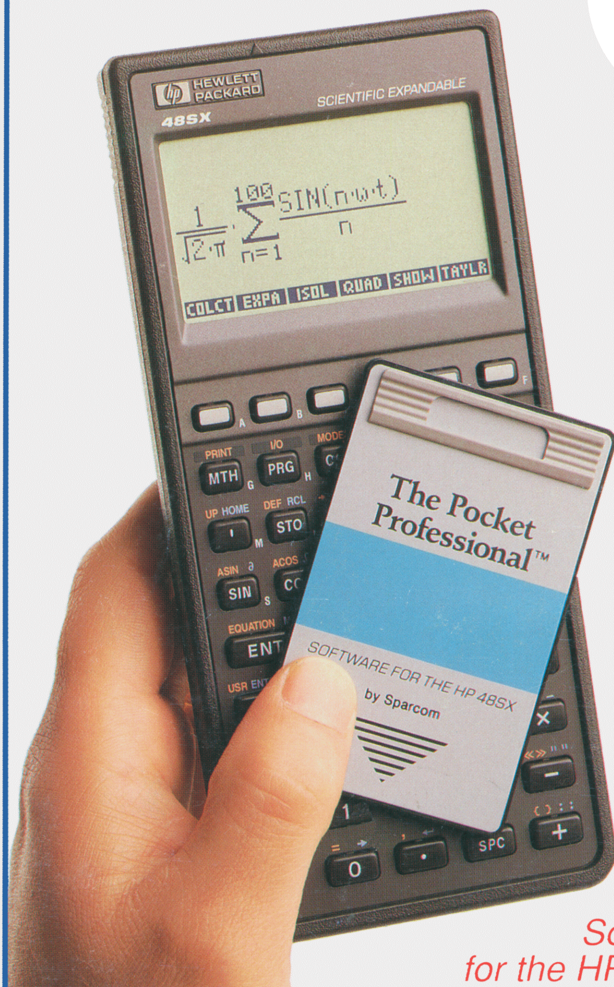
Sparcom

Pocket Professional™

OWNER'S MANUAL

STATISTICS MANUAL



Software for the HP 48SX

The Pocket Professional ™

Statistics

Owner's Manual

SPARCOM CORPORATION

Edition 1
Manual Reorder No. 10101–1M

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Statistics Pac Changes

The following changes were made to the Statistics Pac for version 2.5:

✔ Browser: Cursor movement and scrolling speed have been increased.

HP 48GX USERS ONLY: You should install the application card in Port 1 for two reasons:

1. Application cards installed in Port 1 will execute ~ 20% faster than those installed in Port 2.

2. Application cards installed in Port 2 may experience long pauses (~ 5-10 seconds or more) intermittently during operation. This is not a software defect. It is caused by the new memory architecture of the extended HP 48GX Port 2, which is different from the HP 48SX Port 2. Such pauses will not occur if the application card is operated from Port 1 of the HP 48GX or if it is operated from either port of the HP 48SX.

Statistics Pac Manual Changes

These changes apply to the Statistics Pac Manual, Edition 1, November 1992.

Changes for the HP 48GX

General: To display all libraries on the HP 48GX, press [→] [LIBRARY] instead of [←] [LIBRARY].

General: On the HP 48GX, the [ATTN] key has been replaced by CANCEL.

General: To perform a screen dump on the HP 48GX, press [ON]–[I/O] instead of [ON]–[MTH].

General: To display an item too wide for the display on the HP 48GX, press [→] [CMD] instead of [→] [VISIT].

Page 19: How to Load Data from the Stack: To access the Interactive Stack from an input screen on the HP 48GX, press [←] [EDIT] ↑STK instead of [▲]. Afterwards, press [→] [MENU] to restore the previous menu, if desired.

Page 35: Creating a Directory: Example: On the HP 48GX, press [←] [MEMORY] DIR CRDIR instead of [←] [MEMORY] [NXT] CRDIR to create a directory.

Changes for Version 2.5

Page 18: Using the Search Mode: The search mode is now case-insensitive.

Page 35: Copying a Matrix: When copying a matrix, the name of the original matrix will be supplied as a default name for the copy.

Pages 38, 39: "Delimited" is misspelled in pictures.

Page 39: Add the following section, "Using Text (Tab Delimited) Data on a Computer":

Using Text (Tab Delimited) Data on a Computer

The Matrix Manager transfers matrices between your HP 48SX and a computer and provides automatic translation to the *Text (tab delimited)* and *CSV (comma separated)* formats, as described in "Transferring a Matrix to or from a Computer" in Chapter 2, "Matrix Manager." However, there are two important details about the text and CSV format files created by the Statistics Pac which are not documented in the manual:

- ❑ The first line of the resulting file will be the standard %%HP Kermit header.
- ❑ Quote marks (") will be located at the beginning and end of the data in the resulting file.

Before using the data in a computer spreadsheet or other application, you should delete this extra information.

Example: Send the 'SCORES' matrix from your HP 48SX to a computer, translating it into text (tab delimited) format, and then correct the resulting file on the computer. Make sure you have completed sequentially the manual examples through page 36 in Chapter 2, "Matrix Manager." Starting at the end of the example on page 36 of the manual, press SEND. You will be prompted for ONE or ALL matrices. Press ONE to send only 'SCORES' to the computer. You will be prompted for the outgoing translation method, which determines what format the data will be stored in on the computer. Before selecting an outgoing translation method, you must place the computer in Kermit server mode (ASCII) so it can receive the file. Then, move the pointer to "Text (Tab Delimited)" and press XFER or ENTER to send the 'SCORES' matrix from your HP 48SX to the computer. When the sending operation has completed, you must exit Kermit server mode on the computer and quit Kermit. You will now have a file named 'SCORES' on the computer, which will contain:

```
%%HP: T(3)A(D)F(.);
"30
55
58
60
78
43
99
60
75
55
"
```

(Note: Header may differ slightly in your file, but it's not important.)

You should now open this 'SCORES' file on the computer with a word processor or text editor and delete the first line of the file (the %%HP header) and the quote marks (") at the beginning and end of the data. Then, save the corrected 'SCORES' file on the computer. It is now ready to be used in a computer spreadsheet or other application.

Page 72: Weibull Distribution: The second paragraph should refer to the "Weibull distribution" instead of the "beta distribution."

Page 74: Add the following section, "Equation Reference":

Equation Reference

These are the equations used to calculate the probability distributions described in this Chapter. The upper tail value equations are omitted because they are all numeric integrals or summations from the value of the random variable to the upper end of the range of the probability distribution function.

Probability Distribution Equations

Distribution	Probability Function	Mean	Variance
Beta	$\begin{cases} \dfrac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} X^{\alpha-1}(1-X)^{\beta-1} & 0 \le X \le 1 \\ 0 & \text{elsewhere} \end{cases}$	$\dfrac{\alpha}{\alpha+\beta}$	$\dfrac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$
Binomial	$\binom{N}{X} p^X (1-p)^{N-X} \quad X = 0,1,2,\ldots,N$	Np	$Np(1-p)$

Chi-Square	$\begin{cases} \dfrac{1}{2^{df/2}\Gamma(df/2)} X^{(df-2)/2} e^{-X/2} & X \ge 0 \\ 0 & \text{elsewhere} \end{cases}$	df	2df
Exponential	$\begin{cases} \dfrac{1}{\lambda} e^{-X/\lambda} & X \ge 0 \\ 0 & \text{elsewhere} \end{cases}$	λ	λ^2
F	$\begin{cases} \dfrac{\Gamma\left(\dfrac{df_1+df_2}{2}\right)}{\Gamma\left(\dfrac{df_1}{2}\right)\Gamma\left(\dfrac{df_2}{2}\right)} \left(\dfrac{df_1}{df_2}\right)^{\frac{df_1}{2}} X^{\frac{df_1}{2}-1} \cdot \left(1+\dfrac{df_1}{df_2}X\right)^{-\frac{df_1+df_2}{2}} & X \ge 0 \\ 0 & \text{elsewhere} \end{cases}$	$\dfrac{df_2}{df_2-2}$	$\dfrac{2df_2^2(df_1+df_2-2)}{df_1(df_2-2)^2(df_2-4)}$
Gamma	$\begin{cases} \dfrac{1}{\beta^\alpha \Gamma(\alpha)} X^{\alpha-1} e^{-X/\beta} & X \ge 0 \\ 0 & \text{elsewhere} \end{cases}$	$\alpha\beta$	$\alpha\beta^2$
Geometric	$p(1-p)^{X-1} \qquad X = 1,2,3,\ldots$	$\dfrac{1}{p}$	$\dfrac{1-p}{p^2}$
Hypergeometric	$\dfrac{\binom{a}{X}\binom{b}{N-X}}{\binom{a+b}{N}} \qquad X = 0,1,2,\ldots,N$	$\dfrac{Na}{a+b}$	$\dfrac{Nab(a+b-N)}{(a+b)^2(a+b-1)}$
Negative Binomial	$\binom{X-1}{r-1} p^r (1-p)^{X-r} \qquad X = r, r+1, r+2, \ldots$	$\dfrac{r}{p}$	$\dfrac{r(1-p)}{p^2}$
Normal	$\dfrac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{X-\mu}{\sigma}\right)^2} \qquad -\infty < X < \infty$	μ	σ^2
Poisson	$\dfrac{\lambda^X e^{-\lambda}}{X!} \qquad X = 0,1,2,\ldots$	λ	λ
t	$\dfrac{\Gamma\left(\dfrac{df+1}{2}\right)}{\sqrt{\pi\, df}\,\Gamma(df/2)} \left(1+\dfrac{X^2}{df}\right)^{-\frac{df+1}{2}} \qquad -\infty < X < \infty$	0	$\dfrac{df}{df-2}$
Uniform	$\begin{cases} \dfrac{1}{\beta-\alpha} & \alpha \le X \le \beta \\ 0 & \text{elsewhere} \end{cases}$	$\dfrac{\alpha+\beta}{2}$	$\dfrac{(\beta-\alpha)^2}{12}$

Weibull	$\begin{cases} \frac{\beta}{\alpha}(X-\gamma)^{\beta-1} e^{-\frac{(X-\gamma)^\beta}{\alpha}} & X \geq \gamma \\ 0 & \text{elsewhere} \end{cases}$	$\alpha^{1/\beta}\Gamma\left(1+\frac{1}{\beta}\right)$	$\alpha^{2/\beta}\left[\Gamma\left(1+\frac{2}{\beta}\right)-\Gamma^2\left(1+\frac{1}{\beta}\right)\right]$

Pages 87 and 101: t for $\mu1-\mu2$ ($\sigma1=\sigma2$): The second equation should be $s_p^2 = \frac{(N_1-1)s_1^2 + (N_2-1)s_2^2}{N_1+N_2-2}$.

Page 101: t for $\mu1-\mu2$ ($\sigma1=\sigma2$): The first equation should be $(\bar{x}_1 - \bar{x}_2) \pm t_{\alpha/2, N_1+N_2-2}\, s_p \sqrt{\frac{1}{N_1}+\frac{1}{N_2}}$.

Page 103: F for $\sigma1^2/\sigma w^2$: The first equation should be $\left(\frac{s_2^2}{s_1^2}\frac{1}{F_{\alpha/2(v_2,v_1)}}, \frac{s_2^2}{s_1^2}F_{\alpha/2(v_1,v_2)} \right)$.

Page 106: Normal Test for μ: The equation should be $N = \frac{(z_{\alpha/2}+z_\beta)^2\sigma^2}{(\mu_a-\mu_0)^2}$.

Pages 122, 123: HP 48SX Graphics Environment Operations: On the HP 48GX, the Graphics Environment menus have been re-arranged.

Pages 128-131: The correlation coefficient r has a different meaning than that reported by the built-in HP 48 command CORR—the Statistics Pac r represents the correlation coefficient *between σm and σb* (the uncertainty in the slope and the uncertainty in the intercept), while the value reported by CORR represents the correlation coefficient between the x and y data. Similarly, the covariance Cov is the covariance of m and b, the slope and intercept, rather than the covariance of the x and y data.

Contents

Getting Started

Sparcom's Pocket Professional™ software is the first of its kind, developed to provide speed, efficiency and portability to students and professionals in the technical fields. When you slide the Pocket Professional™ Statistics Pac into your HP 48SX, your calculator is instantly transformed into an "electronic text-book," ready to efficiently solve your Statistics problems.

This section covers:

- ❑ How to Use This Manual and Pac
- ❑ Manual Conventions
- ❑ Installing and Removing an Application Card
- ❑ Using the Library Menu
- ❑ Stack and Flags
- ❑ Memory Requirements
- ❑ The 'SPARCOM' Directory

How to Use This Manual and Pac

This manual is designed to be used with your Sparcom Pocket Professional™ Statistics Pac in the following sequence:

❶ Read this section, "Getting Started," to learn how to install and operate the Statistics Pac and to get an overview of the structure of the Statistics Pac.

❷ Read the chapters in "Part 1: Interactive Menus," to learn how to use the interactive menus of the Statistics Pac, which provide easy-to-use, intuitive access to many of the functions in the Statistics Pac. The interactive menus introduce you to a "recognition" approach to problem-solving, of which the central feature is the *browser menu*—a vertical list of choices in full English words or standard abbreviations. A choice is selected by moving the arrow pointer up and down the menu with the cursor keys and pressing [ENTER]. (For more information, see Chapters 1 through 7.)

❸ Use the table of contents and index to locate further topics of interest.

Manual Conventions

There are a few simple conventions used throughout this and other Pocket Professional™ manuals:

- Keys on the HP 48SX keyboard are shown in a boxed typeface, such as [ENTER] or [ATTN].
- Menukeys (softkeys), which are located at the bottom of the HP 48SX screen and correspond directly to the top row of keys on the HP 48SX keyboard, are shown in an inverse typeface, such as STAT or QUIT.
- Programmable commands are always shown in uppercase letters, such as SIN or GROUP.
- Steps to be followed in a particular order are denoted by ❶, ❷, ❸, etc.
- HP 48SX variables or directories are listed in single quotes, such as '∑DAT' or 'SPARCOM'.

Installing and Removing an Application Card

The HP 48SX has two ports for installing plug-in application cards. You can install your Statistics Pac in either port.

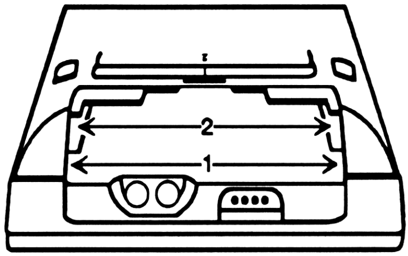
WARNING: Turn off the HP 48SX while installing or removing an application card! Otherwise, user memory may be erased.

Installing an Application Card

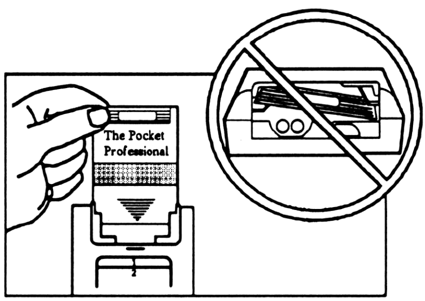
To install an application card, follow these steps:

❶ Turn the HP 48SX off. Do not press [ON] until you have completed the installation procedure.

❷ Remove the port cover. Press against the grip lines and push forward. Lift the cover to expose the two plug-in ports, as shown below:



❸ Select either empty port for the Pocket Professional™ card, and position the card just outside the slot. Point the triangular arrow on the card toward the HP 48SX port opening, as shown below:



❹ Slide the card firmly into the slot. After you first feel resistance, push the card about 1/4 inch further, until it is fully seated.

❺ Replace the port cover.

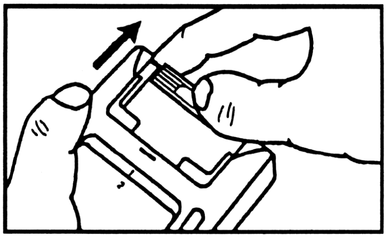
Removing an Application Card

To remove an application card, follow these steps:

❶ Turn the HP 48SX off. Do not press [ON] until you have completed the removal procedure.

❷ Remove the port cover. Press against the grip lines and push forward. Lift the cover to expose the two plug-in ports, as shown above.

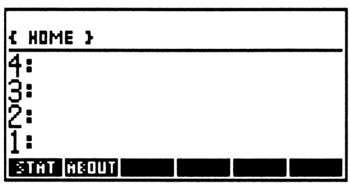
❸ Press against the card's grip and slide the card out of the port, as shown below:



❹ Replace the port cover.

Using the Library Menu

After you turn on your HP 48SX, press [←] [LIBRARY] to display available libraries. Find and press **STAT** to display the Statistics Pac Library menu. The screen displays new menukeys (softkeys) along the bottom, as shown:



The first Library menu softkey provides access to the interactive menus and the second Library menu softkey displays production information about the Statistics Pac.

Library Menu Operations

Key	Description	See
STAT	Provides access to the interactive menus.	Chapters 1–7
ABOUT	Shows product information about the Statistics Pac.	–

Stack and Flags

The flag settings of your HP 48SX will not be modified by the Statistics Pac unless you specifically change them from inside an interactive prompt, and the stack will only be changed as a direct result of a command or if you push →STK from the interactive menus to leave results on the stack. However, pressing ATTN multiple times in rapid succession may abort a command or the interactive menus prematurely, in which case your stack and flag settings may be modified.

The display font size for the interactive menus is controlled by the setting of user flag 57. If flag 57 is clear, the smaller display font will be used; if flag 57 is set, the larger display font will be used. This user flag will be modified by the Statistics Pac if you press FONT during operation.

Memory Requirements

A minimum of about 1.7K bytes free memory is required to access the interactive menus of the Statistics Pac. To use the various commands may require more memory for complicated operations, such as a large regression analysis. If the Statistics Pac appears to be functioning incorrectly, it is possible that there is not enough free memory in your HP 48SX to complete the operation. (For more information, see Chapter 5 of the HP 48SX Owner's Manual, "Calculator Memory.")

The 'SPARCOM' Directory

Sparcom Pocket Professional™ Pacs create the directory 'SPARCOM' in the HOME directory of your HP 48SX. Inside the 'SPARCOM' directory, each Pac creates a subdirectory—for the Statistics Pac, that subdirectory is 'STATD'. When using the interactive menus, some of the variables for the Statistics Pac are stored inside 'STATD', so as not to conflict with your variables in other directories. If you are extremely low on free memory, you can purge the 'STATD' directory, using the command PGDIR. The next time you access the interactive menus, the 'STATD' directory will automatically be re-created. (For more information, see Chapter 7 of the HP 48SX Owner's Manual, "Directories.")

Part 1

Interactive Menus

Chapter 1

Main Menu

The Main menu lists the interactive modules of the Statistics Pac. From the Main menu you can manage matrices, calculate basic statistics, analyze probability distributions, perform estimations, do regressions, and plot your data.

This chapter covers:

- ❑ Using the Main Menu
- ❑ Moving Around the Screen
- ❑ Changing the Font Size
- ❑ Viewing Items Too Wide for the Display
- ❑ Using the Search Mode
- ❑ Text Editing
- ❑ Alpha Lock
- ❑ How to Load Data from the Stack

Using the Main Menu

To get to the Main menu, follow these steps:

❶ Press [⬅] [LIBRARY] to display all libraries available to your HP 48SX.

