- Square root, raise to a power
- Logarithm — Base e and Base 10
- Antilog — Base e and Base 10
- Integer/fraction separation

STANDARD DEVIATION AND MEAN – UNGROUPED DATA

Touch [CLEAR GROUP] to clear data accumulators. Enter data, touching [Σ nxx²] after each observation. When all entries are complete, touch [SD MEAN]. The screen will display the estimate of the sample standard deviation according to the formula:

$$SD=\sqrt{\frac{\Sigma X^2-\frac{(\Sigma X)^2}{n}}{n-1}}$$

Touch [2ND FUNC] and the screen will display the arithmetic mean according to the formula:

$$\bar{X}=\frac{\Sigma X}{n}$$

Computing standard deviation and mean will not affect accumulated results, so you may enter additional data or remove data for further analysis. See page 20 for data removal.

EXAMPLE

For the Data Set 4.5, 6.1, 3.7, 3.9, 6.6, 4.7, 5.2 compute the standard deviation and the mean.

The sequence is:

CLEAR GROUP	4	.	5	Σ nxx²	4.500
	6	.	1	Σ nxx²	6.100
	3	.	7	Σ nxx²	3.700
	3	.	9	Σ nxx²	3.900
	6	.	6	Σ nxx²	6.600
	4	.	7	Σ nxx²	4.700
	5	.	2	Σ nxx²	5.200
				SD MEAN	1.082
				2ND FUNC	4.957

STANDARD DEVIATION AND MEAN – GROUPED DATA

Touch [CLEAR GROUP] to clear data accumulators. Enter the cell class data touching [Σ nxx²] after each, then the number of observations or frequency and touch [=]. When all entries are complete, touch [SD MEAN] The screen will display the standard deviation according to the formula:

$$SD=\sqrt{\frac{\Sigma fX^2-\frac{(\Sigma fX)^2}{\Sigma f}}{\Sigma f-1}}$$

Touch [2ND FUNC] and the screen will display the mean according to the formula:

$$\bar{X}=\frac{\Sigma fX}{\Sigma f}$$

The same data entry sequence may be used with ungrouped data where there are several occurrences of the same value.

By the way, the switch marked  allows you to accumulate single variable data in either of two groups. Setting Group 1 accumulates data, and computes standard deviation on that data. Setting Group 2 does the same in an entirely different set of accumulators. See page 21 for removal of incorrect data items.

EXAMPLE:

For the data set:

OBSERVATION	FREQUENCY
82	2
91	3
90	1
85	7
94	4
86	4
87	1

Compute the Standard Deviation and Mean

[CLEAR GROUP]

8	2	Σ nxx²	82.000
	2	=	2.000
9	1	Σ nxx²	91.000
	3	=	3.000
9	0	Σ nxx²	90.000
8	5	Σ nxx²	85.000
	7	=	7.000

9	4	Σ nxx²	94.000
	4	=	4.000
8	6	Σ nxx²	86.000
	4	=	4.000
8	7	Σ nxx²	87.000
		SD MEAN	3.932
		2ND FUNC	87.681

Notice that when the frequency is 1 it need not be entered.

LINEAR REGRESSION

Select Group 1 (GROUP 1 2), touch CLEAR GROUP XY to clear data accumulators. Enter the data in pairs. Enter the independent variable, X, first; touch XY, then the dependent variable, Y, and touch =. When all entries are made, touch LIN REG. The screen will display the coefficient of correlation, r, computed as:

$$r = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\sqrt{\left(\Sigma X^2 - \frac{(\Sigma X)^2}{n}\right)\left(\Sigma Y^2 - \frac{(\Sigma Y)^2}{n}\right)}}$$

For the slope, m, touch 2ND FUNC. The slope is calculated as:

$$m = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\Sigma X^2 - \frac{(\Sigma X)^2}{n}}$$

The intercept, b, may be displayed by touching 0 and LINE. The intercept is computed by the formula:

$$b = \frac{\Sigma Y}{n} - m\frac{\Sigma X}{n}$$

The form of the Regression Equation is:

$$Y_{est} = mX + b$$

To compute Y_{est} any value of X, enter the X data and touch LINE. The screen will show Y_{est} for that X. The Standard Deviation and Mean of X data and Y data may be calculated. Touch SD MEAN to display SD_X, and 2ND FUNC to display $\bar{X}$. Now switch to Group 2 (GROUP 1 2) and touch SD MEAN to display SD_Y and 2ND FUNC to display $\bar{Y}$.

