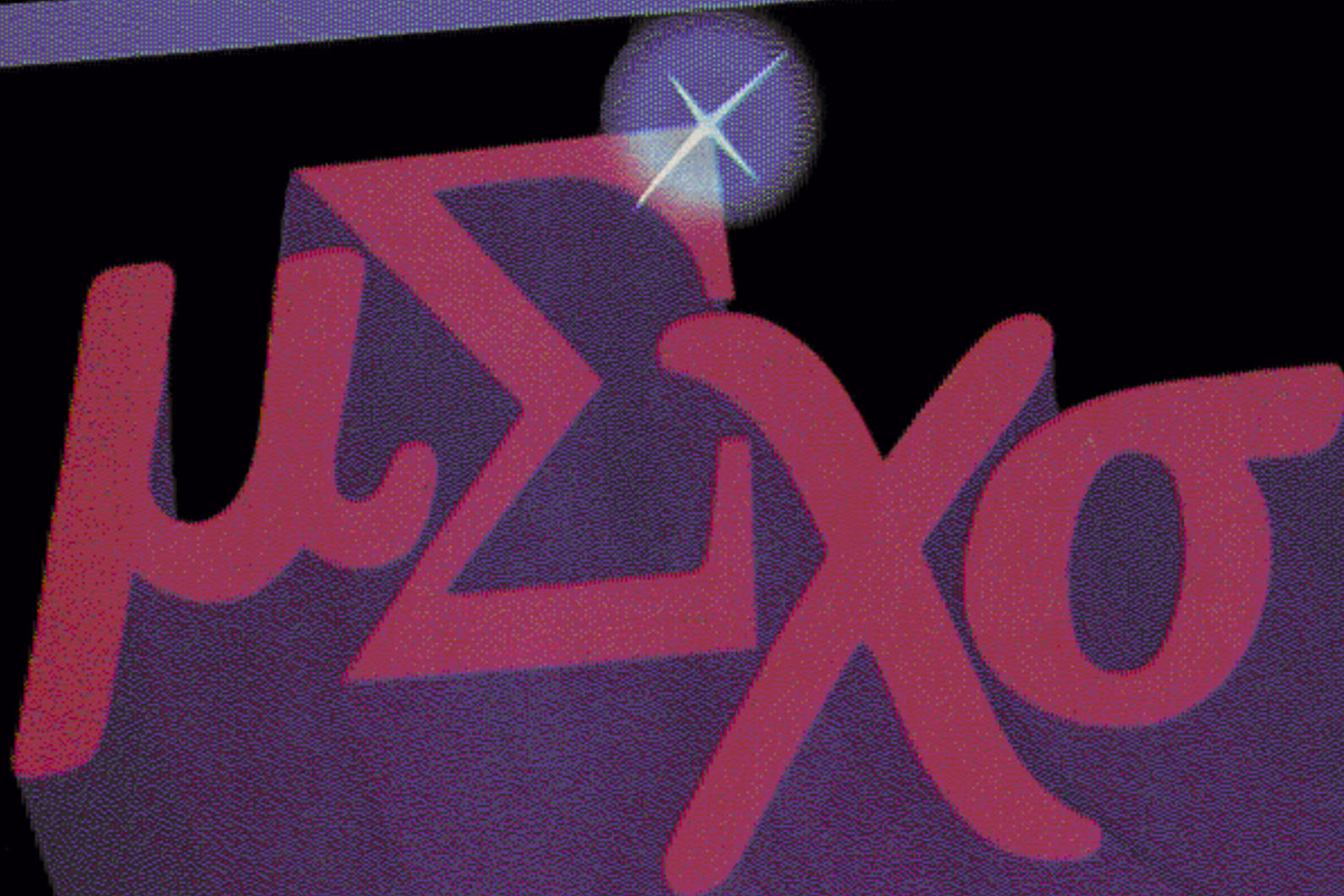


CAT. NO.
26-3704

STATISTICS



PC-2
SOFTWARE
LIBRARY



DSPLY

PRINT

ADD

DELETE

UPDATE

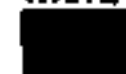
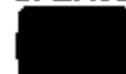
DSPLY

PRINT

#REC

READ

WRITE



OUTPUT

OUTPUT

REC

REC

REC

RECS

RECS

#VAR

TAPE

TAPE



DESCR

DIST

CORR

PRED

MULR

ANOVA



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Statistics

Radio Shack

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10 9 8 7 6 5 4 3 2 1

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Introduction

Statistics is a general data analysis system to be used with the Radio Shack TRS-80® Pocket Computer-2. The system consists of a Statistics program stored on cassette tape, a special keyboard overlay for your Pocket Computer-2, and this step-by-step instruction manual.

The program is easy to use. Even if you have never used a computer before, the instructions and the keyboard overlay will guide you through each of the program functions. You will find that just a few keystrokes allow you to perform data maintenance functions, calculate a wide variety of statistics on your data, display the analysis results on your Pocket Computer-2, or list them on your Pocket Computer-2 printer. The Statistics program and your data remain in the memory of your Pocket Computer-2 even when the computer is turned off.

You can maintain your data file using these special program functions (Chapter 1):

- Enter data.
- Add records to your data file.
- Delete records from your data file.
- Update values on any data record.
- Display records on your Pocket Computer-2.
- List records on your Pocket Computer-2 printer.
- Display the number of records and variables in the file.
- Save your data file on a cassette tape.
- Read a data file stored on cassette tape.

A wide variety of data analysis procedures are available with Statistics (Chapters 3 - 7). These include:

- Descriptive statistics.
- Frequency distribution.
- Graphic histogram (printer).
- Correlation statistics.
- Linear regression equation.
- Least squares prediction.
- T Ratio for means.
- Scattergram with regression line (printer).
- Multiple regression with two independent variables (predictors).
- Analysis of variance for two to five groups.