❷ Find and press **STAT** to display the Statistics Pac Library menu.

❸ Press the first softkey, **STAT** , to start the Statistics Pac interactive menus:

The Main menu lists the interactive modules of the Statistics Pac. A module is selected by moving the pointer to it and pressing [ENTER].

Items in the Main Menu

Each item in the Main menu is briefly described below and is discussed in detail in the various chapters of this manual.

Main Menu Items

Item	Description	See
Matrix Manager	Manages and selects matrices.	Chapter 2
Basic Statistics	Basic descriptive sample statistics.	Chapter 3
Prob. Distributions	Probability distribution parameters.	Chapter 4
Estimation	Testing, intervals, and sample sizes.	Chapter 5
Plotting Manager	Bar, scatter, and frequency plots.	Chapter 6
Regression Analysis	Linear regression fitting.	Chapter 7

Main Menu Operations

Screen	Softkeys
Main Menu	ABOUT →STK PRINT VIEW FONT QUIT

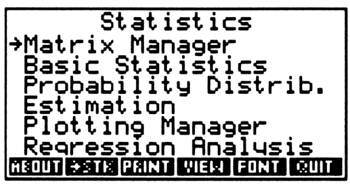
Key	Action
ABOUT	Displays a screen containing the revision number and product information about the Statistics Pac.
FONT	Toggles between the small and large fonts.
PRINT	Prompts for ONE or ALL to select items, and then sends those items to an IR printer.
QUIT	Quits the Statistics Pac to the HP 48SX stack.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack.
VIEW	Displays entire text of an item too wide to fit on the screen.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Moves down one level in the menu structure.
ON–MTH	Dumps the current screen to an IR printer.

Moving Around the Screen

Use the [▲] and [▼] keys to move the pointer up and down in a menu screen. Press [←][▼] to move the pointer to the bottom of the screen, or to page down one screen at a time if the pointer is already at the bottom of the screen. Press [←][▲] to move the pointer to the top of the screen, or to page up one screen at a time. Press [→][▼] to move the pointer to the very end of the menu or press [→][▲] to move the pointer to the very beginning of the menu.

Changing the Font Size

The default font for the Statistics Pac displays information in condensed, upper-case letters only. Pressing **FONT** will toggle the information to display with a larger font, which is case-sensitive:



The font size will remain the same until **FONT** is pressed again.

Viewing Items Too Wide for the Display

If the text of a menu item is too wide to fit within the display, an ellipsis (...) appears at the end of the line. On some screens, the **VIEW** softkey will be present—press **VIEW** to display the entire text of an item, up to one entire screen size. Once the full text has been displayed, press [ENTER] or [ATTN] to return to the menu. At *all* screens, including those screens where **VIEW** is not present, pressing [→][VISIT] will perform the same function. If an item does fit entirely on the screen, **VIEW** or [→][VISIT] will beep and do nothing.

Using the Search Mode

When menu lists are long, it is faster to locate an item using the search mode. To initiate a search, press [α] to display the following screen:

The HP 48SX is now locked in alpha-entry mode, as indicated by the alpha annunciator at the top of the screen (not shown). Alpha entry mode activates the white capital letters printed to the lower right of many keys. (For more information, see "Alpha Lock" below and Chapter 2 of the HP 48SX Owner's Manual, "The Keyboard and Display.")

To perform a search, enter the first letter or letters of the desired string and press [ENTER]. The search function is case-sensitive, and will scan through all information in the current menu. In the alpha entry mode, to enter a lowercase letter, precede the letter with [←]. To abort the search, press [ATTN].

Text Editing

The softkeys present at the search screen and at many data input screens are command line editing keys. They allow you to edit the search string or input data. Their functions are summarized below. (For more information, see Chapter 3 of the HP 48SX Owner's Manual, "The Stack and Command Line.")

Text Editing Operations

Screen	Softkeys
Text Editing	←SKIP SKIP→ ←DEL DEL→ INS ↑STK

Key	Action
←DEL	Deletes all characters in the current word prior to the cursor.
DEL→	Deletes all characters between the cursor's current position and the first character of the next word.
INS	Toggles between insert and type-over modes.
←SKIP	Moves the cursor to the beginning of the current word.

SKIP→	Moves the cursor to the beginning of the next word.
↑STK ▲	Activates a limited version of the Interactive Stack, allowing arguments to be copied from the stack to the command line for editing by pressing ECHO.
ATTN	Clears the command line if there is text present, or aborts text entry if the command line is already blank.
ENTER	Accepts the current command line as the entry and returns to the previous menu or list.

Alpha Lock

Flag –60 controls whether or not Alpha Lock mode is set. The default setting for flag –60 is clear, which means that pressing α places the HP 48SX in alpha-entry mode for only one character, and you must press α α to lock alpha-entry mode. If flag –60 is set, then pressing α only once locks alpha-entry mode. The examples in this manual assume that flag –60 is clear. (For more information, see Chapter 2 of the HP 48SX Owner's Manual, "The Keyboard and Display.")

How to Load Data from the Stack

At all data input prompts, it is possible to copy values from the HP 48SX stack to the command line, even though the Statistics Pac is executing. This is achieved through a limited version of the Interactive Stack. To activate the Interactive Stack at a data input prompt, press ▲, or if that does not work, press ↰ EDIT to display the EDIT menu and then press ↑STK. At this point, unless the stack is empty, the screen will display the contents of the stack. Move the pointer up and down the stack by pressing ▲ and ▼, and when you reach the desired value, press ECHO to copy it to the command line for editing. To exit the Interactive Stack and return to the command line, press ENTER or ATTN. After returning to the command line, you can edit the value with the editing softkeys described above. (For more information, see Chapter 3 of the HP 48SX Owner's Manual, "The Stack and Command Line.")

Chapter 2

Matrix Manager

The Matrix Manager is the core of the Statistics Pac and has three primary purposes: setting the *current directory*, the *current matrix*, and the *current matrix parameters*. The Matrix Manager also allows you to add new matrices, delete unwanted matrices, edit existing matrices, create new directories, move and copy matrices, transfer and translate data between your HP 48SX and a computer, group matrices to create frequency distributions, copy matrices to the stack, print matrices, sort matrices by rows or columns, and transpose matrices.

You can access the Matrix Manager from the Main Menu or from any function in the Statistics Pac which requires you to select a "Matrix."

This chapter covers:

- ❑ Using the Matrix Manager
- ❑ The Current Directory
- ❑ The Current Matrix
- ❑ The Current Matrix Parameters
- ❑ Adding or Manipulating a Matrix
- ❑ Transferring a Matrix to or from a Computer
- ❑ Grouping a Matrix into Frequency Bins
- ❑ Other Matrix Manager Functions

Using the Matrix Manager

To get to the Matrix Manager, follow these steps:

❶ Press [⬅] [LIBRARY] to display all libraries available to your HP 48SX.

❷ Find and press **STAT** to display the Statistics Pac Library menu.

❸ Press the first softkey, **STAT** , to start the Statistics Pac interactive menus.

❹ At Main menu, make sure pointer is at "Matrix Manager" and press [ENTER].

Items in the Matrix Manager

The items listed in the Matrix Manager are the matrices stored in the current directory of your HP 48SX. The following screen assumes you are executing the Statistics Pac for the first time:

To set the current matrix, move the pointer to the desired matrix and press SET. To exit the Matrix Manager to the previous menu, press EXIT. To do both at the same time, move the pointer to the desired matrix and press ENTER.

> **Only real matrices will be displayed in the Matrix Manager. You cannot enter complex matrices, they will not be displayed, and they cannot be used in any statistical calculations.**

Matrix Manager Operations

Screen	Softkeys					
Matrix Manager	SET	ADD	DEL	EDIT	PARS	EXIT
	CRDIR	MOVE	COPY	SEND	RECV	EXIT
	GROUP	→STK	PRINT	CSORT	RSORT	TRN

Key	Action
ADD	Adds a new matrix to the current directory, using the MatrixWriter.
COPY	Copies the matrix selected by the pointer.
CRDIR	Creates a new directory in the current directory.
CSORT	Resorts the matrix selected by the pointer by a column.
DEL	Deletes the matrix selected by the pointer.
EDIT	Edits the matrix selected by the pointer, using the MatrixWriter.
EXIT	Exits the Matrix Manager to the previous menu.
GROUP	Groups the matrix selected by the pointer.

MOVE	Moves the matrix selected by the pointer.
PARS	Sets the current matrix parameters.
PRINT	Prints the matrix selected by the pointer to an IR printer.
RECV	Receives and translates a file from a computer.
RSORT	Resorts the matrix selected by the pointer by a row.
SEND	Sends and translates the matrix selected by the pointer to a computer.
SET	Sets the matrix selected by the pointer to the current matrix.
→STK	Copies the matrix selected by the pointer to the stack.
TRN	Transposes the matrix selected by the pointer.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
◀ UP	Switches to the parent directory of the current directory.
▶ HOME	Switches to the HOME directory of the HP 48SX.
ENTER	If a directory is selected, switches to that directory. If a matrix is selected, sets that matrix to the current matrix and exits the Matrix Manager, returning to the previous menu.

The Current Directory

The *current directory* is the directory displayed in the Matrix Manager.

Setting the Current Directory

To set the current directory, go the Matrix Manager and use [▲], [▼], [⬑][UP], [⮫][HOME], and [ENTER] to switch to the desired directory. That directory becomes the current directory.

Every time you change the current directory, the current matrix and current matrix parameters switch to those in the new current directory.

The Current Matrix

The *current matrix* is located in the current directory and is the data used by the Statistics Pac—you must set the current matrix before you can execute most of the statistical functions. The current matrix or the name of the current matrix is stored in '∑DAT'. Because '∑DAT' is a variable, you can set a different current matrix for each directory. The current matrix used in calculations will be the one located in the current directory.

Setting the Current Matrix

To set the current matrix, go to the Matrix Manager, switch to the desired directory, move the pointer to the desired matrix, and press SET. That matrix will be set to the current matrix for the current directory. To set the current matrix *and* exit the Matrix Manager to the previous menu, move the pointer to the desired matrix and press ENTER.

The current matrix for the current directory is always displayed at the top of the Matrix Manager screen. When you switch directories, the current matrix for the new current directory will be displayed or else "Undefined," if there is no current matrix defined for the new current directory.

Some functions in the Statistics Pac use no current matrix (e.g., probability distributions). In this case, the current matrix information will be ignored. Other functions in the Statistics Pac use two current matrices (e.g., two-sample hypothesis tests). In this case, you will be prompted to enter both "Matrix 1" and "Matrix 2." The second current matrix or the name of the second current matrix will be stored in '∑DAT2'.

Every time you change the current matrix, the current matrix parameters are automatically adjusted to reflect the new current matrix. The data type is set according to the name of the new current matrix and any invalid column parameters are reset to default values. (For more information, see "The Current Matrix Parameters" and "Adding or Manipulating a Matrix" in this chapter.)

The Current Matrix Parameters

The *current matrix parameters* are located in the current directory and determine whether the data in the current matrix is interpreted as raw, grouped, or weighted data and which column(s) of the current matrix are used in calculations. The current matrix parameters are stored in '∑PAR' and '∑PAR2'. Because '∑PAR' and '∑PAR2' are variables, you set different current matrix parameters for each directory. The current matrix parameters used in calculations will be those located in the current directory.

This section covers:

- ❑ Setting the Current Matrix Parameters
- ❑ Data Types
- ❑ Data Column
- ❑ Weight Column
- ❑ X Column
- ❑ Y Column
- ❑ σ Column
- ❑ '∑PAR' Contents
- ❑ '∑PAR2' Contents

Setting the Current Matrix Parameters

To set the current matrix parameters, go to the Matrix Manager, switch to the desired directory, and press **PARS**. This will display the current matrix parameters screen:

```
   Matrix Parameters
→Data Type:    RAW
 Data Column:    1
 Weight Column:  2
 X Column:       1
 Y Column:       2
 σ Column:       0
                  EXIT
```

When you have finished editing the current matrix parameters, press **EXIT** or **ATTN** to return to the Matrix Manager.

Data Types

Data in the current matrix can be interpreted as *raw*, *grouped*, or *weighted* data. Here is more information about each data type:

- ❑ **Raw Data**: A matrix of raw data includes one or more columns of sample data. Raw data is commonly used in Basic Statistics, Estimation, Regression Analysis, and the Plotting Manager.

Example: Here is a sorted version of the matrix 'SCORES', which is created in an example later in this chapter. 'SCORES' is a sample matrix of raw data containing the scores of 10 students on an exam:

'SCORES'

$$\begin{bmatrix} 30 \\ 43 \\ 55 \\ 55 \\ 58 \\ 60 \\ 60 \\ 75 \\ 78 \\ 99 \end{bmatrix}$$

Raw data need not be sorted upon entry, but it should always be entered in columns or entered in rows and then transposed to columns.

- **Grouped Data**: A matrix of grouped data includes a column of class marks (midpoints of class intervals into which the original raw data was grouped) and a column of class frequencies. Grouped data can be created from raw data using GROUP in the Matrix Manager. Grouped data is commonly used in Basic Statistics and the Plotting Manager. (For more information, see "Grouping Data into Frequency Bins" in this chapter.)

  Example: Here is 'SCORES.G1', which is created in an example later in this chapter. 'SCORES.G1' is a sample matrix of grouped data created from 'SCORES' by grouping the data into 5 frequency bins (class intervals) from 0 to 100:

  'SCORES.G1'

$$\begin{bmatrix} 10 & 0 \\ 30 & 1 \\ 50 & 4 \\ 70 & 4 \\ 90 & 1 \end{bmatrix}$$

  The class marks are 10, 30, 50, 70, and 90, which represent the midpoints of the class intervals 0–20, 20–40, 40–60, 60–80, and 80–100, and the class frequencies are 0, 1, 4, 4, and 1, respectively.

- **Weighted Data**: A matrix of weighted data includes a column of data and a column of weights. This is similar to grouped data—the data corresponds to the class marks and the weights correspond to the class frequencies—except that the weights are like normalized class frequencies and commonly add up to 1 or 100, whereas the class frequencies have no specified sum. Weighted data is commonly used in Basic Statistics and the Plotting Manager.

Example: Here are the two alternative versions of 'SCORES.W', a sample matrix of weighted data created from 'SCORES' by manually re-casting the sorted data into weighted form:

'SCORES.W'

$$\begin{bmatrix} 30 & .1 \\ 43 & .1 \\ 55 & .2 \\ 58 & .1 \\ 60 & .2 \\ 75 & .1 \\ 78 & .1 \\ 99 & .1 \end{bmatrix} \quad \text{or} \quad \begin{bmatrix} 30 & 10 \\ 43 & 10 \\ 55 & 20 \\ 58 & 10 \\ 60 & 20 \\ 75 & 10 \\ 78 & 10 \\ 99 & 10 \end{bmatrix}$$

Weights are commonly normalized so they sum to either 1 or 100—in this example, the weights indicate the relative frequency of each score.

Every time you change the current matrix, the data type is automatically adjusted to reflect the new current matrix, based on the name of the matrix. If the name contains .G, the data type is set to grouped. If the name contains .W, the data type is set to weighted. Otherwise, the data type is set to raw. (The only exception is if the new current matrix has only one column, in which case the data type is set to raw, regardless of the name. This is because a one-column matrix cannot contain grouped or weighted data.)

The data type is stored in '∑PAR2'.

Data Column

The data column controls which column of the current matrix will be used as data in a calculation or plot, regardless of the data type. The default value of the data column is 1.

If two current matrices are necessary (e.g., two-sample hypothesis tests), the data column is specified independently for each of the two current matrices. In such cases, since it is possible to set both current matrices to be the same matrix, you can use two different data columns from the same matrix.

Each time you change the current matrix, the data column is automatically adjusted to reflect the new current matrix, based on the number of columns in the matrix. If the previous value of the data column is larger than the number of columns in the new current matrix, the data column is reset to 1.

The data column(s) are stored in '∑PAR2'.

Weight Column

The weight column controls which column of the current matrix will be used as frequencies (for grouped data) or as weights (for weighted data) in a calculation or plot. The default value of the weight column is 2.

Each time you change the current matrix, the weight column is automatically adjusted to reflect the new current matrix, based on the number of columns in the matrix. If the previous value of the weight column is larger than the number of columns in the new current matrix, the weight column is reset to 2.

The weight column is stored in '∑PAR2'.

X Column

The X column controls which column of the current matrix will be used as the X data in a regression analysis or plot. The default value of the X column is 1.

Each time you change the current matrix, the X column is automatically adjusted to reflect the new current matrix, based on the number of columns in the matrix. If the previous value of the X column is larger than the number of columns in the new current matrix, the X column is reset to 1.

The X column is stored in '∑PAR'.

Y Column

The Y column controls which column of the current matrix will be used as the Y data in a regression analysis or plot. The default value of the Y column is 2.

Each time you change the current matrix, the Y column is automatically adjusted to reflect the new current matrix, based on the number of columns in the matrix. If the previous value of the Y column is larger than the number of columns in the new current matrix, the Y column is reset to 2.

The Y column is stored in '∑PAR'.

σ Column

The σ column controls which column of the current matrix will be used as the σ data in a regression analysis. The default value of the σ column is 0, which means no σ data will be expected. If σ data *does* exist, the σ column should be set to the appropriate column of the current matrix.

Each time you change the current matrix, the σ column is automatically adjusted to reflect the new current matrix, based on the number of columns in the matrix. If the previous value of the σ column is larger than the number of columns in the new current matrix, the σ column is reset to 0. It is stored in '∑PAR2'.

The Contents of '∑PAR'

The Statistics Pac shares the reserved variable '∑PAR' with the built-in HP 48SX statistical functions to store some of the current matrix parameters. '∑PAR' should contain the following list of objects:

$$\{ X_{col}\ Y_{col}\ b\ m\ \text{model} \}$$

'∑PAR' Contents

Parameter	Description	Default
X_{col}	X column. Column of current matrix to be used as X data during regression.	1
Y_{col}	Y column. Column of current matrix to be used as Y data during regression.	2
b	Intercept. A real number stored into '∑PAR' during regression.	0
m	Slope. A real number stored into '∑PAR' during regression.	0
Model	Regression model: LINFIT, EXPFIT, PWRFIT, or LOGFIT. Used during regression.	LINFIT

The Contents of '∑PAR2'

The Statistics Pac uses the variable '∑PAR2' to store the remainder of the current matrix parameters. '∑PAR2' should contain the following list of objects:

{ $data_{col1}$ $data_{col2}$ $weight_{col}$ type σ_{col} σ_b σ_m }

'∑PAR2' Contents

Parameter	Description	Default
$data_{col1}$	Data column 1. Column of current matrix to be used as data in calculations.	1
$data_{col2}$	Data column 2. Column of second current matrix to be used as data in calculations. (Used only in two-sample estimations.)	1
$weight_{col}$	Weight column. Column of current matrix to be used as weights (or frequencies) in calculations.	2
type	Data Type. An integer specifying how to interpret the data in the current matrix: 1=raw 2=grouped 3=weighted	1
σ_{col}	σ column. Column of current matrix to be used as uncertainties during regression. A value of 0 means no uncertainties exist.	0
σ_b	Intercept uncertainty. A real number stored into '∑PAR2' during regression.	0
σ_m	Slope uncertainty. A real number stored into '∑PAR2' during regression.	0

Adding or Manipulating a Matrix

Besides setting the current directory, the current matrix, and the current matrix parameters, the Matrix Manager is also useful for adding, modifying, and re-organizing your matrices. An example of student test scores is used to illustrate some of these features.