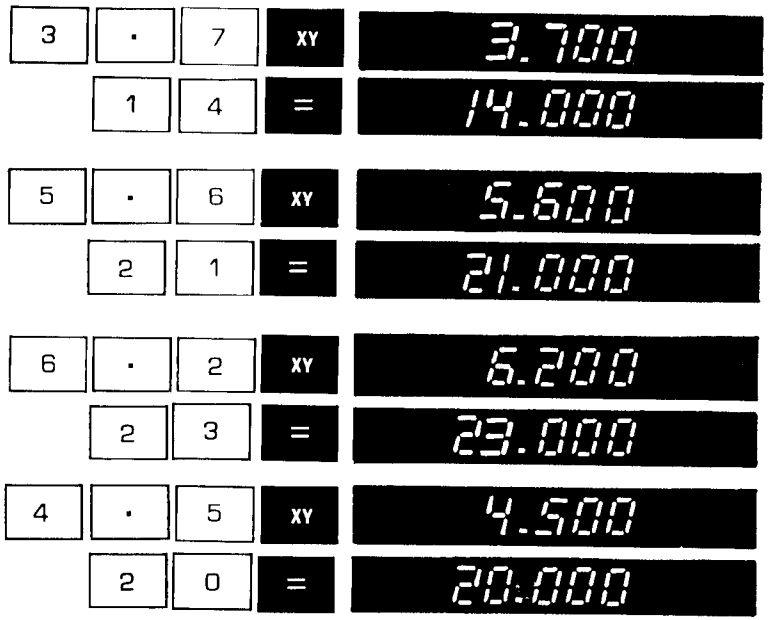
EXAMPLE

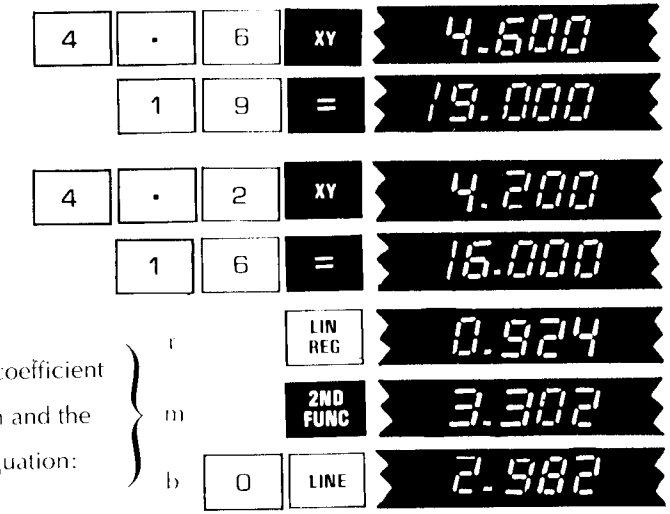
For the data set:

X	Y
3.7	14
5.6	21
6.2	23
4.5	20
4.6	19
4.2	16

Compute the Coefficient of Correlation, Slope, Intercept, Standard Deviation and Mean of X and Y and y_{est} for X=4, X=5, and X=6. CLEAR GROUP XY

Enter your data this way:





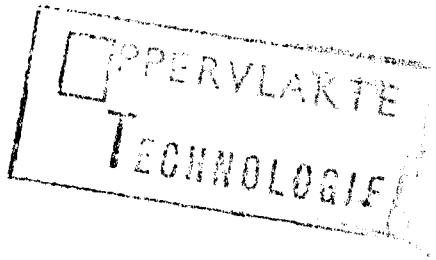
To compute coefficient of correlation and the regression equation:

For the Standard Deviation and Mean of X

For the Standard Deviation and Mean of Y

For estimated values of Y using the regression equation, using X=4, X=5, and X=6

4	LINE	16.191	(Yest)
5	LINE	19.493	(Yest)
6	LINE	22.796	(Yest)



t TEST OF DEPENDENT OR CORRELATED DATA

Touch [CLEAR GROUP] [XY] to clear data accumulators.