Required Equipment

To use the Statistics package, you need the following equipment:

- A TRS-80 Pocket Computer-2
- A TRS-80 Pocket Computer-2 Printer/Cassette Interface
- A TRS-80 Pocket Computer-2 Memory Module (4K) (8K Module optional)
- A cassette recorder, such as the Radio Shack Minisette-9, and connecting cables
- Cassette for data storage (optional)

Note: This manual assumes that you are familiar with the Owner's Manual and the Printer/Cassette Interface Manual.

Backing Up Your Program

The first thing you should do as owner of the Pocket Computer-2 Statistics package is to make a copy, or Backup, of your program tape. This assures you that you will not lose important program information due to accident or mishap. Detailed instructions for making a Backup are in Appendix D.

Loading Instructions

1. Install the computer in the Pocket Computer-2 Printer/Cassette Interface and connect the interface to the cassette recorder. Turn on the computer.
2. Place the statistics cassette in the cassette recorder. Be sure you use the version of the program (4K or 8K) that corresponds to the Memory Module in your Pocket Computer-2. With the Remote switch off, rewind the tape to the beginning. When the tape is rewound, press the "Stop" button. Turn the Remote switch on. We recommend that the volume control setting be between 8 and 10 on your cassette recorder (or between 5 and 7 if you are using a Minisette-9). If your recorder has a tone control, set it a maximum treble. Now set the cassette player to "Play".
3. Press the Mode key until RUN appears on the Pocket Computer-2 display. Type **C L O A D " S A "** and press **ENTER**. A high-pitched tone is emitted while the program is being loaded and the name of the program appears on the display. When this tone stops, your Statistics program is loaded and ready for use.

If the loading process is not successful, try again or consult your Owner's Manual for detailed instructions.

Running Statistics

As with any computer system, very large (positive or negative) values and values containing many decimal places are subject to rounding errors. Rounding errors may be magnified in some operations, but in most instances they are minor. To avoid errors, always be cautious when entering data values.

Some calculations may require several minutes (especially if your data file is large). When the Statistics program is performing these calculations, the word BUSY appears in the upper left corner of the screen. A prompt (>) or an appropriate message appears on the screen when the calculations are complete.

Chapter 1

Data Files and Their Use

Your Statistics program is designed to store and analyze data based on the "record" concept. A record is a group of data items (values) which belong to one subject (person or thing). For example, you may know the age, sex, and income level for four people. The variables are age, sex, and income level. The numbers assigned to those variables are called data values. The data values can be arranged into records. A set of records is called a data file.

When you prepare a data file, you should first organize the data values into a table. Then you can easily enter the values into your computer. The data used for examples throughout this manual is outlined in the following table:

	VARIABLE #1 (AGE)	VARIABLE #2 (SEX)	VARIABLE #3 (INCOME LEVEL)
RECORD #1	33	2	15000
RECORD #2	52	1	27550
RECORD #3	28	1	18475
RECORD #4	49	2	25320

(Sex is coded 1 for female, 2 for male.)

A blank data file worksheet is included near the end of this manual. You can copy it and use it for preparing your own data files. Although there are spaces for entering three data values (variables) on each record, your data may contain

only one or two values per record. If, for example, you have one test score for each of 30 students, enter the test scores into the spaces marked "variable 1" and number the records from 1 through 30.

Preparing a New Data File

Your Pocket Computer-2 can store only a certain amount of data before its memory is filled. With a 4K Memory Module, up to 80 one-variable records can be stored in your Pocket Computer-2, while there is space for 50 two-variable records or 35 three-variable records. If your Pocket Computer-2 has an 8K Memory Module, read Appendix C.

After you have prepared a table containing the information for your data file, enter the data into your computer by following these instructions (you may want to enter the information from the previous table for practice):

If the Statistics program is not already loaded, do so following the instructions on page 3. The name, version and copyright information appears briefly.

Type **(R)(U)(N)** and press **(ENTER)** to start the program. The computer asks:

OF VARIABLES? __

Type the number of variables per record in your data file. (The number must be 1, 2, or 3.) Then press **(ENTER)**.

The computer displays:

REC 1/ VAR 1 ? __

Type the value for the first variable on your first data record and press **(ENTER)**.

What happens next depends on the number you entered earlier for "# of VARIABLES":

- If your data records contain two or three variables, the computer requests the value for the second variable on the first record by displaying:
- If your data records contain only one variable per record, the computer requests the data value for the second record by displaying:

REC 1/ VAR 2 ? __

REC 2/ VAR 1 ? __

For each variable on each record, type in the data value and press **(ENTER)**. You must always enter all of the variables on one record before entering any data for the next record.

After you have entered all of your data records, the computer still asks for more data — it doesn't know how many records you have. For instance, after you have entered all the data in our four-record example, the computer displays:

REC 5/ VAR 1 ? __

When you have no more data, just press **ENTER** (do not type a number). The computer displays the number of data records entered and the number of variables per record:

4 RECORDS 3 VARIABLE(S)

After your data file is stored in the computer (that is, after you have typed in all your data), you must **NOT** type RUN again unless you want to enter an entirely new data file. Beginning the program using the RUN command always erases any data stored in the computer's memory. All other functions in the Statistics program are performed by pressing DEF and the appropriate key as indicated on your keyboard overlay.

Adding Records To Your Data File

You can add new records to your stored data file at any time.

Press **DEF D**. The computer displays (for example):

REC5/ VAR 1 ? _

Enter the data values for the new record just as you entered your original data. After all values on the new record have been entered, the computer again displays the number of records stored:

5 RECORDS 3 VARIABLE(S)

Deleting Records From Your Data File

You may want to remove an entire record from your data file.