This section covers:

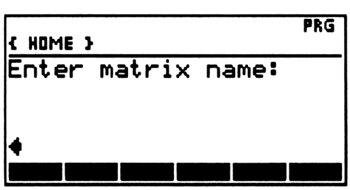
- ❑ Adding a Matrix
- ❑ Deleting a Matrix
- ❑ Editing a Matrix
- ❑ Creating a Directory
- ❑ Copying a Matrix
- ❑ Moving a Matrix

Adding a Matrix

To add a new matrix, go to the Matrix Manager, switch to the directory where you want to add the matrix, and press **ADD**. The MatrixWriter will appear:

Enter the new matrix data in the MatrixWriter. (For more information, see Chapter 20 of the HP 48SX Owner's Manual, "Arrays.")

After you have finished entering the new matrix, press [ENTER] to accept the data, or to abort the add operation, press [ATTN] to return to the Matrix Manager without adding the new matrix. If you pressed [ENTER], you will be prompted for the name of the new matrix:



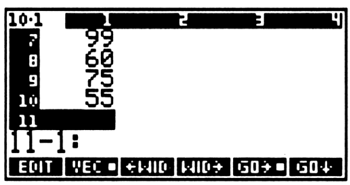
Type in a name for the new matrix and press [ENTER], or to abort the add operation, press [ATTN] to clear the command line (if necessary), and then press [ENTER] or [ATTN] to return to the Matrix Manager without entering a new matrix.

The new matrix will be added to the current directory and will immediately appear in the Matrix Manager. The matrix will automatically be set to the current matrix.

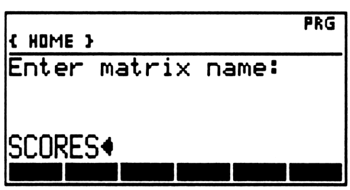
Naming Conventions

If you include .G in the name of a matrix of grouped data or .W in the name of a matrix of weighted data, the Matrix Manager will automatically set the proper data type when that matrix is set to the current matrix. Otherwise, you will have to manually set the data type to grouped or weighted, because the Matrix Manager will not realize the matrix contains grouped or weighted data and will set the data type to raw. Example names: SCORES.G1, SCORES.W, M.G7.

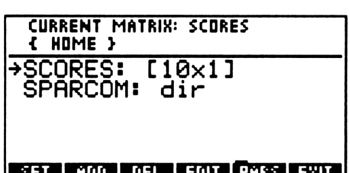
Example: Enter the scores of 10 students on an exam: 30, 55, 58, 60, 78, 43, 99, 60, 75, and 55. Go to the Matrix Manager, as described at the beginning of this chapter. Then press [↱] [HOME] to make sure the current directory is HOME. Press [ADD] to add a new matrix. Type 30 [ENTER] [▼] 55 [SPC] 58 [SPC] 60 [SPC] 78 [SPC] 43 [SPC] 99 [SPC] 60 [SPC] 75 [SPC] 55 [ENTER] to enter the data into the first column:



Press [ENTER] to accept the data. Then type SCORES (no tic marks necessary) as the name of the new matrix:



Press [ENTER] to accept the name. The Matrix Manager will re-appear, with the new matrix displayed:



The new matrix has automatically been set to the current matrix.

Deleting a Matrix

To delete an unwanted matrix, go to the Matrix Manager, switch to the directory containing the unwanted matrix, move the pointer to the unwanted matrix, and press DEL YES. That matrix will be deleted from the current directory. Deleting the current matrix will reset the current matrix to be undefined.

Editing a Matrix

To edit an existing matrix, go to the Matrix Manager, switch to the directory containing the matrix to be edited, move the pointer to the desired matrix, and press EDIT. The MatrixWriter will appear with that matrix loaded for editing.

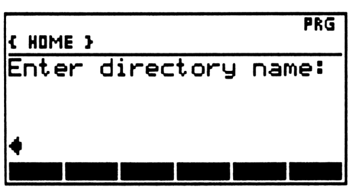
Edit the matrix data in the MatrixWriter. (For more information, see Chapter 20 of the HP 48SX Owner's Manual, "Arrays.")

After you have finished editing the matrix, press ENTER to accept the changes to the data, or to abort the edit operation, press ATTN to return to the Matrix Manager without editing the matrix.

The edited matrix will remain in the current directory and will appear in the Matrix Manager. The matrix will automatically be set to the current matrix.

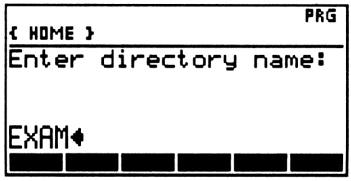
Creating a Directory

To create a directory, go to the Matrix Manager, switch to the directory where you want to create the directory, and press NXT CRDIR. You will be prompted for the name of the directory:

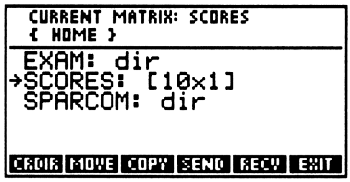


Type in a name for the new directory and press ENTER, or to abort the operation, press ATTN to clear the command line (if necessary), and then press ENTER or ATTN to return to the Matrix Manager without creating a directory. The directory name must be a valid HP 48SX variable name.

Example (cont.): Create a directory named 'EXAM' to organize the information about the student scores. Starting from the Matrix Manager, press ↱ HOME to make sure the current directory is HOME. Then press NXT CRDIR. Type EXAM (no tic marks necessary) as the name of the new directory:



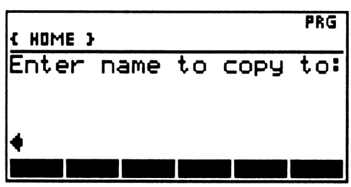
Press [ENTER] to accept the name. The Matrix Manager will re-appear, with the new directory displayed:



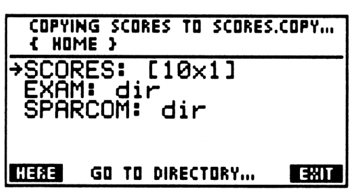
(The same operation could also be performed from the HP 48SX stack by typing [→] [HOME] ['] [α] [α] EXAM [ENTER] [←] [MEMORY] [NXT] CRDIR.)

Copying a Matrix

To copy a matrix, go to the Matrix Manager, switch to the directory containing the matrix you want to copy, move the pointer to the desired matrix, and press [NXT] COPY. You will be prompted for the name of the copy:



Type in a name for the copy and press [ENTER], or to abort the operation, press [ATTN] to clear the command line (if necessary), and then press [ENTER] or [ATTN] to return to the Matrix Manager without copying the matrix. If you entered a name for the copy, you will be prompted to go to the new directory (This screen assumes you are copying the example matrix, 'SCORES'.):

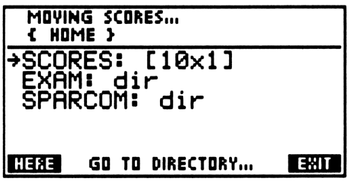


Switch to the new directory and press HERE, or to abort the operation, press ATTN or EXIT to return to the Matrix Manager without copying the matrix.

The new directory will automatically be set to the current directory. The matrix copy will be added to the new current directory and will immediately appear in the Matrix Manager. The matrix will automatically be set to the current matrix.

Moving a Matrix

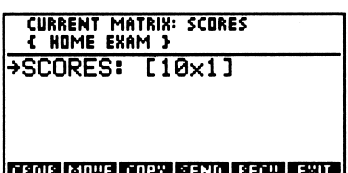
To move a matrix, go to the Matrix Manager, switch to the directory containing the matrix you want to move, move the pointer to the desired matrix, and press NXT MOVE. You will be prompted to go to the new directory (This screen assumes you are moving the example matrix, 'SCORES'.):



Switch to the new directory and press HERE, or to abort the operation, press ATTN or EXIT to return to the Matrix Manager without moving the matrix.

The new directory will automatically be set to the current directory. The moved matrix will be moved to the new current directory and will immediately appear in the Matrix Manager. The matrix will automatically be set to the current matrix.

Example (cont.): Moves the 'SCORES' matrix into the 'EXAM' directory. Starting from the Matrix Manager, press ↱ HOME to make sure the current directory is HOME. Move the pointer to "SCORES: [10x1]" and press MOVE. Then move the pointer to "EXAM: dir" and press ENTER to switch to the directory 'EXAM'. Press HERE to select 'EXAM' as the new directory. The Matrix Manager will re-appear, with 'SCORES' moved to the directory 'EXAM':



'SCORES' no longer exists in the HOME directory, the current directory has automatically been set to 'EXAM', and the current matrix has automatically been set to 'SCORES'.

Transferring a Matrix to or from a Computer

The Matrix Manager also transfers matrices between your HP 48SX and a computer. You can either send matrices from your HP 48SX to a computer for archival purposes or for use in a spreadsheet or you can receive data from a computer for analysis in the Statistics Pac. You have the option of translating data between various HP 48SX and computer formats. The I/O settings of your HP 48SX will automatically be set by the Statistics Pac.

This section assumes you are familiar with Kermit on the computer. When you transfer data to or from the computer, you must place the computer in Kermit server mode so your HP 48SX can send files to or request (receive) files from it.

This section covers:

- ❑ More About Translations
- ❑ Summary of Formats
- ❑ Sending a Matrix
- ❑ Receiving a Matrix

More About Translations

The HP 48SX and the Statistics Pac require array data to be stored in a format which uses square brackets to separate values:

[[1 2] [3 4]]

This is the *HP 48SX ASCII* format. There is also an *HP 48SX Binary* format which can be used to archive HP 48SX matrices onto a computer. Compared to the ASCII format, the binary format has the disadvantage that it cannot be edited on the computer, but it has the advantage of transferring more quickly.

A computer normally requires array data to be stored in a format which uses tabs and carriage returns/linefeeds to separate values:

1 *TAB* 2 *CR* and/or *LF*
3 *TAB* 4 *CR* and/or *LF*

This is the *Text* (*tab delimited*) format. Another common format uses commas and carriage returns/linefeeds to separate values:

1,2 *CR* and/or *LF*
3,4 *CR* and/or *LF*

This is the *CSV* (*comma separated*) format.

Summary of Formats

Here is a summary of the common uses of each format:

- **HP 48SX ASCII**: This is the format required by the Statistics Pac.
- **HP 48SX Binary**: This is a format useful for fast archiving of HP 48SX matrices to a computer.
- **Text (Tab Delimited)**: This format is used by most computer spreadsheets and charting applications.
- **CSV (Comma Separated)**: This format is used by most computer spreadsheets and charting applications.

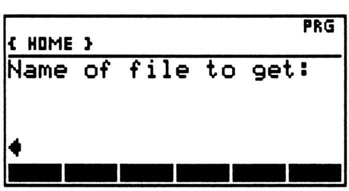
Sending a Matrix

To send a matrix from your HP 48SX to a computer, go to the Matrix Manager, switch to the directory containing the matrix to send, move the pointer to the desired matrix, and press [NXT] SEND. You will be prompted for ONE or ALL matrices. Press ONE to send only the selected matrix to the computer, or press ALL to send all of the matrices in the current directory to the computer. You will be prompted for the outgoing translation method, which determines what format the data will be stored in on the computer:

Before selecting an outgoing translation method, you must place the computer in Kermit server mode (ASCII) so it can receive the file(s). Then, select an outgoing translation method, or to abort the send operation, press EXIT or [ATTN] to return to the Matrix Manager without sending anything.

Receiving a Matrix

To receive data from a computer, go to the Matrix Manager, switch to the directory in which you want to store the incoming data, and press [NXT] RECV. You will be prompted for the name of the file on the computer to get:



Type in the name of the file and press ENTER, or to abort the operation, press ATTN to clear the command line (if necessary), and then press ENTER or ATTN to return to the Matrix Manager without receiving the file.

If you pressed ENTER, you will be prompted for the incoming translation method, which determines what format the Statistics Pac will expect the data to be in:

Before selecting an incoming translation method, you must place the computer in Kermit server mode (ASCII) so it can send the requested file. Then, select an incoming translation method, or to abort the receive operation, press EXIT or ATTN to return to the Matrix Manager without receiving anything.

Upon receipt, if the translation was successful, the new matrix will be added to the current directory and will immediately appear in the Matrix Manager. The matrix will automatically be set to the current matrix.

Grouping a Matrix into Frequency Bins

The Statistics Pac can group raw data into frequency bins. Grouping takes raw data from a matrix, groups it according to grouping parameters you specify, and stores the resulting grouped data into a new matrix.

This section covers:

- Setting the Grouping Parameters
- Grouping and Storing the Data

Setting the Grouping Parameters

To group data, go to the Matrix Manager, switch to the directory containing the matrix to be grouped, move the pointer to the desired matrix, and press [NXT] [NXT] GROUP. This will display the grouping parameters screen (This screen assumes you are grouping the example matrix, 'SCORES'.):

```
  Grouping Parameters
→Column:       1
 Minimum:      30
 Maximum:      99
 Bin Width:    6.9
 No. Bins:     10

GROUP                          EXIT
```

You should now enter or edit the grouping parameters.

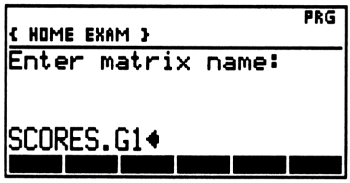
They include:

- **Column**: Column of selected matrix to group. Must be an integer.
- **Minimum**: Minimum value in the column. Default value automatically scanned from selected column. Must be a real number.
- **Maximum**: Maximum value in the column. Default value automatically scanned from selected column. Must be a real number.
- **Bin Width**: Width of the bins. Default value automatically calculated from minimum and maximum values. Must be a positive real number.
- **No. Bins**: Number of bins. Defaults to 10. Must be a positive integer.

If you change the minimum, maximum, or number of bins, the bin width will be re-calculated to compensate for the new value. If you change the bin width, the number of bins will be re-calculated to compensate for the new value.

Grouping and Storing the Data

When you have finished editing the grouping parameters, press GROUP to group the data, or to abort the operation, press EXIT or ATTN to return to the Matrix Manager without grouping the data. If you pressed GROUP, you will be prompted for the name of the new matrix into which to store the grouped data (This screen assumes you grouped the example matrix, 'SCORES'.):



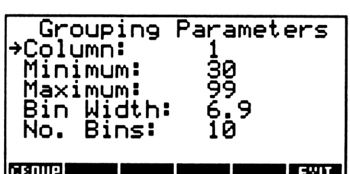
Edit the default name for the new matrix of grouped data and press ENTER, or to abort the operation, press ATTN to clear the command line, and then press ENTER or ATTN to return to the Matrix Manager without storing the new matrix of grouped data.

The new matrix of grouped data will be added to the current directory and will immediately appear in the Matrix Manager. The matrix will automatically be set to the current matrix.

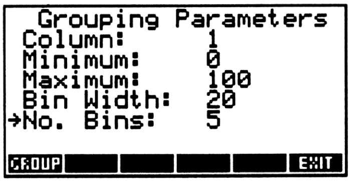
Naming Conventions

The default name for the new matrix of grouped data is a combination of the name of the original matrix of raw data plus .G plus the column which was grouped. If you include .G in the name of a matrix of grouped data, the Matrix Manager will automatically set the data type to grouped when that matrix is set to the current matrix. Otherwise, you will have to manually set the data type to grouped, because the Matrix Manager will not realize the matrix contains grouped data and will set the data type to raw. Example names: SCORES.G1, M.G7.

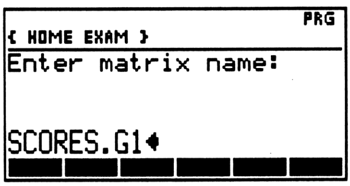
Example (cont.): Group the scores to examine the frequency distribution of the data. Starting from the Matrix Manager, make sure the current directory is 'EXAM'. Then move the pointer to “SCORES: [10x1]” and press NXT GROUP. This will display the grouping parameters screen and the automatically calculated default values:



The default column is 1, the minimum value in column 1 is 30, the maximum value in column 1 is 99, and the bin width is therefore 6.9, assuming 10 bins. Change these parameters to a minimum value of 0, a maximum value of 100, and 5 bins by moving the pointer to the appropriate parameters, pressing ENTER, changing the value, and pressing ENTER to accept the new value. When finished, your screen should look like this:

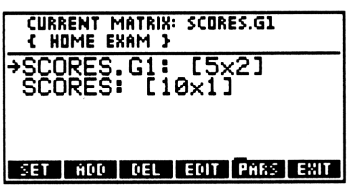


Note that the bin width was automatically re-calculated to 20 when you changed the number of bins to 5. Press GROUP to group the raw data according to these parameters. You will be prompted for the name of the new matrix into which to store the grouped data:



The default name is SCORES.G1, indicating that the original raw data came from the matrix 'SCORES' and that column 1 is being grouped. Press ENTER to accept the default name.

The new matrix of grouped data, 'SCORES.G1', will be added to the current directory and will immediately appear in the Matrix Manager:



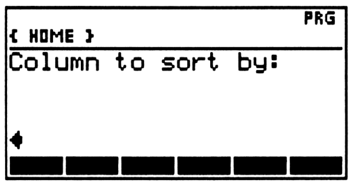
'SCORES.G1' will automatically be set to the current matrix, and the data type will automatically be set to grouped because the name of the new current matrix contains .G.

Other Matrix Manager Functions

This section covers sorting matrices by columns or rows, copying matrices to the stack for later use, and printing matrices on an IR printer.

Sorting a Matrix

To sort a matrix, go to the Matrix Manager, switch to the directory containing the matrix to sort, move the pointer to the desired matrix, and press [NXT] [NXT] CSORT or RSORT, depending on which method of sorting you desire. You will be prompted for the key column or row (the column or row which will be used as the sorting key while sorting the entire matrix):



Type in the desired key row or column and press [ENTER], or to abort the operation, press [ATTN] to clear the command line (if necessary), and then press [ENTER] or [ATTN] to return to the Matrix Manager without sorting the matrix.

Sorting always places the smallest values at the left or top edge of the matrix and the largest values at the right or bottom edge of the matrix. Also, it is not possible to sort a single row or column of a matrix: the entire matrix is always sorted according to the key column or row. The matrix will automatically be set to the current matrix.

Copying a Matrix to the Stack

To copy a matrix to the stack, go to the Matrix Manager, switch to the directory containing the matrix to copy to the stack, move the pointer to the desired matrix, and press [NXT] [NXT] →STK. You will be prompted for ONE or ALL matrices. Press ONE to copy only the selected matrix to the stack, or press ALL to copy all matrices in the current directory to the stack.