Enter the data in pairs. Enter X first, touch [XY], then enter Y and touch [=].

When all entries are made, touch [t_{ind}^{dep}]. The screen will display t_{dep} which is computed by the formula:

$$t_{dep} = \frac{\bar{X} - \bar{Y}}{\sqrt{SD_X^2 + SD_Y^2 - 2r\,SD_X\,SD_Y}}$$

To compute Standard Deviation and Mean of X data and Y data, first switch to Group 1 [GROUP]. Now touch [SD MEAN] and the screen will display SD_X. Touch [2ND FUNC] and the screen will display $\bar{X}$.

Switch to Group 2 [GROUP]. Touch [SD MEAN] for SD_Y and [2ND FUNC] for $\bar{Y}$.

By the way, once your data is entered you can also compute r, m, and b as in the Linear Regression example.

AN EXAMPLE OF DEPENDENT t

To compute the dependent t statistic, Standard Deviation and Mean for both X and Y for the data:

X	Y
31.7	40.0
40.6	41.2
39.9	38.5
35.7	38.7
36.1	39.2

Clear data accumulators [CLEAR GROUP] [XY]

Enter the data:

3 1 . 7 [XY]	31.700
4 0 [=]	40.000
4 0 . 6 [XY]	40.600
4 1 . 2 [=]	41.200
3 9 . 9 [XY]	39.900
3 8 . 5 [=]	38.500
3 5 . 7 [XY]	35.700
3 8 . 7 [=]	38.700

3 6 . 1 [XY]	36.100
3 9 . 2 [=]	39.200

Compute t_{dep} [t_{dep} / t_{ind}] -1.673

Compute Standard Deviation and Mean

Set Group 1 [GROUP] Standard Deviation of X

[SD MEAN] 3.597

X [2ND FUNC] 36.800

Set Group 2 [GROUP]

SD_Y [SD MEAN] 1.103

Y [2ND FUNC] 39.520

t TEST FOR INDEPENDENT MEANS

Select Group 1 

Touch [CLEAR GROUP] to clear data accumulators for X.

Enter each value for X, and touch [Σ nxx²].

Then select Group 2  and [CLEAR GROUP] for Y.

Enter each value of Y touching [Σ nxx²] with each entry.

When all entries have been made, simply touch [t_{dep} t_{ind}] and [2ND FUNC]

The screen will display t_{ind} calculated with the formula:

$$t_{ind} \quad \frac{\bar{X}-\bar{Y}}{\sqrt{\left[\frac{(n_X-1)\,SD_X^2+(n_Y-1)\,SD_Y^2}{n_X+n_Y-2}\right]\left[\frac{1}{n_X}+\frac{1}{n_Y}\right]}}$$

The Standard Deviation and Mean of both X and Y sample data may be calculated by selecting Group 1  and touching [SD MEAN] for SD_X and [2ND FUNC] for $\bar{X}$.

Select Group 2  , touch [SD MEAN] for SD_Y. Touch [2ND FUNC] for $\bar{Y}$.

AN EXAMPLE OF t_{ind}

To compute t_{ind}, SD_X, $\bar{X}$, SD_Y, and $\bar{Y}$ for the data: X = 75.6, 72.3, 69.5, 71.6; and Y=51.4, 62.7, 71.6, 70, 61.:

Select Group 1  , [CLEAR GROUP] and enter the X data.