Press **DEF F**. The computer displays:

DELETE # ? _

Type the record number for the data record that you want to remove from the file. The computer displays the number of remaining records as follows:

4 RECORDS 3 VARIABLE(S)

Whenever you delete a record from your data file, some of the remaining records are moved up to fill the empty record space. Any record which is moved then has a new record number. You should change the data worksheet to reflect the new record numbers, or print a new listing of the records. This way you will not be confused if you later decide to delete or update other records in the file.

Updating Records In Your Data File

Any of the data values on a record may be changed easily.

Press **DEF G**. The computer displays:

UPDATE # ? _

Type the record number of the data record that you want to update. Then press **ENTER**. The computer displays the value of the first variable on that record as follows:

VAR 1 = 52 NEW ? __

- If you want to change the value of the displayed variable, type in the new value and press **ENTER**.
- If the displayed variable is not to be changed, simply press **ENTER**.

For each variable on the selected record, enter a new value or simply press **ENTER**. Then the computer displays the Ready prompt (>).

Displaying Records From Your Data File

You may examine any number of records in your data file. The data are displayed on your Pocket Computer-2 screen.

Press **DEF****H**. The computer asks:

BEGIN AT ? __

- If you want to display the entire data file, simply press **ENTER**.
- If you want to display one record or a group of consecutive records, type in the number of the first record you want and press **ENTER**. The computer asks:

END AT ? __

Type in the number of the last record you want to examine and press **ENTER**.

The computer displays the record number, variable number, and data value for the first selected record as follows:

REC 1 VAR 1 = 33

Successive data items are displayed each time you press **ENTER**. When all of the selected records have been displayed, the computer displays the Ready prompt (>).

Printing Records From Your Data File

You may list any of your data records on the Pocket Computer-2 printer.

Press **DEF****J**. The computer asks:

BEGIN AT ? __

- If you want to list the entire data file on your printer, simply press **ENTER**.
- If you want to print one record or a group of consecutive records, type in the number of the first record you want to print and press **ENTER**. The computer asks:

END AT ? __

Type in the number of the last record that you want to print and press **ENTER**.

The requested records are printed as follows:

RECORD/VARIABLE

2/1 = 52
2/2 = 1
2/3 = 27550

3/1 = 28
3/2 = 1
3/3 = 18475

Then the computer displays the Ready prompt (>).

Checking the Number of Records and Variables in Your File

Press **DEF****K**.

The number of records stored in your Pocket Computer-2 and the number of variables per record are displayed as follows:

4 RECORDS 3 VARIABLE(S)

Saving Your Data File on Cassette Tape

After you have entered your data file into the Pocket Computer-2, you may want to work with different data or load and run a different program. You can store your data file on a cassette tape and read it back into the Pocket Computer-2 at a future date. To save a data file on tape, your Pocket Computer-2 must be connected to a cassette tape recorder through the Pocket Computer-2 Printer/Cassette Interface.

Position the tape so that you will not record on the plastic leader. Be sure that the Remote switch on your Cassette Interface is in the **ON** position. Then press the "Record" and "Play" buttons on your cassette recorder.

Press **DEF****=**. The computer asks:

SAVE AS ? __

You may type in up to 16 characters to form a name for your file. This filename will be recorded on the tape along with your data file. Press **ENTER** after you have typed the name.

The cassette recorder starts running and you will hear a high-pitched tone. Your data file will be stored on the tape. Then the computer displays the Ready prompt (>).

You can verify the **SAVE** by following the instructions in Step 4 of Appendix D.

Be sure to write the filename on your cassette label so that you will be able to identify the filename and load it at a later date.

Reading a Data File From Cassette Tape

If you have saved a data file on cassette tape, you can read (load) the file into the Pocket Computer-2 by following these steps:

Type **RUN** and press **ENTER**. The computer asks:

OF VARIABLES ? __

You must type in the number of variables that comprise each record in the data file that you are going to read from tape. If the number you enter is different from the actual number of variables per record on the tape file, you will get an **ERROR** message when the computer attempts to read the data.

REC 1/ VAR 1 ? __

Do **NOT** enter a number. Simply press **ENTER**. The computer displays (for example):

0 RECORDS 3 VARIABLE(S)

The computer's memory is now cleared and ready to accept records from tape containing the number of variables that you specified. Be sure the Remote switch on your Cassette Interface is in the ON position. Put the cassette tape containing your data file into your recorder and rewind it fully. Then press the "Play" button on your recorder.

Press **DEF****L**. The computer asks:

FILENAME ? __

Type in the name that you gave your file when you saved it on tape. The filename that you enter and the filename stored on the cassette tape must match for the data to be read.

Press **ENTER**.

The cassette recorder starts running and the filename stored on the tape is displayed on your Pocket Computer-2.

If your cassette tape contains several data files, the computer reads through any files ahead of the one you selected, but loads only the file that you specified.

When the entire data file has been loaded, the computer displays the number of records it read as follows:

4 RECORDS 3 VARIABLE(S)

If you put the wrong cassette tape into your cassette recorder or discover that you typed the filename incorrectly, you can stop the computer from reading the rest of the tape by pressing the ON/BREAK key on the computer. Rewind the tape, then press **DEF****L** and re-enter the filename.

Chapter 2

Displaying and Printing Statistical Results

Chapters 3 through 7 describe the statistical analyses that can be performed on your data file and provide you with instructions for performing each analysis. When the Pocket Computer-2 is performing an analysis, the message BUSY will appear on the display. Data cannot be entered while this message is shown. Whenever you run an analysis on your data, the results of the analysis are stored in the computer's memory. You can easily display the results on your Pocket Computer-2 or print the results on your printer.