Printing a Matrix

To print a matrix, go to the Matrix Manager, switch to the directory containing the matrix to print, move the pointer to the desired matrix, and press [NXT] [NXT] PRINT. You will be prompted for ONE or ALL matrices. Press ONE to print only the selected matrix, or press ALL to print all matrices in the current directory.

The selected matrix or matrices will be sent to the IR port for printing on an IR printer.

Transposing a Matrix

To transpose a matrix, go to the Matrix Manager, switch to the directory containing the matrix to transpose, move the pointer to the desired matrix, and press [NXT][NXT] [TRN]. That matrix will be transposed.

The matrix will automatically be set to the current matrix.

Chapter 3

Basic Statistics

Basic Statistics provides interactive prompts for eleven measures of central tendency, eleven measures of dispersion, and four standard errors.

You set the current matrix with the Matrix Manager and the Statistics Pac calculates the values of the statistics, one at a time or all at once. The values will reflect the data type of the current matrix, whether raw, grouped, or weighted.

This chapter covers:

- ❑ Using Basic Statistics
- ❑ Central Tendency
- ❑ Dispersion Measures
- ❑ Standard Errors
- ❑ Formula Reference

Using Basic Statistics

To get to Basic Statistics, follow these steps:

❶ Press [←] [LIBRARY] to display all libraries available to your HP 48SX.

❷ Find and press **STAT** to display the Statistics Pac Library menu.

❸ Press the first softkey, **STAT** , to start the Statistics Pac interactive menus.

❹ At Main menu, make sure the pointer is at "Basic Statistics" and press [ENTER]:

```
    Basic Statistics
→Central Tendency
 Dispersion Measures
 Standard Errors



MAIN  →STK  PRINT  VIEW  FONT  UP
```

The Basic Statistics menu lists the three areas of basic statistics provided by the Statistics Pac. An area is selected by moving the pointer to it and pressing ENTER.

Items in the Basic Statistics Menu

Each item in the Basic Statistics menu is briefly described below and is discussed in detail in the various sections of this chapter.

Basic Statistics Menu Items

Item	Description
Central Tendency	Eleven measures of central tendency.
Dispersion Measures	Eleven measures of dispersion.
Standard Errors	Four standard errors.

Basic Statistics Menu Operations

Screen	Softkeys
Basic	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items to print.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack.
UP	Returns to the Main menu.
VIEW	Displays entire text of an item too wide to fit on the screen.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Moves down one level in the menu structure, selecting the type of basic statistics selected by the pointer.

Central Tendency

These statistics are calculated for the data column of the current matrix. If the current matrix contains grouped or weighted data, the weight column is used.

Make sure the pointer is at "Central Tendency" and press ENTER:

```
▾  Central Tendency
→Matrix: Press ENTER
 N   = Press ENTER
 T   = Press ENTER
 x̄,µ= Press ENTER
 med= Press ENTER
 mod= Press ENTER
MAIN →STK PRINT CALC FONT UP
```

Make sure the current matrix is set. Then press CALC to calculate the values of *all* of the statistics or move the pointer to the desired statistic and press ENTER to calculate the value of that statistic.

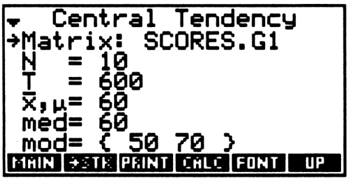
The available measures of central tendency include:

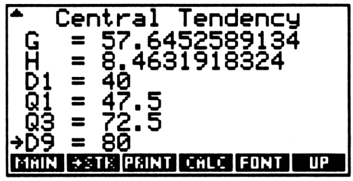
- **N**: Number of data points.
- **T**: Total.
- $\bar{x}$,µ: Mean.
- **Med**: Median.
- **Mod**: Mode. A list of equivalent modes, or an empty list if no mode.
- **G**: Geometric mean.
- **H**: Harmonic mean.
- **D1**: First decile (10th percentile).
- **Q1**: First quartile (25th percentile).
- **Q3**: Third quartile (75th percentile).
- **D9**: Ninth decile (90th percentile).

Once calculated, the statistics can be copied to the stack or printed on a printer. When you have finished viewing the statistics, press UP to return to the Basic Statistics menu, MAIN to return to the Main menu, or ATTN to quit Statistics Pac.

The calculated values of the statistics will be temporarily stored in the 'STATD' directory so you can perform other calculations in the Statistics Pac without having to recalculate these statistics later. But if you change the current matrix with the Matrix Manager or quit the Statistics Pac, the temporarily stored values will be deleted and you will have to recalculate them.

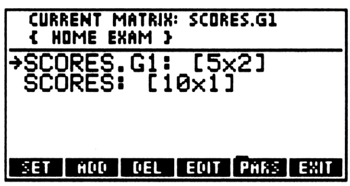
Example: Calculate the values of these statistics for the 'SCORES.G1' matrix (created in Chapter 2), which contains grouped data. Go to Basic Statistics, as described at the beginning of this chapter. Then go to Central Tendency, as described at the beginning of this section. Make sure the current matrix is set to 'SCORES.G1'. Then press CALC to calculate the values of all of the statistics:



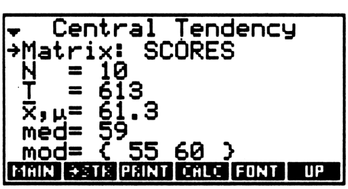


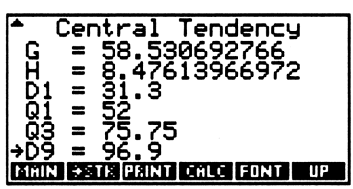
Scroll down to see all values. These measures of central tendency describe the grouped data. Copy any desired values to the stack by pressing →STK ONE.

To see how the statistics differ for the original raw data, calculate them for the 'SCORES' matrix (also created in Chapter 2), which contains the original raw data. To change the current matrix to 'SCORES', move the pointer to "Matrix: SCORES.G1" and press ENTER. The Matrix Manager will appear:



Move the pointer to "SCORES: [10x1]" and press ENTER to set 'SCORES' to be the current matrix and exit the Matrix Manager. The central tendency screen will reappear, with the previous values discarded. Press CALC to calculate the new values of all of the statistics:





Scroll down to see all values. These measures of central tendency describe the raw data. Copy any desired values to the stack by pressing →STK ONE. When you quit the Statistics Pac, you will be able to compare the values on the stack.

Dispersion Measures

These statistics are calculated for the data column of the current matrix. If the current matrix contains grouped or weighted data, the weight column is used.

Make sure the pointer is at "Dispersion Measures" and press [ENTER]:

```
▾ Dispersion Measures
→Matrix: Press ENTER
 min= Press ENTER
 max= Press ENTER
 rng= Press ENTER
 MD = Press ENTER
 σ  = Press ENTER
MAIN →STK PRINT CALC FONT UP
```

Make sure the current matrix is set. Then press CALC to calculate the values of *all* of the statistics or move the pointer to the desired statistic and press [ENTER] to calculate the value of that statistic.

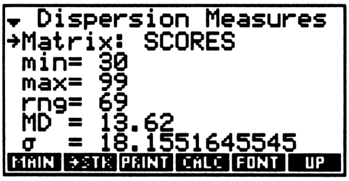
The available measures of dispersion include:

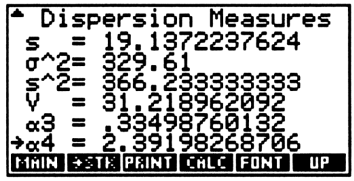
- **Min**: Minimum.
- **Max**: Maximum.
- **Rng**: Range.
- **MD**: Mean deviation (average deviation).
- σ: Population standard deviation.
- s: Sample standard deviation.
- σ^2: Population variance.
- s^2: Sample variance.
- V: Coefficient of variation (relative variation as a percentage).
- α**3**: Moment coefficient of skewness (third moment about the mean).
- α**4**: Moment coefficient of kurtosis (fourth moment about the mean)

Once calculated, the statistics can be copied to the stack or printed on a printer. When you have finished viewing the statistics, press UP to return to the Basic Statistics menu, MAIN to return to the Main menu, or [ATTN] to quit Statistics Pac.

The calculated values of the statistics will be temporarily stored in the 'STATD' directory so you can perform other calculations in the Statistics Pac without having to recalculate these statistics later. But if you change the current matrix with the Matrix Manager or quit the Statistics Pac, the temporarily stored values will be deleted and you will have to recalculate them.

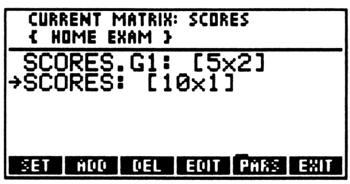
Example: Calculate the values of these statistics for the 'SCORES' matrix, which contains raw data. Go to Basic Statistics, as described at the beginning of this chapter. Then go to Dispersion Measures, as described at the beginning of this section. Make sure the current matrix is set to 'SCORES'. Then press CALC to calculate the values of all of the statistics:



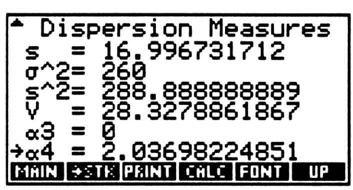


Scroll down to see all values. These measures of dispersion describe the grouped data. Copy any desired values to the stack by pressing →STK ONE.

To see how the statistics differ for the grouped data, calculate them for the 'SCORES.G1' matrix, which contains the grouped data. To change the current matrix to 'SCORES.G1', move the pointer to "Matrix: SCORES" and press ENTER. The Matrix Manager will appear:



Move the pointer to "SCORES.G1: [5x2]" and press ENTER to set 'SCORES.G1' to be the current matrix and exit the Matrix Manager. The dispersion screen will reappear, with the previous values discarded. Press CALC to calculate the new values of all of the statistics:



Scroll down to see all values. These measures of dispersion describe the grouped data. Copy any desired values to the stack by pressing →STK ONE. When you quit the Statistics Pac, you will be able to compare the values on the stack.

Standard Errors

These statistics are calculated for the data column of the current matrix. If the current matrix contains grouped or weighted data, the weight column is used.

Make sure the pointer is at "Standard Errors" and press ENTER:

```
     Standard Errors
→Matrix: Press ENTER
 SE μ,x̄= Press ENTER
 SE med= Press ENTER
 SE s  = Press ENTER
 SE s^2= Press ENTER

MAIN →STK PRINT CALC FONT UP
```

Make sure the current matrix is set. Then press CALC to calculate the values of *all* of the statistics or move the pointer to the desired statistic and press ENTER to calculate the value of that statistic.

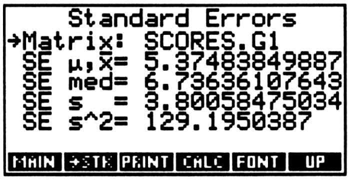
The available standard errors include:

- **SE** μ, $\bar{x}$: Standard error of the mean.
- **SE Med**: Standard error of the median.
- **SE** s: Standard error of the sample standard deviation.
- **SE** s^2: Standard error of the sample variance.

Once calculated, the statistics can be copied to the stack or printed on a printer. When you have finished viewing the statistics, press UP to return to the Basic Statistics menu, MAIN to return to the Main menu, or ATTN to quit Statistics Pac.

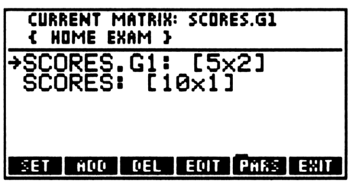
The calculated values of the statistics will be temporarily stored in the 'STATD' directory so you can perform other calculations in the Statistics Pac without having to recalculate these statistics later. But if you change the current matrix with the Matrix Manager or quit the Statistics Pac, the temporarily stored values will be deleted and you will have to recalculate them.

Example: Calculate the values of these statistics for the 'SCORES.G1' matrix, which contains grouped data. Go to Basic Statistics, as described at the beginning of this chapter. Then go to Standard Errors, as described at the beginning of this section. Make sure the current matrix is set to 'SCORES.G1'. Then press CALC to calculate the values of all of the statistics:

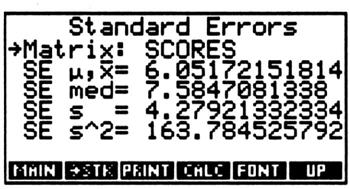


Scroll down to see all values. These standard errors describe the grouped data. Copy any desired values to the stack by pressing →STK ONE.

To see how the statistics differ for the original raw data, calculate them for the 'SCORES' matrix, which contains the original raw data. To change the current matrix to 'SCORES', move the pointer to "Matrix: SCORES.G1" and press ENTER. The Matrix Manager will appear:



Move the pointer to "SCORES: [10x1]" and press ENTER to set 'SCORES' to be the current matrix and exit the Matrix Manager. The standard error screen will reappear, with the previous values discarded. Press CALC to calculate the new values of all of the statistics:



Scroll down to see all values. These standard errors describe the raw data. Copy any desired values to the stack by pressing →STK ONE. When you quit the Statistics Pac, you will be able to compare the values on the stack.

Equation Reference

These are the equations used to calculate the statistics described in this Chapter. In these equations, x represents data in the data column of the current matrix, f represents data in the weight column of the current matrix for grouped data, and w represents data in the weight column of the current matrix for weighted data. (Generally, f and w are analogous.) All summations are from 1 to the number of rows in the current matrix. And when the median, deciles, and quartiles are calculated, the data is first temporarily sorted.

Basic Statistics Equations

Symbol	Statistic	Raw Formula	Grouped Formula	Weighted Formula
N	Number	No. rows.	$\sum f$	$\sum w$
T	Total	$\sum x$	$\sum fx$	$\sum wx$
$\bar{x},\mu$	Mean	$\frac{1}{N}\sum x$	$\frac{1}{N}\sum fx$	$\frac{1}{N}\sum wx$
Med	Median	N odd: middle. N even: mean of middle 2 values.	Interpolate over median class.	Interpolate over median class.
Mod	Mode	If 1 of each, no mode; else most frequent value(s).	Interpolate over modal class.	Interpolate over modal class.
G	Geometric Mean	$\sqrt[N]{\prod x}$	$\sqrt[N]{\prod fx}$	$\sqrt[N]{\prod wx}$
H	Harmonic Mean	$\frac{N}{\sum \frac{1}{x}}$	$\frac{N}{\sum \frac{f}{x}}$	$\frac{N}{\sum \frac{w}{x}}$
D1	1st Decile	$\frac{N+1}{10}$th value	Interpolate over decile class.	Interpolate over decile class.
Q1	1st Quartile	$\frac{N+1}{4}$th value	Interpolate over quartile class.	Interpolate over quartile class.
Q3	3rd Quartile	$\frac{3(N+1)}{4}$th value	Interpolate over quartile class.	Interpolate over quartile class.
D9	9th Decile	$\frac{9(N+1)}{10}$th value	Interpolate over decile class.	Interpolate over decile class.

Min	Minimum	min(x)	min(x)	min(x)
Max	Maximum	max(x)	max(x)	max(x)
Rng	Range	max(x) − min(x)	max(x) − min(x)	max(x) − min(x)
MD	Mean Deviation	$\frac{\sum \lvert x-\bar{x}\rvert}{N}$	$\frac{\sum f\lvert x-\bar{x}\rvert}{N}$	$\frac{\sum w\lvert x-\bar{x}\rvert}{N}$
σ	Population Std Deviation	$\sqrt{\frac{\sum (x-\mu)^2}{N}}$	$\sqrt{\frac{\sum f(x-\mu)^2}{N}}$	$\sqrt{\frac{\sum w(x-\mu)^2}{N}}$
s	Sample Std Deviation	$\sqrt{\frac{\sum (x-\bar{x})^2}{N-1}}$	$\sqrt{\frac{\sum f(x-\bar{x})^2}{N-1}}$	$\sqrt{\frac{\sum w(x-\bar{x})^2}{N-1}}$
σ^2	Population Variance	$\frac{\sum (x-\mu)^2}{N}$	$\frac{\sum f(x-\mu)^2}{N}$	$\frac{\sum w(x-\mu)^2}{N}$
$\mathbf{s^2}$	Sample Variance	$\frac{\sum (x-\bar{x})^2}{N-1}$	$\frac{\sum f(x-\bar{x})^2}{N-1}$	$\frac{\sum w(x-\bar{x})^2}{N-1}$
V	Coefficient of Variation	$100\frac{s}{\bar{x}}$	$100\frac{s}{\bar{x}}$	$100\frac{s}{\bar{x}}$
$\alpha 3$	Moment Coefficient of Skewness	$\frac{1}{Ns^3}\sum (x-\bar{x})^3$	$\frac{1}{Ns^3}\sum f(x-\bar{x})^3$	$\frac{1}{Ns^3}\sum w(x-\bar{x})^3$
$\alpha 4$	Moment Coefficient of Kurtosis	$\frac{1}{Ns^4}\sum (x-\bar{x})^4$	$\frac{1}{Ns^4}\sum f(x-\bar{x})^4$	$\frac{1}{Ns^4}\sum w(x-\bar{x})^4$
SE $\mu, \bar{x}$	Std Error of Mean	$s/\sqrt{N}$	$s/\sqrt{N}$	$s/\sqrt{N}$
SE Med	Std Error of Median	$s\sqrt{\pi/2N}$	$s\sqrt{\pi/2N}$	$s\sqrt{\pi/2N}$
SE s	Std Error of Sample Std Deviation	$\frac{s}{\sqrt{2N}}$	$\frac{s}{\sqrt{2N}}$	$\frac{s}{\sqrt{2N}}$
SE $\mathbf{s^2}$	Std Error of Sample Variance	$s^2\sqrt{\frac{2}{N}}$	$s^2\sqrt{\frac{2}{N}}$	$s^2\sqrt{\frac{2}{N}}$

Chapter 4

Probability Distributions

Probability Distributions provides interactive prompts for analyzing fourteen probability distributions, including beta, binomial, chi-square, exponential, F, gamma, geometric, hypergeometric, negative binomial, normal, Poisson, t, uniform, and Weibull distributions.

You specify all unknown distribution parameters and a value of the random variable, and the Statistics Pac then calculates the probability function value, the upper-tail value, the mean, and the variance of the probability distribution.

This chapter covers:

- ❑ Using Probability Distributions
- ❑ Parameter Screen Tips
- ❑ Beta Distribution
- ❑ Binomial Distribution
- ❑ Chi-Square Distribution
- ❑ Exponential Distribution
- ❑ F Distribution
- ❑ Gamma Distribution
- ❑ Geometric Distribution
- ❑ Hypergeometric Distribution
- ❑ Negative Binomial Distribution
- ❑ Normal Distribution
- ❑ Poisson Distribution
- ❑ t Distribution
- ❑ Uniform Distribution
- ❑ Weibull Distribution
- ❑ Result Screen Operations

Using Probability Distributions

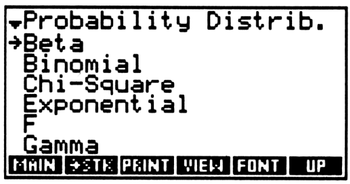
To get to Probability Distributions, follow these steps:

❶ Press [←][LIBRARY] to display all libraries available to your HP 48SX.

❷ Find and press STAT to display the Statistics Pac Library menu.