7	5	.	6	Σ nxx²	75.600
7	2	.	3	Σ nxx²	72.300
6	9	.	5	Σ nxx²	69.500
7	1	.	6	Σ nxx²	71.600

Now select Group 2  , [CLEAR GROUP] again and enter the Y sample data.

5	1	.	4	Σ nxx²	51.400
6	2	.	7	Σ nxx²	62.700
7	1	.	6	Σ nxx²	71.600
7	0			x̄	70.000
6	1	.	7	Σ nxx²	61.700

To compute t_{ind}, touch [t_{dep} t_{ind}] and [2ND FUNC] → 2.076

Select Group 1 [GROUP], touch [SD MEAN] for SD → 2.530

touch [2ND FUNC] for $\bar{X}$ → 72.250

Select Group 2 [GROUP], touch [SD MEAN] for SD_Y → 8.033

touch [2ND FUNC] for $\bar{Y}$ → 63.480

Z SCORE

To compute $Z=\frac{X_i-\bar{X}}{SD_X}$ in order to determine probability from a normal probability table, clear the accumulators touching [CLEAR GROUP]*. Enter the sample data for X, touching [Σ nxx²] after each entry.

Then enter X_i and touch [Z]. The screen will show Z for the data entered. Either Group 1 or Group 2 may be used. You may wish to know the Standard Deviation and Mean of the sample also. Touch [SD MEAN] for SD_X and [2ND FUNC] for $\bar{X}$.

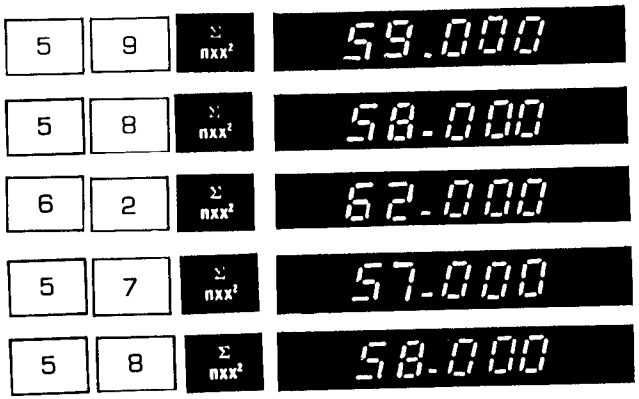
EXAMPLE

Find the probability that a student will be at least 60 inches in height if some of his classmates measure: 58, 61, 60, 56, 60, 54, 59, 58, 62, 57, 58.

Select Group 1 [GROUP], [CLEAR GROUP] to clear data accumulators, and enter the data:

5	8	[Σ nxx²]	58.000
6	1	[Σ nxx²]	61.000
6	0	[Σ nxx²]	60.000
5	6	[Σ nxx²]	56.000
6	0	[Σ nxx²]	60.000
5	4	[Σ nxx²]	54.000

*In this case, $SD_X=\sqrt{\frac{\Sigma X^2-\frac{(\Sigma X)^2}{n}}{n}}$



Now enter 6 0 and touch Z 0.705

From the probability table, we know p_Z=.758, or there is a 75.8% probability that a student will be at least 60 inches tall.

For SD_X touch SD MEAN 2.296

For X touch 2ND FUNC 59.454

DATA ACCUMULATORS

All of the preceding statistics rely on the use of accumulated data. The use of the Σ nxx² key and the sequence XY ... = cause data to be accumulated in three or more registers. Here is a summary of these registers and the values they contain, along with the controlling keys:

CONTROL KEYS	REGISTER							
	GROUP	0	1	2	3	4	5	6
Σ	1		n	Σx	Σx²			
	2					n	Σx	Σx²
XY,=	1 or 2	Σxy	n	Σx	Σx²	n	Σy	Σy²
CLEAR GROUP	1		0	0	0			
	2					0	0	0
CLEAR GROUP, XY	1 or 2	0	0	0	0	0	0	0

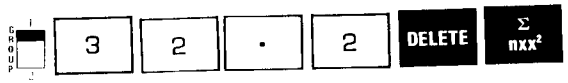
Individual summations in these registers may be examined by touching RCL_n followed by the appropriate register number. The contents of the register are displayed. The contents are not changed by RCL_n or any of the keys which perform calculations using stored data. There is more on storage registers on page 27.