Displaying Statistical Results (after performing an analysis)

Press **DEF****A**. The computer will display a label describing the first result. For example:

MEAN =

Press **ENTER** and the computer displays the value associated with the first label. For example:

4.95

Continue pressing **ENTER** to display successive labels and values. When all of the statistical results have been displayed, the computer displays the Ready prompt (>).

The results of your statistical analysis remain in the computer's memory until you perform another analysis on your data.

Printing Statistical Results

Press **DEF****S**. The computer prints the results of your statistical analysis on your printer. For each result there is a label and a numerical value. For example:

MEAN =
4.95

- After printing the results of a frequency distribution analysis (Chapter 4), the computer produces a graphic histogram of your data on the printer.
- After printing the results of a correlation/regression analysis (Chapter 5), the computer produces a graphic scattergram of your data values and plots the regression line.

Sample printouts from all of the statistical analysis procedures are found in Appendix B.

Chapter 3

Descriptive Statistics

The Descriptive Statistics procedure calculates basic statistics for one variable on each record in your data file. Output from the analysis includes:

MEAN	Arithmetic mean
SUM	Sum of the data values
SUMSQ	Sum of squares
SD	Standard deviation
SDev	Estimate of population SD
MINIMUM	Minimum data value
MAXIMUM	Maximum data value

Instructions for Descriptive Statistics

In this program, DV refers to Dependent Variable and IV refers to Independent Variable.

Press **DEF****Z**.

If your data records contain more than one variable, the computer asks:

WHICH IS DV ? __

Type **1**, **2**, or **3** to indicate which variable you want to analyze. Then press **ENTER**.

The computer performs the analysis and then displays the Ready prompt (>).

The results of the analysis can be displayed or printed (see Chapter 2).

Sample Run (using our sample data file)

Computer displays:	You type:
>	DEF Z
WHICH IS DV ? __	1 ENTER
>	DEF A
MEAN	ENTER
40.5	ENTER
SUM =	ENTER
162	ENTER
SUMSQ =	ENTER
417	ENTER
SD =	ENTER
10.21028893	ENTER
SDev =	ENTER
11.78982612	ENTER
MINIMUM =	ENTER
28	ENTER
MAXIMUM =	ENTER
52	ENTER
>	

Special Considerations

If any of your variables are "codes" rather than actual measures, you should not perform the Descriptive Statistics procedure on that variable. Means and standard deviations are not meaningful for coded variables (1 = female, 2 = male).

Chapter 4

Distribution and Histogram

The Distribution and Histogram procedure calculates an equal-interval frequency distribution for one variable on each record in your data file. You specify the number of intervals in the distribution when you perform the analysis. Up to five intervals are allowed. Output from the analysis includes:

MINIMUM	Smallest value in the distribution
(f) int	Number of cases in the interval
(%) int	Percentage of cases in the interval
Graphic Histogram	(Printed results)

Instructions for Distribution and Histogram

Press **DEF** **X**.

If your data records contain more than one variable, the computer asks:

WHICH IS DV ? __

Type **1**, **2**, or **3** to indicate the variable for which you want a distribution calculated. Then press **ENTER**.

The computer asks:

INTERVALS ? __

Type in the number of intervals that you want (1 through 5).
Then press **ENTER**.

The computer performs the analysis, and then displays the Ready prompt (>).

The results of the analysis can be displayed or printed (see Chapter 2).

Sample Run (using our sample data)

Computer displays:

You type:

```
>
WHICH IS DV ? _
# OF INTERVALS ? _
>
MINIMUM =
28
(f)40.5 =
2
(f)52 =
2
(%)40.5 =
50
(%)52 =
50
>
```

```
DEF X
1 ENTER
2 ENTER
DEF A
ENTER
ENTER
ENTER
ENTER
ENTER
ENTER
ENTER
ENTER
ENTER
```

How to Read the Distribution Results

When you select the number of intervals for the distribution, the computer places the data into that many equally spaced intervals. In our Sample Run, the computer set up the following intervals:

Interval	Data Values
1	numbers from 28 through 40.5
2	numbers > 40.5 through 52

The label (f) 40.5 is read, "frequency (number of data values) in the interval 28 through 40.5." Two of the records in our sample data file fall into that interval.

The label (%) 40.5 is read, "percentage of all data values falling into the interval 28 through 40.5." Since there are two data records in the interval and four data records in the file, the percentage for that interval is 50%.

Special Considerations

If you list the results of the Distribution and Histogram procedure on your printer, a histogram is produced after the frequency and percentage results.

Chapter 5

Correlation and Regression

The Correlation and Regression procedure allows you to obtain a variety of statistics for pairs of variables on each record in your data file. Output from the analysis includes:

r	Pearson PM correlation coefficient
SLOPE	Slope of the regression line
Y-INT	Y intercept for regression line
t	t-ratio for means (DV-IV)
df	Degrees of freedom for t-test
Y	Predicted Y values
Scattergram	(Printed results)

Instructions for Correlation and Regression

Press **DEF** **C**. The computer asks:

WHICH IS DV ? __

Type **1**, **2**, or **3** to indicate which variable will be the Y variable in the analysis. Then press **ENTER**.

If your data records contain more than two variables, the computer asks:

WHICH IS IV ? __

Type **1**, **2**, or **3** to indicate which variable will be the X variable in the analysis. Then press **ENTER**.

The computer performs the analysis, calculating the correlation between X and Y. A regression line for predicting Y from X is fitted using the method of least squares. Finally, the computer performs a t-test on the mean values for X and Y, and displays the Ready prompt (>).

The results of the analysis can be displayed or printed (see Chapter 2).

Predicting Values for Y

After the computer has performed a Correlation and Regression analysis, you can obtain predicted values for Y based on the regression equation.