❸ Press the first softkey, STAT , to start the Statistics Pac interactive menus.

❹ At Main menu, make sure pointer is at "Probability Distributions" and press [ENTER]:



The Probability Distribution menu lists the fourteen probability distributions of the Statistics Pac. A distribution is selected by moving the pointer to it and pressing [ENTER].

Items in the Probability Distribution Menu

Each item in the Probability Distributions menu is briefly described below and is discussed in detail in the various sections of this chapter.

Probability Distributions Menu Items

Item	Description
Beta	Analyzes the beta distribution.
Binomial	Analyzes the binomial distribution.
Chi-Square	Analyzes the chi-square distribution.
Exponential	Analyzes the exponential distribution.
F	Analyzes the F distribution.
Gamma	Analyzes the gamma distribution.
Geometric	Analyzes the geometric distribution.
Hypergeometric	Analyzes the hypergeometric distribution.
Negative Binomial	Analyzes the negative binomial distribution.

Normal	Analyzes the normal distribution.
Poisson	Analyzes the Poisson distribution.
t	Analyzes the t distribution.
Uniform	Analyzes the uniform distribution.
Weibull	Analyzes the Weibull distribution.

Probability Distributions Menu Operations

Screen	Softkeys
Probability	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items to print.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack.
UP	Returns to the Main menu.
VIEW	Displays entire text of an item too wide to fit on the screen.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Moves down one level in the menu structure, executing the probability distribution selected by the pointer.

Parameter Screen Tips

Each probability distribution is controlled by a parameter screen, where you input values for the various parameters of the distribution before calculating the results.

Here are some useful things to know about entering or editing parameters:

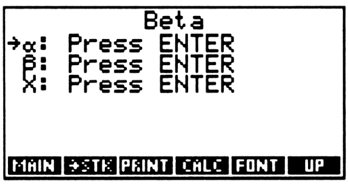
- To enter or edit the value of a parameter, move the pointer to it and press [ENTER]. After entering or editing the value of a parameter, press [ENTER] to accept the new value and return to the parameter screen.
- Once you have begun entering or editing a parameter value, to abort the change, press [ATTN] to clear the command line (if necessary) and then press [ENTER] or [ATTN] to return to the parameter screen without changing the parameter value.
- You only need to enter values for those parameters that initially display, "Press ENTER." Other parameters may be given default values which you may modify if you wish.
- Some HP 48SX modes can be changed at the prompts where parameter values are entered (e.g., pressing [⬅] [RAD] will toggle Radians mode).
- After entering all parameters, press CALC to perform the calculation.

Beta Distribution

The beta distribution is a continuous distribution used to model the probabilistic behavior of random variables defined over an arbitrary finite range, such as a proportion, which is constrained to fall in the interval (0,1).

The beta distribution upper tail value is calculated by solving a numerical integral, and the speed of the solution will depend on the display mode setting of your HP 48SX. For faster results, set your HP 48SX to 4 FIX or fewer digits.

Make sure the pointer is at "Beta" and press [ENTER]:



You should now enter or edit the parameters. They include:

- ❑ α: Must be a positive real number.
- ❑ β: Must be a positive real number.
- ❑ **X**: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

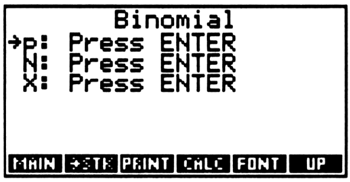
- ❑ **P**β: Probability of observing value of random variable.
- ❑ **UTP**β: Upper tail value, calculated using value of random variable.
- ❑ μ: Mean of the probability distribution.
- ❑ σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Binomial Distribution

The binomial distribution is a discrete distribution describing the number of successes in n trials, when the probability of a success remains constant from trial to trial and the trials are independent. It is commonly used in quality control and is a limiting case of the hypergeometric distribution.

Make sure the pointer is at "Binomial" and press ENTER:



You should now enter or edit the parameters. They include:

- **p**: Probability of "successful" event occurring at each trial. Must be a real number between 0 and 1 inclusive.
- **N**: Number of trials. Must be a positive integer.
- **X**: Random variable. Must be an integer between 0 and N inclusive.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **PB**: Probability of observing value of random variable.
- **UTPB**: Upper tail value, calculated using value of random variable.
- μ: Mean of the probability distribution.
- σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Chi-Square Distribution

The chi-square distribution is a continuous distribution used to measure the discrepancy between observed and expected frequencies, to calculate confidence limits of the variance of normally distributed random variables, and as part of analysis of variance calculations.

Make sure the pointer is at "Chi-Square" and press ENTER:

You should now enter or edit the parameters. They include:

- **df**: Degrees of freedom. Must be a positive integer.
- **X**: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

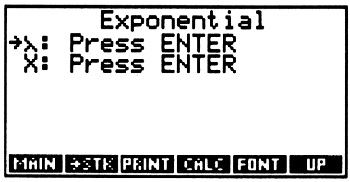
- **PC**: Probability of observing value of random variable.
- **UTPC**: Upper tail value, calculated using value of random variable.
- μ: Mean of the probability distribution.
- σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Exponential Distribution

The exponential distribution (also known as the negative exponential distribution) is a continuous distribution which has important applications in engineering to reliability studies and life testing and in queuing theory.

Make sure the pointer is at "Exponential" and press ENTER:



You should now enter or edit the parameters. They include:

- ❑ λ: Must be a positive real number.
- ❑ X: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **PE**: Probability of observing value of random variable.
- ❑ **UTPE**: Upper tail value, calculated using value of random variable.
- ❑ μ: Mean of the probability distribution.
- ❑ σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

F Distribution

The F distribution (also known as the variance-ratio distribution) is a continuous distribution fundamentally important in analysis of variance. It arises as the sampling distribution of the ratio of the values of two independent random variables having chi-square distributions, each divided by its degrees of freedom.

Make sure the pointer is at "F" and press [ENTER]:

```
            F
→df1: Press ENTER
 df2: Press ENTER
 X: Press ENTER



MAIN →STK PRINT CALC FONT  UP
```

You should now enter or edit the parameters. They include:

- **df1**: Numerator degrees of freedom. Must be a positive integer.
- **df2**: Denominator degrees of freedom. Must be a positive integer.
- **X**: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **PF**: Probability of observing value of random variable.
- **UTPF**: Upper tail value, calculated using value of random variable.
- μ: Mean of the probability distribution.
- σ^2: Variance of the probability distribution.

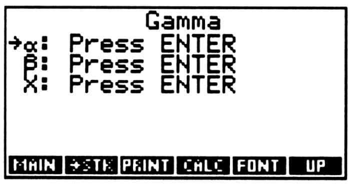
Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Gamma Distribution

The gamma distribution is a continuous distribution applicable to reliability physics, queuing theory, statistical mechanics, and software error rate development modeling. Special cases of the gamma distribution include the chi-square distribution and the exponential distribution.

The gamma distribution upper tail value is calculated by solving a numerical integral, and the speed of the solution will depend on the display mode setting of your HP 48SX. For faster results, set your HP 48SX to 4 FIX or fewer digits.

Make sure the pointer is at "Gamma" and press ENTER:



You should now enter or edit the parameters. They include:

- ❑ α: Shape parameter. Must be a positive real number.
- ❑ β: Scale parameter. Must be a positive real number.
- ❑ X: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

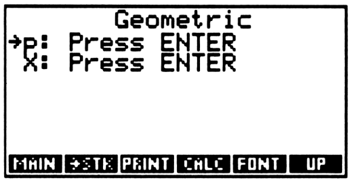
- ❑ Pγ: Probability of observing value of random variable.
- ❑ UTPγ: Upper tail value, calculated using value of random variable.
- ❑ μ: Mean of the probability distribution.
- ❑ σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Geometric Distribution

The geometric distribution is a discrete distribution used to determine the probability that a given number of trials must be made before the *first* success is observed.

Make sure the pointer is at "Geometric" and press ENTER:



You should now enter or edit the parameters. They include:

- **p**: Probability of "successful" event occurring at each trial. Must be a real number between 0 and 1 inclusive.
- **X**: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **PG**: Probability of observing value of random variable.
- **UTPG**: Upper tail value, calculated using value of random variable.
- μ: Mean of the probability distribution.
- σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Hypergeometric Distribution

The hypergeometric distribution is a discrete distribution which applies to sampling without replacement from a finite population, and is used widely in quality control and sample survey analysis. It describes the probability of getting a number of elements of one kind in a random sample.

Make sure the pointer is at "Hypergeometric" and press [ENTER]:

```
     Hypergeometric
→a: Press ENTER
 b: Press ENTER
 N: Press ENTER
 X: Press ENTER

MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- ❑ **a**: Number of elements of one kind. Must be a positive integer.
- ❑ **b**: Number of elements of another kind. Must be a positive integer.
- ❑ N: Sample size. Must be a positive integer less than or equal to $a + b$, the total number of elements.
- ❑ X: Random variable. Must be a non-negative integer less than or equal to either N or a, whichever is smaller.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **PH**: Probability of observing value of random variable.
- ❑ **UTPH**: Upper tail value, calculated using value of random variable.
- ❑ μ: Mean of the probability distribution.
- ❑ σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Negative Binomial Distribution

The negative binomial distribution (also known as the Pascal distribution) defines the total number of trials to make a specific number of observations of a given event.

Make sure the pointer is at "Negative Binomial" and press ENTER:

```
    Negative Binomial
→p: Press ENTER
 r: Press ENTER
 X: Press ENTER



MAIN →STK PRINT CALC FONT  UP
```

You should now enter or edit the parameters. They include:

- ❑ **p**: Probability of "successful" event occurring at each trial. Must be a real number between 0 and 1 inclusive.
- ❑ **r**: Number of observations. Must be a positive integer.
- ❑ **X**: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **PNB**: Probability of observing value of random variable.
- ❑ **UTPNB**: Upper tail value, calculated using value of random variable.
- ❑ μ: Mean of the probability distribution.
- ❑ σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Normal Distribution

The normal distribution (also known as the Gaussian distribution) is a continuous distribution used to describe a great deal of all variable statistical data.

Make sure the pointer is at "Normal" and press ENTER:

```
        Normal
→μ: Press ENTER
 σ: Press ENTER
 X: Press ENTER



MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- ❑ μ: Mean. Must be a real number.
- ❑ σ: Standard deviation. Must be a non-zero real number.
- ❑ X: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

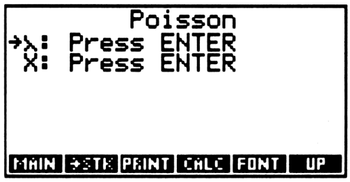
- ❑ **PN**: Probability of observing value of random variable.
- ❑ **UTPN**: Upper tail value, calculated using value of random variable.
- ❑ μ: Mean of the probability distribution.
- ❑ σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Poisson Distribution

The Poisson distribution is a discrete distribution, which is the limiting form of the binomial distribution, is used when the probability of a success on an individual trial approaches zero, the number of trials becomes infinite, and the product of these two quantities remains constant.

Make sure the pointer is at "Poisson" and press ENTER:



You should now enter or edit the parameters. They include:

- λ: Must be a positive real number.
- **X**: Random variable. Must be a positive integer.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **PP**: Probability of observing value of random variable.
- **UTPP**: Upper tail value, calculated using value of random variable.
- μ: Mean of the probability distribution.
- σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

t Distribution

The t distribution (also known as the Student-t distribution) is a continuous distribution used largely for inferences concerning the mean (or means) of normal distributions whose variances are unknown.

Make sure the pointer is at “t” and press ENTER:

You should now enter or edit the parameters. They include:

- **df**: Degrees of freedom. Must be a positive integer.
- **X**: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **PT**: Probability of observing value of random variable.
- **UTPT**: Upper tail value, calculated using value of random variable.
- μ: Mean of the probability distribution.
- σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see “Result Screen Operations.”

Uniform Distribution

The uniform distribution (also known as the rectangular distribution) is a continuous distribution with a constant probability density over a given interval, such as the distribution of random numbers. (The uniform distribution can also be formulated in a discrete case.)

Make sure the pointer is at "Uniform" and press ENTER:

```
        Uniform
→α: Press ENTER
 β: Press ENTER
 X: Press ENTER



MAIN →STK PRINT CALC FONT  UP
```

You should now enter or edit the parameters. They include:

- α: Interval start. Must be a positive real number less than β.
- β: Interval end. Must be a real number greater than α.
- X: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **PU**: Probability of observing value of random variable.
- **UTPU**: Upper tail value, calculated using value of random variable.
- μ: Mean of the probability distribution.
- σ^2: Variance of the probability distribution.

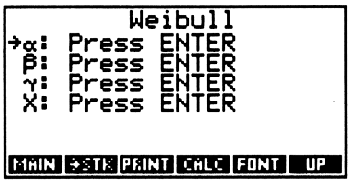
Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Weibull Distribution

The Weibull distribution is a continuous distribution used extensively in the study of industrial product reliability. One feature of this distribution is that the failure rate can be made to increase, decrease, or remain constant over time. If constant, the Weibull distribution reduces to the exponential distribution.

The beta distribution upper tail value is calculated by solving a numerical integral, and the speed of the solution will depend on the display mode setting of your HP 48SX. For faster results, set your HP 48SX to 4 FIX or fewer digits.

Make sure the pointer is at "Weibull" and press ENTER:



You should now enter or edit the parameters. They include:

- ❑ α: Scale parameter. Must be a positive real number.
- ❑ β: Shape parameter. Must be a positive real number.
- ❑ γ: Location parameter. Must be a non-negative real number.
- ❑ X: Random variable. Must be a real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **PW**: Probability of observing value of random variable.
- ❑ **UTPW**: Upper tail value, calculated using value of random variable.
- ❑ μ: Mean of the probability distribution.
- ❑ σ^2: Variance of the probability distribution.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Probability Distributions menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Result Screen Operations

These are the operations available at all result screens.

Result Screen Operations

Screen	Softkeys
Result Screen	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items, and then sends those items to an IR printer.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack. The items are placed in a list if ALL was chosen.
UP	Returns to the Probability Distributions menu.
VIEW	Displays the entire text of an item too wide to fit on the screen, up to one entire screen size.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Either views the result in the EquationWriter (equation) or displays the result expanded to a full screen (not equation).

Chapter 5

Estimation

Estimation provides interactive prompts for eight hypothesis tests, seven confidence intervals, and two estimations of sample size. These include normal tests, proportion tests, t tests, F tests, corresponding confidence intervals, and estimations of sample size for normal hypothesis tests and confidence intervals.

You set the current matrix with the Matrix Manager (which is automatically scanned to determine all unknown sample parameters) and specify all unknown population parameters, and the Statistics Pac calculates hypothesis test results, confidence interval limits, or estimated sample sizes. The current matrix should contain raw data.

This chapter covers:

- ❑ Using Estimation
- ❑ Parameter Screen Tips
- ❑ Hypothesis Testing
- ❑ Confidence Intervals
- ❑ Sample Sizes
- ❑ Result Screen Operations

Using Estimation

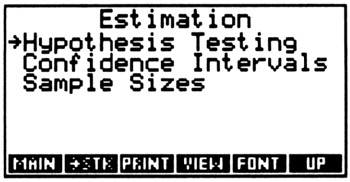
To get to Estimation, follow these steps:

❶ Press [⬅] [LIBRARY] to display all libraries available to your HP 48SX.

❷ Find and press **STAT** to display the Statistics Pac Library menu.

❸ Press the first softkey, **STAT**, to start the Statistics Pac interactive menus.

❹ At Main menu, make sure pointer is at "Estimation" and press [ENTER]:



The Estimation menu lists the three areas of estimation provided by the Statistics Pac. An area is selected by moving the pointer to it and pressing [ENTER].

Items in the Estimation Menu

Each item in the Estimation menu is briefly described below and is discussed in detail in the various sections of this chapter.

Estimation Menu Items

Item	Description
Hypothesis Testing	Eight hypothesis tests.
Confidence Intervals	Seven confidence intervals.
Sample Sizes	Two sample size estimations.

Estimation Menu Operations

Screen	Softkeys					
Estimation	MAIN	→STK	PRINT	VIEW	FONT	UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items to print.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack.
UP	Returns to the Main menu.
VIEW	Displays entire text of an item too wide to fit on the screen.
[ATTN]	Quits the Statistics Pac to the HP 48SX stack.
[ENTER]	Moves down one level in the menu structure, selecting the type of estimation selected by the pointer.

Parameter Screen Tips

Each type of estimation is controlled by a parameter screen, where you input values for the various parameters of the estimation before calculating the results.

Here are some useful things to know about entering or editing parameters:

- To enter or edit the value of a parameter, move the pointer to it and press [ENTER]. After entering or editing the value of a parameter, press [ENTER] to accept the new value and return to the parameter screen.
- Once you have begun entering or editing a parameter value, to abort the change, press [ATTN] to clear the command line (if necessary) and then press [ENTER] or [ATTN] to return to the parameter screen without changing the parameter value.
- You only need to enter values for those parameters that initially display, "Press ENTER." Other parameters may be given default values which you may modify if you wish.
- Some HP 48SX modes can be changed at the prompts where parameter values are entered (e.g., pressing [←][RAD] will toggle Radians mode).
- After entering all parameters, press CALC to perform the calculation.

Hypothesis Testing

Hypothesis tests are rules, or procedures, for deciding whether to accept or reject a hypothesis. A *hypothesis* is an assertion about a parameter of a population. For example, one might formulate and test the hypothesis that a sample comes from a population with the mean μ. The hypothesis test is the test which provides a criterion for deciding whether a difference between theory and practice can reasonably be attributed to chance. All of the hypothesis tests included in the Statistics Pac are *two-tailed tests*.

Hypothesis Testing Inputs

Each hypothesis test parameter screen generally requires the following inputs:

- The current matrix or matrices, which are automatically scanned to determine the necessary sample parameters, such as the sample mean $\overline{x}$. If desired, however, the scanned values can be modified. The current matrix or matrices should contain raw data. Make sure the current matrix parameters are set correctly for the current matrix or matrices. (For more information, see Chapter 2, "Matrix Manager.")
- Certain population parameters, such as the population mean μ.
- The level of significance α (also known as the *producer's risk*), which is the risk of a Type I error (the rejection of the null hypothesis when it is actually true).

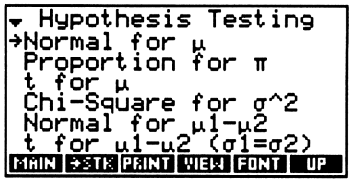
Hypothesis Testing Outputs

Each hypothesis test calculates the following values:

- The z (or t or c or F) value, which is the value of the test statistic for the specified input parameters. This value describes the relationship between the sample and population values.
- The $z_{\alpha/2}$ (or $t_{\alpha/2}$ or $\chi^2_{\alpha/2}$ or $F_{\alpha/2}$) value, which is the value of the test statistic for which the probability that the observed value violates the null hypothesis in a two-tailed test is α.
- The P-value, which is the attained significance level (the smallest significance level at which the observed result would lead to rejection of the null hypothesis in a two-tailed test).