The DELETE key is a real time saver. Used in conjunction with Σ nxx² or XY it will remove data items from the accumulations. If you have erroneously included a number in an accumulation, or you want to see the effect on your statistics that removing an entry has, simply enter the item to be removed, and touch DELETE before Σ nxx² or before the =

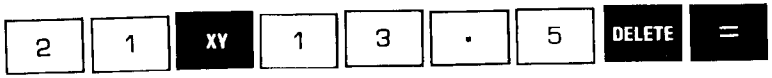
when using XY

EXAMPLE

To remove 32.2 from Group I:



To remove the pair (21, 13.5) from XY accumulation:



ENTERING NUMBERS

From the preceding statistical examples, you know that entering numbers means simply entering digits in the sequence in which they appear, using the decimal point when applicable. Numbers may include a maximum of thirteen digits (twelve if · is entered first).

Numbers may be entered in scientific notation, too, if desired, with a 13 digit mantissa and a two-digit exponent. The exponent can range from −99 to +99. The EXP key is used to enter one- or two-digit exponents. The CHG SIGN key makes either mantissa or exponent negative. Try these examples:

1 2 3 EXP 4 8

123.000 48

CLEAR ENTRY

· 0 0 0 4 5 EXP 3

0.00045 03

CLEAR ENTRY

1 7 6 · 5 1 EXP CHG SIGN

1 4

176.51 −14

CLEAR ENTRY

1 6 · 7 1 CHG SIGN EXP 2 7

CHG SIGN

−16.71 −27

ILLEGAL CALCULATIONS

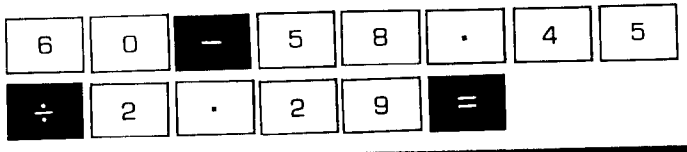
Now you have an idea of how your data goes in. By the way, if you enter too many digits, suddenly the screen shows E----. This means error, and may be cleared with CLEAR ENTRY or RESET CLEAR ENTRY clears the screen. RESET does too, but it also clears any arithmetic string that preceded it. It won't clear accumulated data, though. E---- shows up any time there is an illegal operation or if you press two keys at once.

ARITHMETIC

Arithmetic on the Micro Statistician is simple and convenient. Just enter your problem as it appears.

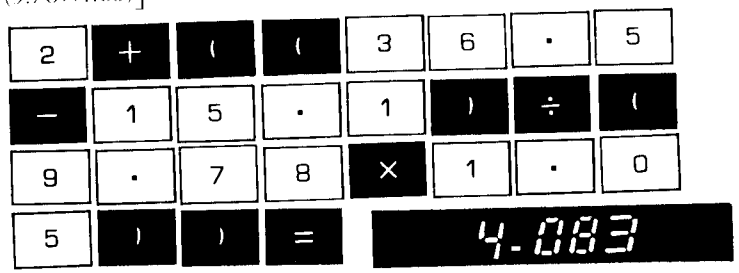
For example: $\frac{60 - 58.45}{2.29}$?

Enter



Or $2+\left[\frac{(36.5-15.1)}{(9.78\times1.05)}\right]=?$

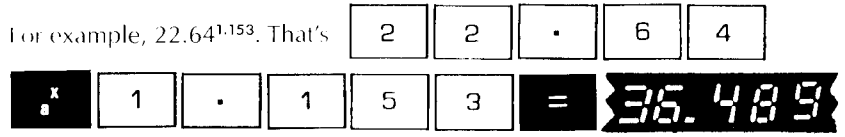
Enter



In other words, + − × ÷ = can be used in any algebraic sequence you need to perform your calculation, and when you want to interrupt that sequence in the middle, use ( ). Remember that the parentheses can be nested two deep. Any more and you see E----. Use RESET this time.