Press **DEF****V**. The computer asks:

X ? _

Type in a value for X and press **ENTER**. The computer displays the predicted value of Y. For example:

Y = 16837.14029

Sample Run (using our sample data file)

Computer displays:

You type:

>
WHICH IS DV ? _
WHICH IS IV ? _
>

DEF**C**
3**ENTER**
1**ENTER**
DEF**A**

Computer displays:

You type:

r =
9.119892337E-01
SLOPE =
452.2961631
Y-INT
3268.255395
t =
7.383295101
df =
3
>
X ? _
Y = 16837.14029
>

ENTER
ENTER
ENTER
ENTER
ENTER
ENTER
ENTER
ENTER
DEF**V**
3**0****ENTER**
ENTER

Error Messages and Special Considerations

The Correlation and Regression procedure should be performed only for X and Y values that are measures rather than "coded" variables.

Exercise the usual caution when making predictions based on X values that lie outside the range of your data set.

If you list the results of the Correlation and Regression procedure on your printer, the computer produces a scattergram of your data values and plots the regression line.

If you attempt to perform the Correlation and Regression procedure on data records containing only one variable, the computer displays:

WRONG # OF VARIABLES!

If you attempt to run a correlation on any variable having no variance (i.e., the value of that variable is the same on every record in the data file) you will get a division by zero error:

ERROR 38

Chapter 6

Multiple Regression

The Multiple Regression procedure provides least squares regression statistics for data records containing three variables. You specify the dependent variable. The computer uses the remaining variables as independent (predictor) variables. Output from the analysis includes:

b1	Regression coefficient #1
b2	Regression coefficient #2
a	Constant term for regression equation
SSreg	Regression sum of squares
SSres	Residual (error) sum of squares
F	Regression F-ratio
DFreg	Regression degrees of freedom
DFres	Residual degrees of freedom
Rsqr	Coefficient of determination

Instructions for Multiple Regression

Press **DEF****B**. The computer asks:

WHICH IS DV ? _

Type **1**, **2**, or **3** to indicate which variable on your data records will be the dependent variable. Press **ENTER**. The computer calculates the regression statistics using the remaining variables as predictors and then displays the Ready prompt (>).

The Multiple Regression results can be displayed or printed (see Chapter 2).

Sample Run (using our sample data file)

Computer displays:	You type:
>	DEF B
WHICH IS DV ? _	3 ENTER
>	DEF A
b1 =	ENTER
-3312.740385	ENTER
b2 =	ENTER
460.2403846	ENTER
a =	ENTER
7915.625001	ENTER
SSreg =	ENTER
96254380.29	ENTER
SSres =	ENTER
6311388.41	ENTER
F =	ENTER
7.625452122	ENTER
DFreg =	ENTER
2	ENTER
DFres =	ENTER
1	ENTER
Rsq	ENTER
9.384649626E-01	ENTER
>	

Error Messages and Special Considerations

You will always specify the variable which is to be used as the dependent variable in the analysis. Since there are three variables on each record, the computer automatically uses the remaining variables as IV#1 and IV#2. The table below allows you to determine which one of the remaining variables the computer has assigned to IV#1 and IV#2.

Your DV Selection	Computer-selected IV#1	Computer-selected IV#2
Variable 1	Variable 2	Variable 3
Variable 2	Variable 1	Variable 3
Variable 3	Variable 2	Variable 1

If you attempt to perform the Multiple Regression procedure on data records containing only one or two variables, the computer displays:

WRONG # OF VARIABLES!

If you attempt to run a multiple regression on any variable having no variance (i.e., the value of that variable is the same on every record in the data file) you get a division by zero error:

ERROR 38

Chapter 7

Analysis of Variance

The Analysis of Variance procedure performs a one-way (randomized) analysis of variance for up to five groups (levels). Each record in your data file must contain at least two variables. One variable is the dependent variable, while a second variable is used to place the records into the appropriate analysis groups. Output from the analysis includes:

SST	Total sum of squares
SSb	Between-groups sum of squares
SSw	Within-groups sum of squares
DFb	Degrees of freedom (between)
DFw	Degrees of freedom (within)
MSb	Between-groups mean square
MSw	Within-groups mean square
F	F-ratio

Instructions for Analysis of Variance

Press **DEF****(N)**. The computer asks:

WHICH IS DV ?

Enter **(1)**, **(2)**, or **(3)** to indicate which variable is the dependent variable. Then press **(ENTER)**. The computer asks:

WHICH IS IV ?

Enter (1), (2), or (3) to indicate which variable is the independent variable. Then press (ENTER). The independent variable contains values which tell the computer the analysis group to which each record belongs. In our sample data file (Chapter 1), the second variable contains a "1" for female subjects and a "2" for male subjects. That variable can be used to test for differences in income between female and male subjects (in a two-group design).

The computer asks:

OF LEVELS ? __

Type a number from 2 to 5 to tell the computer how many analysis groups there will be. (Typing any other number will eventually result in an error message.) Then press (ENTER).

For each level in your design, the computer asks (for example):

CODE FOR LEVEL 1 ? __

Type in the exact independent variable data value that will be found on all records that are to be placed into the first analysis group. Press (ENTER). In our sample data file, we can place all females into the first analysis group by typing (1). All males will be placed into the first analysis group if you type (2).