Using Hypothesis Testing

Make sure pointer is at "Hypothesis Testing" and press ENTER:



The Hypothesis Testing menu lists the eight hypothesis tests provided by the Statistics Pac. A test is selected by moving the pointer to it and pressing ENTER.

Items in the Hypothesis Testing Menu

Each item in the Hypothesis Testing menu is briefly described below and is discussed in detail in the various sections of this chapter.

Hypothesis Testing Menu Items

Item	Description
Normal for μ	Hypothesis test that a large sample comes from a population with mean μ.
Proportion for π	Hypothesis test that a large sample comes from a population with proportion π.
t for μ	Hypothesis test that a sample comes from a population with mean μ.
Chi-square for σ^2	Hypothesis test that a sample comes from a population with variance σ^2.
Normal for $\mu1-\mu2$	Hypothesis test that the difference between the means of two large samples is $\mu1-\mu2$.
t for $\mu1-\mu2$ ($\sigma1=\sigma2$)	Hypothesis test that the difference between the means of two samples (equal variance) is $\mu1-\mu2$.
t for $\mu1-\mu2$ ($\sigma1\neq\sigma2$)	Hypothesis test that the difference between the means of two samples (unequal variance) is $\mu1-\mu2$.
F for $\sigma1^2/\sigma2^2$	Hypothesis test that the ratio of the variances of two samples is $\sigma1^2/\sigma2^2$.

Hypothesis Testing Menu Operations

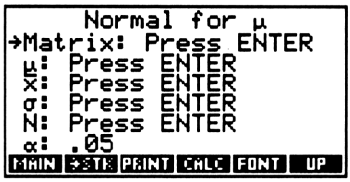
Screen	Softkeys
Hypothesis	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items to print.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack.
UP	Returns to the Estimation menu.
VIEW	Displays entire text of an item too wide to fit on the screen.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Moves down one level in the menu structure, executing the hypothesis test selected by the pointer.

Normal for μ

This hypothesis test uses the statistic $z = \dfrac{\bar{x} - \mu}{\sigma/\sqrt{N}}$ to examine the hypothesis that a sample with mean $\bar{x}$ comes from a population with mean μ. The population must be normally distributed with known standard deviation σ or the sample size must be large enough $(N > 30)$ that the sample standard deviation s may be substituted for σ.

Make sure the pointer is at “Normal for μ” and press ENTER:



You should now enter or edit the parameters. They include:

- ❑ **Matrix**: Current matrix selected with the Matrix Manager.
- ❑ μ: Population mean. Must be a real number.
- ❑ $\bar{x}$: Sample mean. Scanned from matrix. Must be a real number.
- ❑ σ: Population standard deviation. Scanned from matrix, because for large samples, σ can be estimated by the sample standard deviation, s.
- ❑ N: Sample size. Scanned from matrix. Must be a positive integer.
- ❑ α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **z**: Value of the z statistic.
- ❑ $z_{\alpha/2}$: Value of the z statistic necessary to violate the null hypothesis.
- ❑ **P-value**: Attained significance level for a two-tailed test.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see “Result Screen Operations.”

Proportion for π

This hypothesis test uses the statistic $z = \dfrac{p - \pi}{\sqrt{\pi(1 - \pi)/N}}$ to examine the hypothesis that a sample with proportion p comes from a population with proportion π.

Make sure the pointer is at "Proportion for π" and press ENTER:

```
   Proportion for π
→π: Press ENTER
 p: Press ENTER
 N: Press ENTER
 α: .05

MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- ❑ π: Population proportion. Must be a real number between 0 and 1.
- ❑ p: Sample proportion. Must be a real number between 0 and 1.
- ❑ N: Sample size. Must be a positive integer.
- ❑ α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **z**: Value of the z statistic.
- ❑ $\mathbf{z}_{\alpha/2}$: Value of the z statistic necessary to violate the null hypothesis.
- ❑ **P-value**: Attained significance level for a two-tailed test.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

t for μ

This hypothesis test uses the statistic $t = \dfrac{\bar{x} - \mu}{s/\sqrt{N}}$ to examine the hypothesis that a sample comes from a population with mean μ. The population must be normally distributed.

Make sure the pointer is at "t for μ" and press ENTER:

```
        t for μ
→Matrix: Press ENTER
 μ: Press ENTER
 x̄: Press ENTER
 s: Press ENTER
 N: Press ENTER
 α: .05
MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- **Matrix**: Current matrix selected with the Matrix Manager.
- μ: Population mean. Must be a real number.
- $\bar{x}$: Sample mean. Scanned from matrix. Must be a real number.
- s: Sample standard deviation. Scanned from matrix.
- N: Sample size. Scanned from matrix. Must be a positive integer.
- α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **t**: Value of the t statistic.
- **df**: Degrees of freedom.
- $\mathbf{t}_{\alpha/2}$: Value of the t statistic necessary to violate the null hypothesis.
- **P-value**: Attained significance level for a two-tailed test.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Chi-Square for σ^2

This hypothesis test uses the statistic $\chi^2 = \dfrac{(N-1)s^2}{\sigma^2}$ to examine the hypothesis that a sample with variance s^2 comes from a population with variance σ^2.

Make sure the pointer is at "Chi-square for σ^2" and press ENTER:

```
  Chi-Square for σ^2
→Matrix: Press ENTER
 σ^2: Press ENTER
 s^2: Press ENTER
 N: Press ENTER
 α: .05

MAIN | →STK | PRINT | CALC | FONT | UP
```

You should now enter or edit the parameters. They include:

- **Matrix**: Current matrix selected with the Matrix Manager.
- σ^2: Population variance. Must be a real number.
- s^2: Sample variance. Scanned from matrix. Must be a real number.
- N: Sample size. Scanned from matrix. Must be a positive integer.
- α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- c: Value of the χ^2 statistic.
- df: Degrees of freedom.
- $c_{\alpha/2}$: Value of the χ^2 statistic necessary to violate the null hypothesis.
- **P-value**: Attained significance level for a two-tailed test.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Normal for μ1–μ2

This hypothesis test uses the statistic $z = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\sigma_1^2/N_1 + \sigma_2^2/N_2}}$ to examine the hypothesis that two samples with difference of means $x_1 - x_2$ come from populations with difference of means $\mu_1 - \mu_2$. The populations must be normally distributed with known standard deviations σ_1 and σ_2 or the sample sizes must be large $(N_1 > 30$ and $N_2 > 30)$, so the sample standard deviations s_1 and s_2 may be substituted for σ_1 and σ_2.

Make sure the pointer is at "Normal for μ1–μ2" and press ENTER:

```
▾  Normal for μ1-μ2
→Matrix 1: Press ENTER
 Matrix 2: Press ENTER
 μ1-μ2: 0
 x̄1: Press ENTER
 x̄2: Press ENTER
 σ1: Press ENTER
MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- ❑ **Matrix 1**: Current matrix 1 selected with the Matrix Manager.
- ❑ **Matrix 2**: Current matrix 2 selected with the Matrix Manager. Matrix 2 can actually be the same as matrix 1, provided you specify a different data column for matrix 2 in the PARS menu of the Matrix Manager.
- ❑ μ_1–μ_2: Difference of population means. Must be a real number.
- ❑ $\bar{x}_1$: Sample mean 1. Scanned from matrix 1. Must be a real number.
- ❑ $\bar{x}_2$: Sample mean 2. Scanned from matrix 2. Must be a real number.
- ❑ σ_1: Population standard deviation 1. Scanned from matrix 1, because for large samples, σ_1 can be estimated by the sample standard deviation, s_1.
- ❑ σ_2: Population standard deviation 2. Scanned from matrix 2, because for large samples, σ_2 can be estimated by the sample standard deviation, s_2.
- ❑ N_1: Sample size 1. Scanned from matrix 1. Must be a positive integer.
- ❑ N_2: Sample size 2. Scanned from matrix 2. Must be a positive integer.
- ❑ α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **z**: Value of the z statistic.
- $\mathbf{z_{\alpha/2}}$: Value of the z statistic necessary to violate the null hypothesis.
- **P-value**: Attained significance level for a two-tailed test.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

t for $\mu 1-\mu 2$ ($\sigma 1=\sigma 2$)

This hypothesis test uses the statistic $t = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{s_p\sqrt{1/N_1 + 1/N_2}}$ where

$s_p = \dfrac{(N_1 - 1)s_1^2 + (N_2 - 1)s_2^2}{N_1 + N_2 - 2}$ to examine the hypothesis that two samples with difference of means $x_1 - x_2$ come from populations with difference of means $\mu_1 - \mu_2$ and equal variances. The populations must be normally distributed.

Make sure the pointer is at "t for μ1–μ2 (σ1=σ2)" and press ENTER:

You should now enter or edit the parameters. They include:

- **Matrix 1**: Current matrix 1 selected with the Matrix Manager.
- **Matrix 2**: Current matrix 2 selected with the Matrix Manager. Matrix 2 can actually be the same as matrix 1, provided you specify a different data column for matrix 2 in the PARS menu of the Matrix Manager.
- $\mu_1 - \mu_2$: Difference of population means. Must be a real number.
- $\bar{x}_1$: Sample mean 1. Scanned from matrix 1. Must be a real number.
- $\bar{x}_2$: Sample mean 2. Scanned from matrix 2. Must be a real number.
- s_1: Sample standard deviation 1. Scanned from matrix 1.
- s_2: Sample standard deviation 2. Scanned from matrix 2.
- N_1: Sample size 1. Scanned from matrix 1. Must be a positive integer.
- N_2: Sample size 2. Scanned from matrix 2. Must be a positive integer.
- α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **t**: Value of the t statistic.
- **df**: Degrees of freedom.
- $\mathbf{t}_{\alpha/2}$: Value of the t statistic necessary to violate the null hypothesis.
- **P-value**: Attained significance level for a two-tailed test.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

t for μ1–μ2 (σ1≠σ2)

This hypothesis test uses the statistic $t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{s_1^2/N_1 + s_2^2/N_2}}$ to examine the hypothesis that two samples with difference of means $x_1 - x_2$ come from populations with difference of means $\mu_1 - \mu_2$ and unequal variances. The populations must be normally distributed.

Make sure the pointer is at "t for μ1–μ2 (σ1≠σ2)" and press ENTER:

```
▾ t for μ1-μ2 (σ1≠σ2)
→Matrix 1: Press ENTER
 Matrix 2: Press ENTER
 μ1-μ2: 0
 x̄1: Press ENTER
 x̄2: Press ENTER
 s1: Press ENTER
MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- ❑ **Matrix 1**: Current matrix 1 selected with the Matrix Manager.
- ❑ **Matrix 2**: Current matrix 2 selected with the Matrix Manager. Matrix 2 can actually be the same as matrix 1, provided you specify a different data column for matrix 2 in the PARS menu of the Matrix Manager.
- ❑ $\mu_1 - \mu_2$: Difference of population means. Must be a real number.
- ❑ $\bar{x}_1$: Sample mean 1. Scanned from matrix 1. Must be a real number.
- ❑ $\bar{x}_2$: Sample mean 2. Scanned from matrix 2. Must be a real number.
- ❑ s_1: Sample standard deviation 1. Scanned from matrix 1.
- ❑ s_2: Sample standard deviation 2. Scanned from matrix 2.
- ❑ N_1: Sample size 1. Scanned from matrix 1. Must be a positive integer.
- ❑ N_2: Sample size 2. Scanned from matrix 2. Must be a positive integer.
- ❑ α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **t**: Value of the t statistic.

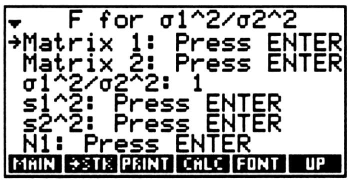
- **df**: Degrees of freedom.
- **$t_{\alpha/2}$**: Value of the t statistic necessary to violate the null hypothesis.
- **P-value**: Attained significance level for a two-tailed test.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

F for $\sigma 1^2/\sigma 2^2$

This hypothesis test uses the statistic $F = \frac{s_1^2}{\left(\sigma_1^2/\sigma_2^2\right)s_2^2}$ to examine the hypothesis that two samples with ratio of variances s_1^2/s_2^2 come from populations with ratio of variances σ_1^2/σ_2^2. The populations must be normally distributed.

Make sure the pointer is at "F for σ1^2/σ2^2" and press ENTER:



You should now enter or edit the parameters. They include:

- ❑ **Matrix 1**: Current matrix 1 selected with the Matrix Manager.
- ❑ **Matrix 2**: Current matrix 2 selected with the Matrix Manager. Matrix 2 can actually be the same as matrix 1, provided you specify a different data column for matrix 2 in the PARS menu of the Matrix Manager.
- ❑ $\boldsymbol{\sigma_1^2/\sigma_2^2}$: Ratio of population variances. Must be a real number.
- ❑ $\boldsymbol{s_1^2}$: Sample variance 1. Scanned from matrix 1. Must be a positive real number.
- ❑ $\boldsymbol{s_2^2}$: Sample variance 2. Scanned from matrix 2. Must be a positive real number.
- ❑ $\boldsymbol{N_1}$: Sample size 1. Scanned from matrix 1. Must be a positive integer.
- ❑ $\boldsymbol{N_2}$: Sample size 2. Scanned from matrix 2. Must be a positive integer.
- ❑ α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **F**: Value of the F statistic.

- **$F_{\alpha/2}$**: Value of the F statistic necessary to violate the null hypothesis.
- **P-value**: Attained significance level for a two-tailed test.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Hypothesis Testing menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Confidence Intervals

Confidence intervals are intervals for which one can assert with a given probability $1 - \alpha$, called the *degree of confidence* or the *confidence coefficient*, that it will contain the parameter it is intended to estimate. The endpoints of a confidence interval are referred to as the *upper* and *lower confidence limits*; they are generally values of random variables calculated on the basis of sample data. All of the confidence intervals included in the Statistics Pac are *two-sided intervals.*

Confidence Intervals Inputs

Each confidence interval parameter screen generally requires the following inputs:

- ❑ The current matrix or matrices, which are automatically scanned to determine the necessary sample parameters, such as the sample mean $\bar{x}$. If desired, however, the scanned values can be modified. The current matrix or matrices should contain raw data. Make sure the current matrix parameters are set correctly for the current matrix or matrices. (For more information, see Chapter 2, "Matrix Manager.")
- ❑ The level of significance α (also known as the *producer's risk*), which is the risk of a Type I error (the rejection of the null hypothesis when it is actually true).

Confidence Intervals Outputs

Each confidence interval calculates the following values:

- ❑ The lower confidence limit on the parameter.
- ❑ The upper confidence limit on the parameter.

Using Confidence Intervals

Make sure pointer is at "Confidence Intervals" and press ENTER:

```
▾Confidence Intervals
→Normal for μ
 Proportion for π
 t for μ
 Chi-Square for σ^2
 Normal for μ1-μ2
 t for μ1-μ2 (σ1=σ2)
 MAIN →STK PRINT VIEW FONT UP
```

The Confidence Intervals menu lists the seven confidence intervals provided by the Statistics Pac. A confidence interval is selected by moving the pointer to it and pressing ENTER.

Items in the Confidence Intervals Menu

Each item in the Confidence Intervals menu is briefly described below and is discussed in detail in the various sections of this chapter.

Confidence Interval Menu Items

Item	Description
Normal for μ	Confidence interval for a large sample from a population with mean μ.
Proportion for π	Confidence interval for a large sample from a population with proportion π.
t for μ	Confidence interval for a sample from a population with mean μ.
Chi-square for σ^2	Confidence interval for a sample from a population with variance σ^2.
Normal for $\mu1-\mu2$	Confidence interval for the difference between the means of two large samples of $\mu1-\mu2$.
t for $\mu1-\mu2$ ($\sigma1=\sigma2$)	Confidence interval for the difference between the means of two samples (equal variance) of $\mu1-\mu2$.
F for $\sigma1^2/\sigma2^2$	Confidence interval for the ratio of the variances of two samples of $\sigma1^2/\sigma2^2$.

Confidence Intervals Menu Operations

Screen	Softkeys
Confidence	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items to print.
→STK	Prompts for ONE or ALL to copy items to the stack.
UP	Returns to the Estimation menu.
VIEW	Displays entire text of an item too wide to fit on the screen.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Moves down one level in the menu structure, executing the confidence interval selected by the pointer.

Normal for μ

This constructs the confidence interval $\bar{x} \pm \frac{z_{\alpha/2}\,\sigma}{\sqrt{N}}$ about the sample mean $\bar{x}$.

The population must be normally distributed with known standard deviation σ or the sample size must be large enough $(N > 30)$ that the sample standard deviation s may be substituted for σ.

Make sure the pointer is at "Normal for μ" and press [ENTER]:

```
     Normal for μ
→Matrix: Press ENTER
 x̄: Press ENTER
 σ: Press ENTER
 N: Press ENTER
 α: .05

MAIN  →STK  PRINT  CALC  FONT  UP
```

You should now enter or edit the parameters. They include:

- **Matrix**: Current matrix selected with the Matrix Manager.
- $\bar{x}$: Sample mean. Scanned from matrix. Must be a real number.
- σ: Population standard deviation. Scanned from matrix, because for large samples, σ can be estimated by the sample standard deviation, s.
- N: Sample size. Scanned from matrix. Must be a positive integer.
- α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

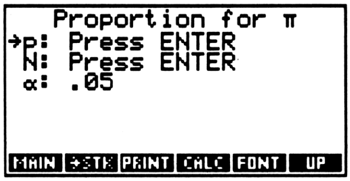
- **Lower**: Lower confidence limit.
- **Upper**: Upper confidence limit.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Proportion for π

This constructs the confidence interval $p \pm z_{\alpha/2}\sqrt{\frac{p(1-p)}{N}}$ about the proportion p.

Make sure the pointer is at "Proportion for π" and press ENTER:



You should now enter or edit the parameters. They include:

- p: Sample proportion. Must be a real number between 0 and 1.
- N: Sample size. Must be a positive integer.
- α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **Lower**: Lower confidence limit.
- **Upper**: Upper confidence limit.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

t for μ

This constructs the confidence interval $\bar{x} \pm \frac{t_{\alpha/2}\, s}{\sqrt{N}}$ about the sample mean $\bar{x}$. The population must be normally distributed.