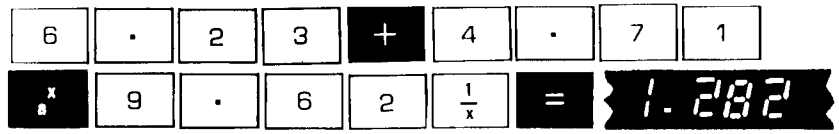
For raising numbers to powers use a^x

For example, $22.64^{1.153}$. That's



They can be more complicated, like $2.62\sqrt{6.23+4.71}$.

Enter



$\frac{1}{x}$ you see, gives reciprocal.

$\sqrt{}$ gives square root.

$\frac{1}{x}$ of zero and $\sqrt{}$ of a negative gives you E----. Clear with CLEAR ENTRY or RESET.

Common and natural logs are simple. Ln LOG calculates them both.

Enter [2] [0] [0] [Ln LOG]

That's Ln 200 on the screen. For Log 200 touch [2ND FUNC]

[Ln LOG] of 0 gives E----.

[e^x 10^x] gives antilogs.

Enter [.] [6] [9] [3] [2] [e^x 10^x]

e^x is on the screen. [2ND FUNC] will show you 10^x.

[e^x 10^x] of numbers greater than 99.9999 give E----.

[INT FR] separates a number on the screen into its integer and fractional parts.

(How can a family have 2.61 children?)

Try this:

[3] [1] [.] [6] [2] [5] [INT FR]

The fractional part is the [2ND FUNC]

STORAGE REGISTERS

The Micro Statistician has 10 storage registers, numbered 0 through 9. Seven (0-6) of these do double duty as data accumulators, as you know. It's best to use registers 7, 8, and 9 for storage of constants and intermediate results first, so there's no conflict. But use the others, too, when they are not needed for accumulation.

To store in a register, enter the number, touch [ST_n] and the digit naming the register:

[3] [.] [1] [4] [1] [5] [ST_n] [7]

Now [CLEAR ENTRY]

To recall, touch [RCL_n] and the digit name of the register. [RCL_n] [7]

To see what's in a register without losing what's in the display screen, we've put in a key called exchange [$EXCH_n$]

For example: 1.23

[1] [.] [2] [3] [$EXCH_n$] [7]

[$EXCH_n$] [7]

Direct arithmetic into and out of storage registers is particularly useful to statistical users. To add to a register, just touch [ST_n], followed by [+], followed by the register name:

[4] [ST_n] [+] [7] → 4.000

Now [RCL_n] [7] → 7.141

[ST_n] [×] multiplies, [ST_n] [−] subtracts from, and [ST_n] [÷] divides into the designated register.

Arithmetic out of registers is just as simple. Use [RCL_n] instead of [ST_n]. To divide 3421.6 by register 7, enter [3] [4] [2] [1] [.] [6] [RCL_n] [÷] [7]

479.115

PROGRAMMING

The Micro Statistician Model 342 includes an even more powerful capability than all those we've described so far — the ability to program up to 80 steps of a repetitive process. To use the programming feature, simply press [RESET] and slide the program entry switch to RUN/LOAD, then enter your calculation. The screen will look like this:

0.000000 00 01

MANTISSA EXPONENT STEP

As you do your calculation, the Micro Statistician displays each result in scientific notation on the left portion of the screen. The right two digits count the steps for you. After 80 steps the program returns to step one and starts over, so watch the program counter.

The [START/STOP] key is used in RUN/LOAD to start execution. In RUN/LOAD [START/STOP] tells the program to stop for entry of variable data or to display a computed result on the screen.