Sample Run (using our sample data file)

Computer displays:

```
>
WHICH IS DV ? __
WHICH IS IV ? __
# OF LEVELS ? __
CODE FOR LEVEL 1 ? __
CODE FOR LEVEL 2 ? __
>
SSt =
102565768.8
SSb =
8136755.8
SSw =
94429013
Dft =
3
DFb =
1
DFw =
2
MSb =
8136755.8
MSw =
47214506.5
F =
1.723359282E-01
>
```

You type:

```
(DEF) (N)
(3) (ENTER)
(2) (ENTER)
(2) (ENTER)
(1) (ENTER)
(2) (ENTER)
(DEF) (A)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
(ENTER)
```

Error Messages and Special Considerations

Unlike other Statistics procedures, Analysis of Variance calculates its statistics on only a portion of your data records. Some records contribute to "Group 1" statistics, some to another analysis group, and some may be excluded from the analysis completely (if the value on the independent variable does not match any of the level codes). Therefore, if you want to obtain descriptive statistics or distribution information for the separate analysis groups, you must enter the data records for each group into a separate file, and then perform the extra analyses.

If you attempt to perform the Analysis of Variance procedure on data records containing only one variable, the computer displays:

WRONG # OF VARIABLES!

Please note that some statistical references refer to "between-groups" as "among-groups."

When running an analysis of variance on "real" data, you should have at least five data records in each analysis group.

The Analysis of Variance procedure can be run with 2, 3, 4, or 5 levels (groups). Although you can enter any number when the computer asks, # OF LEVELS?, you eventually get an error message if the number you enter is less than 2 or greater than 5.

Appendix A

Data File Worksheet For Statistics

RECORD #	VARIABLE 1	VARIABLE 2	VARIABLE 3

VARIABLE NAME: _____

FILE DESCRIPTION: _____

DATE: _____ SAVED AS: _____

Appendix B

Sample Printouts

LISTING OF A DATA FILE

RECORD/VARIABLE

1/1 = 2	10/1 = 8
1/2 = 2	10/2 = 6
1/3 = 4	10/3 = 3
2/1 = 1	11/1 = 3
2/2 = 2	11/2 = 4
2/3 = 4	11/3 = 5
3/1 = 1	12/1 = 3
3/2 = 1	12/2 = 3
3/3 = 4	12/3 = 5
4/1 = 1	13/1 = 6
4/2 = 1	13/2 = 6
4/3 = 3	13/3 = 9
5/1 = 5	14/1 = 6
5/2 = 3	14/2 = 6
5/3 = 6	14/3 = 8
6/1 = 4	15/1 = 10
6/2 = 4	15/2 = 8
6/3 = 6	15/3 = 6
7/1 = 7	16/1 = 9
7/2 = 5	16/2 = 9
7/3 = 3	16/3 = 7
8/1 = 6	17/1 = 6
8/2 = 5	17/2 = 10
8/3 = 4	17/3 = 5
9/1 = 7	18/1 = 6
9/2 = 7	18/2 = 9
9/3 = 3	18/3 = 5

DESCRIPTIVE STATISTICS

MEAN =
4.95

SUM =
99

SUMSQ =
134.95

SD =
2.597595042

SDest =
2.66507628

MINIMUM =
1

MAXIMUM =
10

DISTRIBUTION AND HISTOGRAM

MINIMUM =

1

(f)3.5 =

6

(f)6 =

9

(f)8.5 =

2

(f)10 =

3

(%)3.5 =

30

(%)6 =

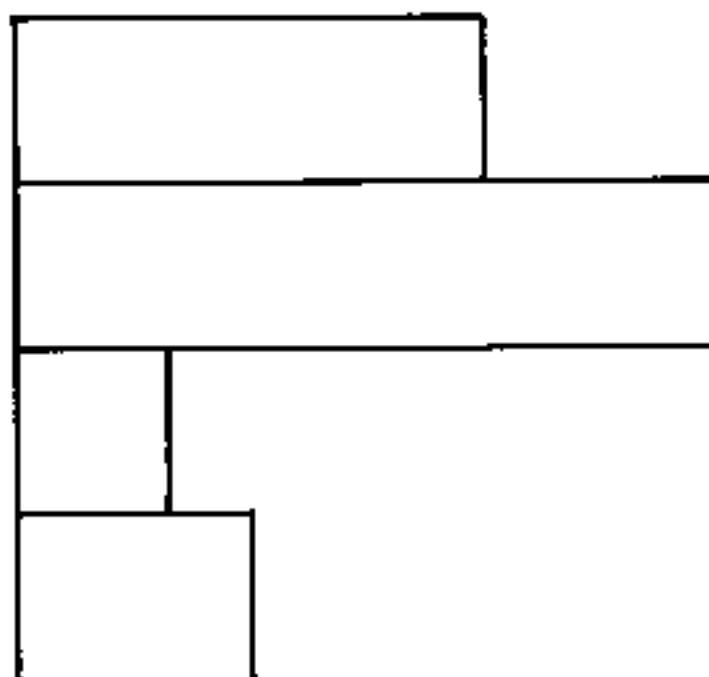
45

(%)8.5 =

10

(%)10 =

15



CORRELATION AND REGRESSION

$r =$

9.389222977E-01

SLOPE =

7.317073173E-0

Y-INT =

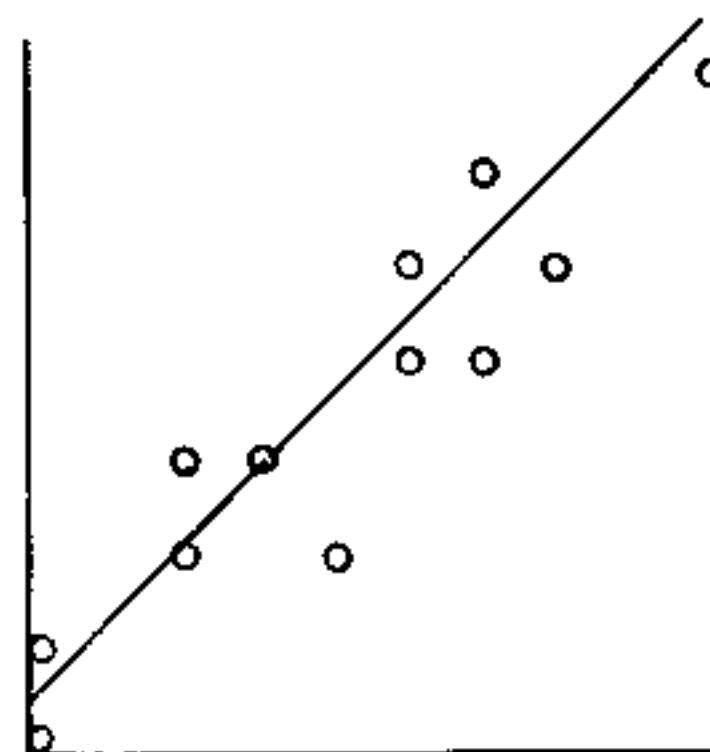
7.853658524E-01

$t =$

-1.704928055

$df =$

14



X: 1 TO 10

Y: 1 TO 8

MULTIPLE REGRESSION

b1 =
6.770816557E-01
b2 =
3.934409728E-01
a =
1.025527457E-01
SSreg =
83.39090434
SSres =
81.60909566
F =
8.685584384
DFreg =
2
DFres =
17
Rsq =
5.053994202E-01

ANALYSIS OF VARIANCE

SSt =
98.91666668
SSb =
32.16666668
SSw =
66.75
DFt =
11
DFb =
2
DFw =
9
MSb =
16.08333334
MSw =
7.416666667
F =
2.168539327

Appendix C

8K Version of Statistics

The 8K version of Statistics can be loaded and run if your Pocket Computer-2 has an 8K RAM Memory Module installed. This increases your data file capacity as follows:

- 250 1-Variable Records
- 200 2-Variable Records
- 150 3-Variable Records

Due to the different file characteristics of 4K and 8K data files, a data tape created by the 4K version of the program cannot be read by the 8K version. Likewise, data tapes created by the 8K version can be read only by that program.

Although the 8K version of Statistics will load in a Pocket Computer with a 4K RAM Memory Module, the program produces an Out of Memory message (ERROR 10) when it is run.

Appendix D

Making A Backup

A Backup is a tape copy of a program and is an extremely effective method of insuring that an accident or equipment fault will not result in the loss of software. Your first action as owner of the Statistics package should be to make working copies of the original cassette and then put the original away in a safe place.

Although it may be possible to make direct copies using two cassette recorders or cassette duplicating equipment, the most reliable method is to use the computer itself to make the Backup. Also, you may wish to put frequently used programs on separate cassettes for easier loading. Here are step-by-step instructions for making a Backup:

1. Install the computer in the Printer/Cassette Interface and connect the Printer/Cassette Interface to the cassette recorder. Make sure the Remote switch is **OFF**.
2. Place the cassette containing the program to be copied in the recorder and either rewind the tape to the beginning or position the tape to a blank area just prior to the desired program. Make a note of the counter number where your saved information will begin, and turn the Remote switch **ON**. Place the recorder in the "Play" mode. It is recommended that the volume control setting be between 8 and 10 on your recorder (or between 5 and 7 on a Minisette-9). If your recorder has a tone control, set it at maximum treble.

3. Turn on the computer, make sure that it is in **RUN mode**, and type: **C L O A D " S A "** and press **ENTER**.

4. When the program has been loaded into the computer and the cassette has stopped, turn the remote switch **OFF** and rewind the tape to the blank space just prior to the program. Turn the Remote switch **ON**, and put the recorder into the "Play" mode. Type: **C L O A D ? " S A "** and press **ENTER**.

This is the computer's verifying function. The recorder will compare the cassette program with the program in the computer's memory. If the load is good, the recorder will stop at the end of the program and the prompt sign (>) will reappear on the display. If an error occurred during the load verification, the display will show: ERROR 43. This means that the format of data to be loaded does not match the file format.

If the error message appears on the display, check the recorder volume setting, try the **CLOAD** function again, and verify the load.

5. When the program has been loaded successfully, remove the cassette and replace it with the cassette which is to receive the program copy. Turn the Remote switch **OFF**, and either rewind the tape to the beginning, or position it to the point where the copy is to start. You should leave from 5-10 seconds of blank space if the copy is to follow another program on the same cassette. Turn the Remote switch **ON**, and place the recorder in **RECORD** mode.

6. Make sure that the computer is in the **RUN** mode. Type: **C S A V E " S A "** and press **ENTER**. The recorder will save your program.

7. To make absolutely sure that the program has been saved correctly, use the verification procedure as described in the fourth instruction of this appendix. If the error message appears on the display, check the recorder volume setting and try the **CLOAD?** function once more. If you still get an error, the tape copy is probably damaged. Use the **CSAVE** function once more and verify the load. It is recommended that you use Radio Shack Supertape or TRS-80 certified cassettes for backing up your Pocket Computer-2 programs.

8. Put the original cassettes in a safe place and use them only for making working copies.

Appendix E

Maintenance

Maintenance of your Pocket Computer-2 system is not difficult. Attention to the simplest points listed below should provide the best reliability and satisfaction:

1. Keep your program cassettes in their boxes when not in use. Do not expose cassettes to temperature extremes or magnetic fields. Never touch the exposed surface of the tape on the front edge of the cassette.
2. Clean and demagnetize the tape heads in the recorder at regular intervals. Follow the recommendations in the cassette recorder's manual.
3. The most reliable loading and saving is achieved by operating the cassette recorder on AC current, rather than batteries.
4. Use only fresh alkaline-type batteries in the recorder when operating your system away from AC current.
5. Always press the recorder's "Stop" key immediately after loading or saving a program. This will release the pressure on the rubber roller which pulls the tape and prevent the roller from damaging the tape at the point of contact.
6. Always turn the computer **OFF** before installing it in or removing it from the Printer/Cassette Interface.
7. After removing the computer from the Printer/Cassette Interface, be sure to reinstall the protective plug to keep dirt out of the connector on the computer. Never touch the exposed parts on the Printer/Cassette Interface.