Once a program is entered, it will automatically go from the last step entered to the first entered when executing. Let's try a couple of programming examples. Suppose you had the problem of calculating $Y = 1/\sqrt{\text{Log } X}$ for several values of X. The normal sequence is:

Enter X [Ln/LOG] [2ND/FUNC] [$\sqrt{}$] [$\frac{1}{x}$]

For X = 4, the screen would show 1.208

To program this sequence, do the following:

RUN | START STOP | 4 | Ln LOG | 2ND FUNC | √ | 1/x | START STOP | RUN | LOAD

1.288

Same answer.

For X=6, touch START STOP, enter 6, touch START STOP and see

1.133

In this program START STOP means stop to display the answer. The program can be simplified slightly. By entering 4 and then the program, we eliminate touching START STOP twice to get the answer:

4 | RUN | LOAD | Ln LOG | 2ND FUNC | √ | 1/x | START STOP | RUN | LOAD

1.288

Now just enter 6 and touch START STOP 1.133

Try it with 8

Several START STOP steps can be used in the program for data entries and multiple results. Suppose we want to calculate Z = $1/\sqrt{\text{Log x}}$ as before, and Y=f/t$\sqrt{Z}$. Here we enter X, t and f, and record Z and Y for these values. Let's say we want to enter X and record Z, then enter t and f and record Y.

Initially X = 4, t=2.1, and f=50.63:

4 | RUN | LOAD | Ln LOG | 2ND FUNC | √ | 1/x | START STOP

then displays the first Z 1.288783 00 06

x^y START STOP to enter the variable t

2 | . | 1

Notice that this display is normal and that the step counter is not shown (it's not changing) during entry of the number after START STOP 2.10

1/x | = | 1/x | × | START STOP to enter f

5 | 0 | . | 6 | 3 50.63

= | START STOP to display Y 4.486846 01 15

RUN | LOAD 44.868

For X = 6, t=2.03, and f=61.5, the sequence is

6 | START STOP, read Z 1.133 START STOP, enter t

2 | . | 0 | 3 | START STOP and f= 6 | 1 | .

5 | START STOP, the new Y is 57.815

Programming greatly expands the use of your Micro Statistician for everyday calculations. There are no special limitations on program sequences other than the maximum capacity of 80 steps. The keys which depend on the Group Select Switch (CLEAR GROUP , Σ nxx², SD MEAN , Z) will use the Group Set while the program is entered and do not depend on position while the program is executed.

BATTERY OPERATION AND RECHARGING

Your Micro Scientist may be operated with the batteries it is shipped with or on normal AC with the accessory adapter/charger provided (set the adapter/charger to your line voltage).

The nickel-cadmium batteries supplied are rechargeable. Useful life is approximately 1,000 charge/discharge cycles – nearly four years of average daily operation. When fully discharged, the batteries will require about 15 hours to become fully charged, with the charger plugged in and the Micro Scientist turned off. With the machine turned on and operating, recharging will take somewhat longer.

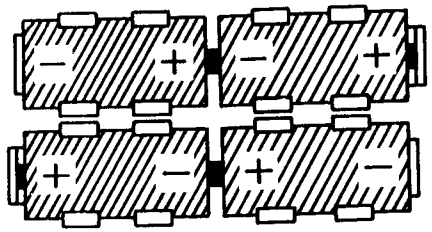
In an emergency, any standard "D" cell may be used. Carbon-zinc batteries have a life of approximately two hours. Alkaline batteries will last approximately two and one-half hours.

WARNING

Standard "D" cell carbon zinc flashlight batteries may not be used while the adapter is connected and operating on AC power. It could be dangerous or cause severe damage to the calculator.

To remove the batteries, turn the Micro Scientist over. Squeeze the two round plungers at the top of the case together and pull outward on the

handle. The battery compartment will swing open. Remove the batteries and replace with fresh ones. Nickel-cadmium batteries, Compucorp Part No. 3400017, are recommended.



NOTE: Observe polarity of batteries when installing. Improper battery installation may severely damage the calculator. Follow this diagram when installing batteries.