APPENDIX F FORMULAS USED IN STATISTICS

DESCRIPTIVE STATISTICS

$$\text{SUM OF SQUARES} = \Sigma(x - \bar{x})^2$$

$$\text{STANDARD DEVIATION} = \sqrt{\Sigma(x - \bar{x})^2 / N}$$

$$\text{STD. DEV. (POPULATION EST.)} = \sqrt{\Sigma(x - \bar{x})^2 / (N - 1)}$$

CORRELATION & REGRESSION (WHERE N = # OF PAIRS)

$$\begin{aligned} \text{CORRELATION COEFFICIENT} &= \frac{\Sigma xy - \frac{(\Sigma x)(\Sigma y)}{N}}{\sqrt{\Sigma(x - \bar{x})^2 \cdot \Sigma(y - \bar{y})^2}} \\ \text{(R)} & \end{aligned}$$

$$\text{SLOPE} = \frac{\Sigma xy - \frac{(\Sigma x)(\Sigma y)}{N}}{\Sigma(x - \bar{x})^2}$$

$$\text{Y-INTERCEPT} = \bar{y} - \left(\Sigma xy - \frac{(\Sigma x)(\Sigma y)}{N} \right) \cdot \bar{x}$$

$$\text{T-RATIO} = \frac{\bar{y} - \bar{x}}{\left(\frac{\Sigma(x - \bar{x})^2}{(N - 1)} \right) \cdot \left(\frac{\Sigma(y - \bar{y})^2}{(N - 1)} \right) - 2 \cdot R \cdot \left(\frac{\Sigma(x - \bar{x})^2}{N} \right) \cdot \left(\frac{\Sigma(y - \bar{y})^2}{N} \right)}$$

$$\text{DF} = N - 1 \qquad \text{Y PREDICTED} = \text{SLOPE} \cdot \left(\text{Input } X \right) + \text{Y-INTERCEPT}$$

MULTIPLE REGRESSION ($y = D.V.$, $x_1 = IV\#1$, $x_2 = IV\#2$)

$$b_1 = \frac{\sum(x_2 - \bar{x}_2)^2 \cdot \sum((x_1 - \bar{x}_1) \cdot (y - \bar{y})) - \sum((x_1 - \bar{x}_1) \cdot (x_2 - \bar{x}_2)) \cdot \sum((x_2 - \bar{x}_2) \cdot (y - \bar{y}))}{\sum(x_1 - \bar{x}_1)^2 \cdot \sum(x_2 - \bar{x}_2)^2 - \sum((x_1 - \bar{x}_1) \cdot (x_2 - \bar{x}_2))^2}$$

$$b_2 = \frac{\sum(x_1 - \bar{x}_1)^2 \cdot \sum((x_2 - \bar{x}_2) \cdot (y - \bar{y})) - \sum((x_1 - \bar{x}_1) \cdot (x_2 - \bar{x}_2)) \cdot \sum((x_1 - \bar{x}_1) \cdot (y - \bar{y}))}{\sum(x_1 - \bar{x}_1)^2 \cdot \sum(x_2 - \bar{x}_2)^2 - \sum((x_1 - \bar{x}_1) \cdot (x_2 - \bar{x}_2))^2}$$

$$\text{CONSTANT (a)} = \bar{y} - b_1 \cdot \bar{x}_1 - b_2 \cdot \bar{x}_2$$

$$SS_{\text{REGR}} = b_1 \cdot \sum((x_1 - \bar{x}_1) \cdot (y - \bar{y})) + b_2 \cdot \sum((x_2 - \bar{x}_2) \cdot (y - \bar{y}))$$

$$SS_{\text{RESID}} = \sum(y - \bar{y})^2 - SS_{\text{REGR}}$$

$$DF_{\text{REGR}} = \#IVs = 2$$

$$DF_{\text{RESID}} = N - \#IVs - 1 = N - 2 - 1 = N - 3$$

$$F\text{-RATIO}_{\text{REGR}} = \frac{SS_{\text{REGR}}/2}{SS_{\text{RESID}}/(N-3)}$$

$$\text{COEFFICIENT OF DETERMINATION (R}^2\text{)} = \frac{SS_{\text{REGR}}}{\sum(y - \bar{y})^2}$$

ANALYSIS OF VARIANCE

$$SS_{\text{TOTAL}} = \sum X_T^2 - \frac{(\sum X_T)^2}{N_T}$$

$$SS_{\text{BETWEEN}} = \frac{(\sum X_1)^2}{N_1} + \dots + \frac{(\sum X_K)^2}{N_K} - \frac{(\sum X_T)^2}{N_T} \quad \left\{ \begin{array}{l} \text{where} \\ K = \# \text{ of} \\ \text{groups} \end{array} \right.$$

$$SS_{\text{WITHIN}} = SS_{\text{TOTAL}} - SS_{\text{BETWEEN}}$$

$$DF_{\text{BETWEEN}} = K - 1 \quad (\# \text{ GROUPS} - 1)$$

$$DF_{\text{WITHIN}} = N_T - K \quad (N - \# \text{ GROUPS})$$

$$MS_{\text{BETWEEN}} = SS_{\text{BETWEEN}}/DF_{\text{BETWEEN}}$$

$$MS_{\text{WITHIN}} = SS_{\text{WITHIN}}/DF_{\text{WITHIN}}$$

$$F\text{-RATIO} = MS_{\text{BETWEEN}}/MS_{\text{WITHIN}}$$

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