Make sure the pointer is at "t for μ" and press ENTER:

```
         t for μ
→Matrix: Press ENTER
 x̄: Press ENTER
 s: Press ENTER
 N: Press ENTER
 α: .05

MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- **Matrix**: Current matrix selected with the Matrix Manager.
- $\bar{x}$: Sample mean. Scanned from matrix. Must be a real number.
- s: Sample standard deviation. Scanned from matrix.
- N: Sample size. Scanned from matrix. Must be a positive integer.
- α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

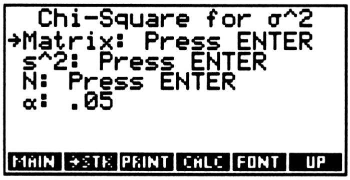
- **Lower**: Lower confidence limit.
- **Upper**: Upper confidence limit.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Chi-Square for σ^2

This constructs the confidence interval $\left(\frac{(N-1)s^2}{\chi^2_{\alpha/2,N-1}}, \frac{(N-1)s^2}{\chi^2_{1-\alpha/2,N-1}} \right)$.

Make sure the pointer is at "Chi-square for σ^2" and press ENTER:



You should now enter or edit the parameters. They include:

- ❑ **Matrix**: Current matrix selected with the Matrix Manager.
- ❑ s^2: Sample variance. Scanned from matrix. Must be a real number.
- ❑ N: Sample size. Scanned from matrix. Must be a positive integer.
- ❑ α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ **Lower**: Lower confidence limit.
- ❑ **Upper**: Upper confidence limit.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Normal for μ1–μ2

This constructs the confidence interval $\left(\bar{x}_1 - \bar{x}_2\right) \pm z_{\alpha/2}\sqrt{\dfrac{\sigma_1^2}{N_1} + \dfrac{\sigma_2^2}{N_2}}$ about the difference of sample means $x_1 - x_2$. The populations must be normally distributed with known standard deviations σ_1 and σ_2 or the sample sizes must be large $\left(N_1 > 30 \text{ and } N_2 > 30\right)$, so the sample standard deviations s_1 and s_2 may be substituted for σ_1 and σ_2.

Make sure the pointer is at "Normal for μ1–μ2" and press [ENTER]:

```
▾  Normal for μ1-μ2
→Matrix 1: Press ENTER
 Matrix 2: Press ENTER
 x̄1: Press ENTER
 x̄2: Press ENTER
 σ1: Press ENTER
 σ2: Press ENTER
MAIN  →STK  PRINT  CALC  FONT  UP
```

You should now enter or edit the parameters. They include:

- ❑ **Matrix 1**: Current matrix 1 selected with the Matrix Manager.
- ❑ **Matrix 2**: Current matrix 2 selected with the Matrix Manager. Matrix 2 can actually be the same as matrix 1, provided you specify a different data column for matrix 2 in the [PARS] menu of the Matrix Manager.
- ❑ $\bar{x}_1$: Sample mean 1. Scanned from matrix 1. Must be a real number.
- ❑ $\bar{x}_2$: Sample mean 2. Scanned from matrix 2. Must be a real number.
- ❑ σ_1: Population standard deviation 1. Scanned from matrix 1, because for large samples, σ_1 can be estimated by the sample standard deviation, s_1.
- ❑ σ_2: Population standard deviation 2. Scanned from matrix 2, because for large samples, σ_2 can be estimated by the sample standard deviation, s_2.
- ❑ N_1: Sample size 1. Scanned from matrix 1. Must be a positive integer.
- ❑ N_2: Sample size 2. Scanned from matrix 2. Must be a positive integer.
- ❑ α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press [CALC] to calculate the results, or at any time press [UP] to return to the Confidence Intervals menu, [MAIN] to return to the Main menu, or [ATTN] to quit the Statistics Pac.

After pressing **CALC**, the results will appear. They include:

- **Lower**: Lower confidence limit.
- **Upper**: Upper confidence limit.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press **UP** to return to the Confidence Intervals menu, **MAIN** to return to the Main menu, or [ATTN] to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

t for μ1–μ2 (σ1=σ2)

This constructs the confidence interval $\left(\bar{x}_1 - \bar{x}_2\right) \pm t_{\alpha/2, N_1 - N_2 - 2}\, s_p \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}$

where $s_p = \frac{\left(N_1 - 1\right) s_1^2 + \left(N_2 - 1\right) s_2^2}{N_1 + N_2 - 2}$ about the difference of sample means $x_1 - x_2$. The populations must be normally distributed.

Make sure the pointer is at "t for μ1–μ2 (σ1=σ2)" and press ENTER:

```
▾ t for μ1–μ2 (σ1=σ2)
→Matrix 1: Press ENTER
 Matrix 2: Press ENTER
 x̄1: Press ENTER
 x̄2: Press ENTER
 s1: Press ENTER
 s2: Press ENTER
MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- **Matrix 1**: Current matrix 1 selected with the Matrix Manager.
- **Matrix 2**: Current matrix 2 selected with the Matrix Manager. Matrix 2 can actually be the same as matrix 1, provided you specify a different data column for matrix 2 in the PARS menu of the Matrix Manager.
- $\bar{x}_1$: Sample mean 1. Scanned from matrix 1. Must be a real number.
- $\bar{x}_2$: Sample mean 2. Scanned from matrix 2. Must be a real number.
- s_1: Sample standard deviation 1. Scanned from matrix 1.
- s_2: Sample standard deviation 2. Scanned from matrix 2.
- N_1: Sample size 1. Scanned from matrix 1. Must be a positive integer.
- N_2: Sample size 2. Scanned from matrix 2. Must be a positive integer.
- α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

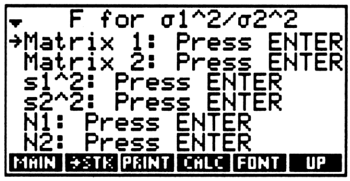
- **Lower**: Lower confidence limit.
- **Upper**: Upper confidence limit.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or [ATTN] to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

F for $\sigma 1^2/\sigma 2^2$

This constructs the confidence interval $\left(\frac{s_2^2}{s_1^2} \frac{1}{F_{\alpha/2(\nu_2,\nu_1)}}, \frac{s_2^2}{s_1^2} \frac{1}{F_{\alpha/2(\nu_1,\nu_2)}} \right)$ where $\nu_1 = N_1 - 1$ and $\nu_2 = N_2 - 1$. The populations must be normally distributed.

Make sure the pointer is at "F for σ1^2/σ2^2" and press ENTER:



You should now enter or edit the parameters. They include:

- **Matrix 1**: Current matrix 1 selected with the Matrix Manager.
- **Matrix 2**: Current matrix 2 selected with the Matrix Manager. Matrix 2 can actually be the same as matrix 1, provided you specify a different data column for matrix 2 in the PARS menu of the Matrix Manager.
- s_1^2: Sample variance 1. Scanned from matrix 1. Positive real number.
- s_2^2: Sample variance 2. Scanned from matrix 2. Positive real number.
- N_1: Sample size 1. Scanned from matrix 1. Must be positive integer.
- N_2: Sample size 2. Scanned from matrix 2. Must be positive integer.
- α: Level of significance. Must be a real number between 0 and 1.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- **Lower**: Lower confidence limit.
- **Upper**: Upper confidence limit.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Confidence Intervals menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Samples Sizes

Sample size estimation can be used to ensure a certain accuracy before carrying out an experiment. All of the sample size estimations included in the Statistics Pac are based on *two-tailed tests* or *two-sided intervals.*

Sample Sizes Inputs

Each sample size parameter screen generally requires the following inputs:

- Certain population parameters, such as the population standard deviation σ.
- Either the desired difference of the means for the hypothesis testing sample size estimation or the half-width of the interval for the confidence interval sample size estimation.
- The level of significance α (also known as the *producer's risk*), which is the risk of a Type I error (the rejection of the null hypothesis when it is actually true).
- β (also known as the *consumer's risk*), which is the risk of a Type II error (the acceptance of the null hypothesis when it is actually false).

Sample Sizes Outputs

Each sample size calculates the following value:

- The estimated sample size necessary.

Using Sample Sizes

Make sure pointer is at "Sample Sizes" and press [ENTER]:

```
     Sample Sizes
→Normal Test for μ
 Normal Interval, μ



MAIN →STK PRINT VIEW FONT UP
```

The Sample Sizes menu lists the two sample sizes provided by the Statistics Pac. A sample size is selected by moving the pointer to it and pressing [ENTER].

Items in the Sample Sizes Menu

Each item in the Sample Sizes menu is briefly described below and is discussed in detail in the various sections of this chapter.

Sample Sizes Menu Items

Item	Description
Normal Test for μ	Hypothesis test that a large sample comes from a population with mean μ.
Normal Interval for μ	Confidence interval for a large sample from a population with mean μ.

Sample Sizes Menu Operations

Screen	Softkeys
Sample Sizes	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items to print.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack.
UP	Returns to the Estimation menu.
VIEW	Displays entire text of an item too wide to fit on the screen.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Moves down one level in the menu structure, executing the sample size selected by the pointer.

Normal Test for μ

This estimates the sample size for a normal hypothesis test for mean according to $N = \frac{z_{\alpha/2} + z_{\beta}}{\mu_a - \mu_0}$.

Make sure the pointer is at "Normal Test for μ" and press ENTER:

```
   Normal Test for μ
→α: Press ENTER
 β: Press ENTER
 σ: Press ENTER
 μa-μ0: Press ENTER

MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- ❑ α: Level of significance or producer's risk. Must be a real number between 0 and 1.
- ❑ β: Consumer's risk. Must be a real number between 0 and 1.
- ❑ σ: Population standard deviation. Must be a real number.
- ❑ $\mu_a - \mu_0$: Difference of population means. Must be a positive real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Sample Sizes menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ N: Estimated sample size.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Sample Sizes menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Normal Interval for μ

This estimates the sample size for a normal confidence interval about the sample mean according to $N = \left(\frac{z_{\alpha/2}\,\sigma}{h} \right)^2$.

Make sure the pointer is at "Normal Interval for μ" and press ENTER:

```
  Normal Interval, μ
→α: Press ENTER
 σ: Press ENTER
 h: Press ENTER



MAIN →STK PRINT CALC FONT UP
```

You should now enter or edit the parameters. They include:

- ❑ α: Level of significance or producer's risk. Must be a real number between 0 and 1.
- ❑ σ: Population standard deviation. Must be a real number.
- ❑ **h**: Half-width of interval. Must be a positive real number.

When you have finished entering the parameters, press CALC to calculate the results, or at any time press UP to return to the Sample Sizes menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

After pressing CALC, the results will appear. They include:

- ❑ N: Estimated sample size.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Sample Sizes menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac. For a complete summary of operations, see "Result Screen Operations."

Result Screen Operations

These are the operations available at all result screens.

Result Screen Operations

Screen	Softkeys
Result Screen	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items, and then sends those items to an IR printer.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack. The items are placed in a list if ALL was chosen.
UP	Returns to the Probability Distributions menu.
VIEW	Displays the entire text of an item too wide to fit on the screen, up to one entire screen size.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Either views the result in the EquationWriter (equation) or displays the result expanded to a full screen (not equation).

Chapter 6

Plotting Manager

The Plotting Manager provides interactive prompts for plotting your data in a variety of formats, including histograms, bar plots, scatter plots, relative frequency plots, and cumulative frequency plots (ogives).

You set the current matrix with the Matrix Manager and choose a plot format, and the Statistics Pac graphs your data and provides access to the HP 48SX Graphics Environment so you can examine the results.

This chapter covers:

- ❑ Using the Plotting Manager
- ❑ More About Plotting
- ❑ Histograms
- ❑ Bar Plots
- ❑ Scatter Plots
- ❑ Relative Frequency Plots
- ❑ Cumulative Frequency Plots (Ogives)
- ❑ HP 48SX Graphics Environment Operations

Using the Plotting Manager

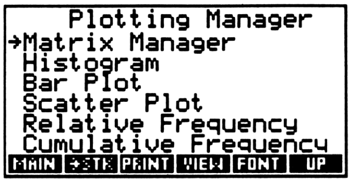
To get to the Plotting Manager, follow these steps:

❶ Press [⬅] [LIBRARY] to display all libraries available to your HP 48SX.

❷ Find and press **STAT** to display the Statistics Pac Library menu.

❸ Press the first softkey, **STAT** , to start the Statistics Pac interactive menus.

❹ At the Main menu, make sure the pointer is at "Plotting Manager" and press [ENTER]:



The Plotting Manager menu lists the five types of plots included in the Statistics Pac. A plot type is selected by moving the pointer to it and pressing ENTER.

Items in the Plotting Manager Menu

Each item in the Plotting Manager menu is briefly described below and is discussed in detail in the various sections of this chapter.

Plotting Manager Menu Items

Item	Description
Matrix Manager	Accesses the Matrix Manager. (See Chapter 2.)
Histogram	Creates a histogram.
Bar Plot	Creates a bar plot.
Scatter Plot	Creates a scatter plot.
Relative Frequency	Creates a relative frequency plot.
Cumulative Frequency	Creates a cumulative frequency plot.

Plotting Manager Menu Operations

Screen	Softkeys
Plotting	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items to print.
→STK	Prompts for ONE or ALL to copy items to the stack.
UP	Returns to the Main menu.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Creates the plot selected by the pointer.

More About Plotting

The five plot types supported by the Statistics Pac Plotting Manager include the three built-in HP 48SX statistical plot types for making histograms, bar plots, and scatter plots, along with two new plot types for making relative frequency and cumulative frequency plots (ogives).

Plot Types

The Plotting Manager uses the current matrix selected with the Matrix Manager, but some plot types have restrictions as to which data types can be plotted:

- **Histograms**: Requires grouped or weighted data. Plots weight column vs. data column.
- **Bar Plots**: Any type of data is allowed, but raw data is most commonly used. Plots X column vs. row number.
- **Scatter Plots**: Requires raw data. Plots Y column vs. X column, with an optional regression analysis fit overlaid on the data.
- **Relative Frequency Plots**: Requires grouped or weighted data. Plots weight column vs. data column.
- **Cumulative Frequency Plots (Ogives)**: Requires grouped or weighted data. Plots weight column vs. data column.

After plotting your data, the Plotting Manager will provide access to the built-in HP 48SX Graphics Environment so you can examine the results. (For more information, see Chapter 21 of the HP 48SX Owner's Manual, "Statistics.")

Histograms

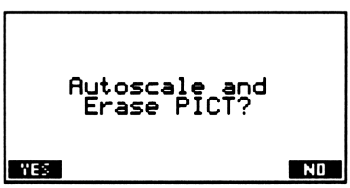
A histogram is a graph of a frequency distribution obtained by drawing rectangles whose bases coincide with the class intervals and whose areas are proportional to the class frequencies. Because the grouping function in the Statistics Pac always creates equal-width classes, the heights of the rectangles are also proportional to the class frequencies.

A histogram requires grouped or weighted data. If the current matrix is undefined, the Matrix Manager will appear so you can set the current matrix. If the current matrix contains raw data, the grouping parameters screen will appear so you can group the raw data into frequency bins and store the grouped data into a new matrix, which will automatically be set to the current matrix and used to create the histogram.

A histogram plots the weight column vs. the data column.

Creating a Histogram

To create a histogram, go to the Matrix Manager, set the current matrix, and exit the Matrix Manager. Then go to the Plotting Manager. Make sure the pointer is at "Histogram" and press ENTER. If the current matrix contains raw data, the grouping parameters screen will appear, and you must group the data and store the new matrix of grouped data, which will automatically be set to the current matrix. Once the current matrix contains grouped or weighted data, you will be prompted to autoscale and erase PICT:



Press YES to erase the previous contents of PICT (the graphics area) and autoscale the data, press NO to overlay the new histogram over the previous contents of PICT, using the previous axes scales, or press ATTN to abort the operation and return to the Plotting Manager without creating a histogram.

If you pressed YES or NO, a histogram will be created. The data column of the current matrix determines the locations of the bars along the X axis, while the weight column of the current matrix determines the heights of the bars along the Y axis. After the histogram has been created, you will be given access to the HP 48SX Graphics Environment so you can examine the results.

Example: Create a histogram for the 'SCORES.G1' matrix (created in Chapter 2), which contains grouped data. Go to the Matrix Manager, set the current matrix to 'SCORES.G1', and exit the Matrix Manager. Then go to the Plotting Manager, as described at the beginning of this chapter. Make sure the pointer is at "Histogram" and press ENTER. You will be prompted to autoscale and erase PICT. Press YES to erase the previous contents of PICT and autoscale the data. The histogram will be created and you will be given access to the HP 48SX Graphics Environment so you can examine the results:

The histogram indicates the distribution of exam scores over the class intervals 0–20, 20–40, 40–60, 60–80, and 80–100, where the class frequencies are 0, 1, 4, 4, and 1, respectively. When you have finished examining the histogram, press ATTN to return to the Plotting Manager.

Bar Plots

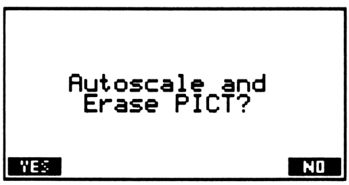
A bar plot is a graph which consists of rectangles (bars) of equal width, whose heights are proportional to the values (or frequencies) they represent.

A bar plot allows any data type, but raw data is most commonly used. If the current matrix is undefined, the Matrix Manager will appear so you can set the current matrix.

A bar plot plots the X column vs. the row number.

Creating a Bar Plot

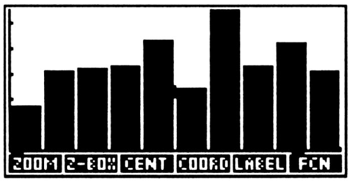
To create a bar plot, go to the Matrix Manager, set the current matrix, and exit the Matrix Manager. Then go to the Plotting Manager. Make sure the pointer is at "Bar Plot" and press ENTER. You will be prompted to autoscale and erase PICT:



Press YES to erase the previous contents of PICT (the graphics area) and autoscale the data, press NO to overlay the new bar plot over the previous contents of PICT, using the previous axes scales, or press ATTN to abort the operation and return to the Plotting Manager without creating a bar plot.

If you pressed YES or NO, a bar plot will be created. The row numbers of the current matrix determine the locations of the bars along the X axis, while the X column of the current matrix determines the heights of the bars along the Y axis. After the bar plot has been created, you will be given access to the HP 48SX Graphics Environment so you can examine the results.

Example: Create a bar plot for the 'SCORES' matrix (created in Chapter 2), which contains raw data. Go to the Matrix Manager, set the current matrix to 'SCORES', and exit the Matrix Manager. Then go to the Plotting Manager, as described at the beginning of this chapter. Make sure the pointer is at "Bar Plot" and press [ENTER]. You will be prompted to autoscale and erase PICT. Press [YES] to erase the previous contents of PICT and autoscale the data. The bar plot will be created and you will be given access to the HP 48SX Graphics Environment so you can examine the results:



The bar plot indicates the distribution of exam scores, although the data is unsorted. When you have finished examining the bar plot, press [ATTN] to return to the Plotting Manager.

Scatter Plots

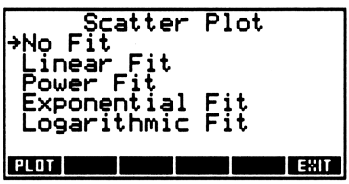
A scatter plot is a set of points obtained by plotting paired measurements as points in a plane.

A scatter plot requires raw data. If the current matrix is undefined, the Matrix Manager will appear so you can set the current matrix.

A scatter plot plots the Y column vs. the X column, with an optional regression analysis fit overlaid on the data.

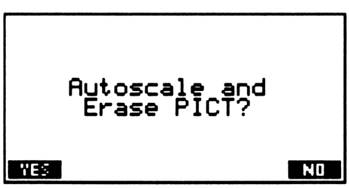
Creating a Scatter Plot

To create a scatter plot, go to the Matrix Manager, set the current matrix, and exit the Matrix Manager. Then go to the Plotting Manager. Make sure the pointer is at "Scatter Plot" and press [ENTER]. You will be prompted for the fitting model, which determines what regression analysis (or none) is performed on the data:



Select a fitting model (or no fit), or to abort the operation, press [ATTN] to return to the Plotting Manager without creating a scatter plot. You can choose to overlay the scatter plot with no fit, a linear fit, an exponential fit, a logarithmic fit, or a power fit. If you choose a fit, the appropriate regression analysis will be performed and the resulting equation overlaid on the data.

If you selected a fitting model (or no fit), you will be prompted to autoscale and erase PICT:



Press YES to erase the previous contents of PICT (the graphics area) and autoscale the data, press NO to overlay the new scatter plot over the previous contents of PICT, using the previous axes scales, or press [ATTN] to abort the operation and return to the Plotting Manager without creating a scatter plot.

If you pressed **YES** or **NO**, a scatter plot will be created. The X column determines the coordinates of the points along the X axis, while the Y column determines the coordinates of the points along the Y axis. If you selected a fitting model, the appropriate regression analysis will be performed and the resulting equation overlaid on the data. After the scatter plot has been created, you will be given access to the HP 48SX Graphics Environment so you can examine the results.

Relative Frequency Plots

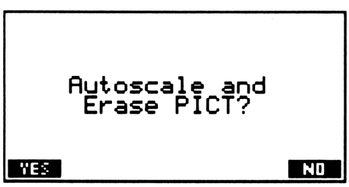
A relative frequency plot is a graph of a frequency distribution obtained by plotting the percentages corresponding to the class boundaries and connecting successive points with straight lines. Relative frequency plots require the class marks (values in the data column) to be equally distributed.

A relative frequency requires grouped or weighted data. If the current matrix is undefined, the Matrix Manager will appear so you can set the current matrix. If the current matrix contains raw data, the grouping parameters screen will appear so you can group the raw data into frequency bins and store the grouped data into a new matrix, which will automatically be set to the current matrix and used to create the relative frequency plot.

A relative frequency plot plots the percentages of the weight column (class frequency divided by total frequency) vs. the class boundaries calculated from the data column.

Creating a Relative Frequency Plot

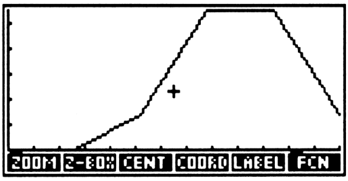
To create a relative frequency plot, go to the Matrix Manager, set the current matrix, and exit the Matrix Manager. Then go to the Plotting Manager. Make sure the pointer is at "Relative Frequency" and press ENTER. If the current matrix contains raw data, the grouping parameters screen will appear, and you must group the data and store the new matrix of grouped data, which will automatically be set to the current matrix. Once the current matrix contains grouped or weighted data, you will be prompted to autoscale and erase PICT:



Press YES to erase the previous contents of PICT (the graphics area) and autoscale the data, press NO to overlay the new relative frequency plot over the previous contents of PICT, using the previous axes scales, or press ATTN to abort the operation and return to the Plotting Manager without creating a relative frequency plot.

If you pressed YES or NO, a relative frequency plot will be created. Calculations using the data column of the current matrix determine the coordinates of the points along the X axis, while the weight column of the current matrix determines the coordinates of the points along the Y axis. After the relative frequency plot has been created, you will be given access to the HP 48SX Graphics Environment so you can examine the results.

Example: Create a relative frequency plot for the 'SCORES.G1' matrix (created in Chapter 2), which contains grouped data. Go to the Matrix Manager, set the current matrix to 'SCORES.G1', and exit the Matrix Manager. Then go to the Plotting Manager, as described at the beginning of this chapter. Make sure the pointer is at "Relative Frequency" and press ENTER. You will be prompted to autoscale and erase PICT. Press YES to erase the previous contents of PICT and autoscale the data. The relative frequency plot will be created and you will be given access to the HP 48SX Graphics Environment so you can examine the results:



The relative frequency plot indicates the distribution of exam scores over the class intervals 0–20, 20–40, 40–60, 60–80, and 80–100, where the class frequencies are 0, 1, 4, 4, and 1, respectively, and the relative frequencies at the class boundaries are therefore 0.0 at 0, 0.0 at 20, 0.1 at 40, 0.4 at 60, 0.4 at 80, and 0.1 at 100. When you have finished examining the relative frequency plot, press ATTN to return to the Plotting Manager.

Cumulative Frequency Plots (Ogives)

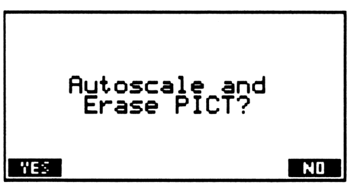
A cumulative frequency plot (ogive) is a graph of a frequency distribution obtained by plotting the cumulative percentages corresponding to the class boundaries and connecting successive points with straight lines. Ogives require the class marks (values in the data column) to be equally distributed. Ogives are also referred to as *sigmoids*.

An ogive requires grouped or weighted data. If the current matrix is undefined, the Matrix Manager will appear so you can set the current matrix. If the current matrix contains raw data, the grouping parameters screen will appear so you can group the raw data into frequency bins and store the grouped data into a new matrix, which will automatically be set to the current matrix and used to create the ogive.

An ogive plots the cumulative percentages of the weight column (cumulative class frequencies divided by total frequency) vs. the data column. The cumulative percentages of the weight column will always sum to 1, so autoscaling an ogive will always result in a Y axis from 0 to 1.

Creating an Ogive

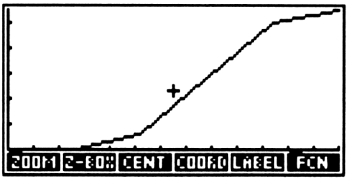
To create an ogive, go to the Matrix Manager, set the current matrix, and exit the Matrix Manager. Then go to the Plotting Manager. Make sure the pointer is at "Cumulative Frequency" and press [ENTER]. If the current matrix contains raw data, the grouping parameters screen will appear, and you must group the data and store the new matrix of grouped data, which will automatically be set to the current matrix. Once the current matrix contains grouped or weighted data, you will be prompted to autoscale and erase PICT:



Press YES to erase the previous contents of PICT (the graphics area) and autoscale the data, press NO to overlay the new ogive over the previous contents of PICT, using the previous axes scales, or press [ATTN] to abort the operation and return to the Plotting Manager without creating an ogive.

If you pressed YES or NO, an ogive will be created. Calculations using the data column of the current matrix determine the coordinates of the points along the X axis, while the weight column of the current matrix determines the coordinates of the points along the Y axis. After it has been created, you will be given access to the HP 48SX Graphics Environment to examine the results.

Example: Create an ogive for the 'SCORES.G1' matrix (created in Chapter 2), which contains grouped data. Go to the Matrix Manager, set the current matrix to 'SCORES.G1', and exit the Matrix Manager. Then go to the Plotting Manager, as described at the beginning of this chapter. Make sure the pointer is at "Cumulative Frequency" and press ENTER. You will be prompted to autoscale and erase PICT. Press YES to erase the previous contents of PICT and autoscale the data. The ogive will be created and you will be given access to the HP 48SX Graphics Environment so you can examine the results:



The ogive indicates the distribution of exam scores over the class intervals 0–20, 20–40, 40–60, 60–80, and 80–100, where the class frequencies are 0, 1, 4, 4, and 1, respectively, and the cumulative frequencies at the class boundaries are therefore 0.0 at 0, 0.0 at 20, 0.1 at 40, 0.5 at 60, 0.9 at 80, and 1.0 at 100. When you have finished examining the ogive, press ATTN to return to the Plotting Manager.

HP 48SX Graphics Environment Operations

These are the operations available at the HP 48SX Graphics Environment.

HP 48SX Graphics Environment Operations

Screen	Softkeys					
HP 48SX Graphics Environment	ZOOM	Z-BOX	CENT	COORD	LABEL	FCN
	DOT+	DOT-	LINE	TLINE	BOX	CIRCL
	MARK	REPL	SUB	DEL	+ -	KEYS

Key	Action
CENT	Redraws the graph with the current cursor position at the center of the display.
COORD	Turns on coordinate display in the menu area. Press [+] or any softkey to restore the menu. The coordinates can be copied to the stack by pressing [ENTER].
FCN	Performs a linear regression fit to the data according to the current fitting model and plots the resulting equation. **Note:** Uses the built-in HP 48SX LR command, *not* the Statistics Pac regression functions, so the results may differ slightly.
KEYS	Turns off menu to show more of the graph. Press [-] or any softkey to restore the menu.
LABEL	Adds axis labels to the graph.
MARK	Sets the mark at the cursor location.
Z-BOX	Redraws the graph so the rectangular area whose opposite corners are defined by the mark and cursor fills the display.
ZOOM	Displays the HP 48SX GRAPHICS ZOOM menu.
+ -	Toggles cursor type between dark and inverted.
[ATTN]	Exits the HP 48SX Graphics Environment to the Statistics Pac.
[ENTER]	Copies the x- and y-coordinates of the cursor to the stack as a complex number.
[←] [GRAPH]	Toggles scrolling mode on and off. In scrolling mode, cursor keys scroll oversize graphs in the indicated direction.

◄ ► ▲ ▼	Move the cursor in the indicated direction. When prefixed with ⮣, move the cursor to the edge of the screen in the indicated direction, or to the edge of PICT if already at the edge of the screen.
+	Toggles coordinate display on and off (see COORD).
-	Toggles menu on and off (see KEYS).
+/-	Toggles cursor type (same as + -).
⮢ REVIEW	Temporarily displays the PLOT status message, including the plot type, current equation(s), and independent variable.
STO	Copies PICT to the stack as a graphics object (GROB).
ON – MTH	Dumps the current screen to an IR printer.

For more information, see Chapter 19 of the HP 48SX Owner's Manual, "More About Plotting and Graphics Objects."

Chapter 7

Regression Analysis

Regression Analysis provides interactive prompts for performing a linear regression of your data according to a number of models, including linear, exponential, logarithmic, and power fits.

You set the current matrix with the Matrix Manager and choose a fitting model, and the Statistics Pac calculates the fitting equation, parameters, standard errors, and goodness-of-fit measures. The current matrix should contain raw data.

This chapter covers:

- ❑ Using Regression Analysis
- ❑ More About Linear Regression
- ❑ Linear Fit
- ❑ Exponential Fit
- ❑ Logarithmic Fit
- ❑ Power Fit
- ❑ Result Screen Operations

Using Regression Analysis

To get to Regression Analysis, follow these steps:

❶ Press [←] [LIBRARY] to display all libraries available to your HP 48SX.

❷ Find and press **STAT** to display the Statistics Pac Library menu.

❸ Press the first softkey, **STAT** , to start the Statistics Pac interactive menus.

❹ At the menu, make sure the pointer is at "Regression Analysis" and press [ENTER]:

```
  Regression Analysis
→Matrix Manager
 Linear Fit
 Exponential Fit
 Logarithmic Fit
 Power Fit

MAIN →STK PRINT VIEW FONT UP
```

The Regression Analysis menu lists the fitting models included in the Statistics Pac. A model is selected by moving the pointer to it and pressing ENTER.

Items in the Regression Analysis Menu

Each item in the Regression Analysis menu is briefly described below and is discussed in detail in the various sections of this chapter.

Regression Analysis Menu Items

Item	Description
Matrix Manager	Accesses the Matrix Manager. (See Chapter 2.)
Linear Fit	Performs a linear regression fit.
Exponential Fit	Performs an exponential regression fit.
Logarithmic Fit	Performs a logarithmic regression fit.
Power Fit	Performs a power regression fit.

Regression Analysis Menu Operations

Screen	Softkeys
Regression	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items to print.
→STK	Prompts for ONE or ALL to copy items to the stack.
UP	Returns to the Main menu.
VIEW	Displays entire text of an item too wide to fit on the screen.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Performs the regression fit selected by the pointer.

More About Linear Regression

Linear regression models data by fitting it to a straight-line model with two adjustable parameters, commonly referred to as the slope and intercept. The Statistics Pac linear regression routines are more powerful versions of the built-in HP 48SX routines because they allow inclusion of individual errors in your data and they provide several additional calculated results. As with the built-in routines, the exponential, logarithmic, and power models are calculated using transformations that allow the data to be fitted by standard linear regression.

Regression Analysis Inputs

The regression routines in the Statistics Pac use the current matrix and these current matrix parameters:

- X column. Data in the X column must be positive for the logarithmic and power models. The X column defaults to 1, but you can change it in the current matrix parameters screen of the Matrix Manager.
- Y column. Data in the Y column must be positive for the exponential and power models. The Y column defaults to 2, but you can change it in the current matrix parameters screen of the Matrix Manager.
- σ column. Data in the σ column represents the individual measurement errors of the data in the Y column. This column is optional, but if it is not included, the σ column must be set to 0. The σ column defaults to 0, but you can change it in the current matrix parameters screen of the Matrix Manager.

(For more information, see Chapter 2, "Matrix Manager.")

Regression Analysis Outputs

The regression routines in the Statistics Pac calculate the following values:

- Parameters (slope m and intercept b)
- Error estimates on the parameters (σm and σb)
- Correlation and covariance (r and cov)
- Chi-square value and goodness-of-fit measure (chi and P-value)

You should be aware that the latter two values (chi and P-value) are *meaningless* unless your raw data includes a σ column of individual measurement errors.

Linear Fit

The linear model fits data to the equation $y = mx + b$.

Before performing a regression fit, make sure the current matrix is set, that the current matrix contains raw data, and that the X, Y, and σ columns are correct.

Once the current matrix is set, make sure the pointer is at "Linear Fit" and press ENTER to calculate the regression results, which include:

- **EQ**: Equation of the best linear fit.
- **m**: Slope.
- **b**: Intercept.
- **σm**: Standard deviation of the slope.
- **σb**: Standard deviation of the intercept.
- **r**: Correlation coefficient.
- **Cov**: Covariance.
- **Chi**: Chi-square function relating the parameters to the original data.
- **N**: Number of data points.
- **P-value**: Attained significance level of the chi-square value.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Regression Analysis menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

Exponential Fit

The exponential model fits data to the equation $y = b e^{mx}$.

Before performing a regression fit, make sure the current matrix is set, that the current matrix contains raw data, and that the X, Y, and σ columns are correct.

Once the current matrix is set, make sure the pointer is at "Exponential Fit" and press ENTER to calculate the regression results, which include:

- **EQ**: Equation of the best exponential fit.
- **m**: Slope.
- **b**: Intercept.
- **σm**: Standard deviation of slope.
- **σb**: Standard deviation of intercept.
- **r**: Correlation coefficient.
- **Cov**: Covariance.
- **Chi**: Chi-square function relating the parameters to the original data.
- **N**: Number of data points.
- **P-value**: Attained significance level of the chi-square value.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Regression Analysis menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

Logarithmic Fit

The logarithmic model fits data to the equation $y = m \ln x + b$.

Before performing a regression fit, make sure the current matrix is set, that the current matrix contains raw data, and that the X, Y, and σ columns are correct.

Once the current matrix is set, make sure the pointer is at "Logarithmic Fit" and press ENTER to calculate the regression results, which include:

- **EQ**: Equation of the best logarithmic fit.
- **m**: Slope.
- **b**: Intercept.
- **σm**: Standard deviation of slope.
- **σb**: Standard deviation of intercept.
- **r**: Correlation coefficient.
- **Cov**: Covariance.
- **Chi**: Chi-square function relating the parameters to the original data.
- **N**: Number of data points.
- **P-value**: Attained significance level of the chi-square value.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press UP to return to the Regression Analysis menu, MAIN to return to the Main menu, or ATTN to quit the Statistics Pac.

Power Fit

The power model fits data to the equation $y = bx^m$.

Before performing a regression fit, make sure the current matrix is set, that the current matrix contains raw data, and that the X, Y, and σ columns are correct.

Once the current matrix is set, make sure the pointer is at "Power Fit" and press [ENTER] to calculate the regression results, which include:

- **EQ**: Equation of the best power fit.
- **m**: Slope.
- **b**: Intercept.
- **σm**: Standard deviation of slope.
- **σb**: Standard deviation of intercept.
- **r**: Correlation coefficient.
- **Cov**: Covariance.
- **Chi**: Chi-square function relating the parameters to the original data.
- **N**: Number of data points.
- **P-value**: Attained significance level of the chi-square value.

Once calculated, the results can be copied to the stack or printed on an IR printer. When you have finished viewing the results, press [UP] to return to the Regression Analysis menu, [MAIN] to return to the Main menu, or [ATTN] to quit the Statistics Pac.

Result Screen Operations

These are the operations available at all result screens.

Result Screen Operations

Screen	Softkeys
Result Screen	MAIN →STK PRINT VIEW FONT UP

Key	Action
FONT	Toggles between the small and large fonts.
MAIN	Returns to the Main menu.
PRINT	Prompts for ONE or ALL to select items, and then sends those items to an IR printer.
→STK	Prompts for ONE or ALL to select items, and then copies those items to the stack. The items are placed in a list if ALL was chosen.
UP	Returns to the Regression Analysis menu.
VIEW	Displays the entire text of an item too wide to fit on the screen, up to one entire screen size.
ATTN	Quits the Statistics Pac to the HP 48SX stack.
ENTER	Either views the result in the EquationWriter (equation) or displays the result expanded to a full screen (not equation).

Appendices and Index

Appendix A

Warranty and Service

Pocket Professional™ Support

You can get answers to your questions about using your Pocket Professional™ Pac from Sparcom. If you don't find the information in this manual or in the HP 48SX Owner's Manual, contact us in one of the following ways:

❶ E-Mail

From Internet: support@sparcom.com
From Compuserve: >Internet:support@sparcom.com
From FidoNet: To:support@sparcom.com

❷ Standard Mail

Sparcom Corporation
897 NW Grant Avenue
Corvallis, OR 97330
Attn: Technical Support Department

❸ Telephone

(503) 757–8416
9 a.m. – 5 p.m. Pacific Standard Time

❹ FAX

(503) 753–7821

Limited One-Year Warranty

What is Covered

A Pocket Professional™ Pac is warranted by Sparcom Corporation against defects in material and workmanship for one year from the date of original purchase. If you sell your application card or give it as a gift, the warranty is automatically transferred to the new owner and remains in effect for the original one-year period. During the warranty period, we will repair or replace (at no charge) a product that proves to be defective, provided you return the product and proof of purchase, shipping prepaid, to Sparcom.

What is Not Covered

This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by any entity other than Sparcom Corporation.

No other warranty is given. The repair or replacement of a product is your exclusive remedy. ANY OTHER IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS IS LIMITED TO THE ONE-YEAR DURATION OF THIS WRITTEN WARRANTY. IN NO EVENT SHALL SPARCOM CORPORATION BE LIABLE FOR CONSEQUENTIAL DAMAGES. Products are sold on the basis of specifications applicable at the time of manufacture. Sparcom shall have no obligation to modify or update products, once sold.

If the Application Card Requires Service

Sparcom will repair an application card, or replace it with the same model or one of equal or better functionality, whether it is under warranty or not.

Service Charge

There is a fixed charge for standard out-of-warranty repairs. This charge is subject to the customer's local sales or value-added tax, wherever applicable. Application cards damaged by accident or misuse are not covered by fixed charges. These charges are individually determined based on time and material.

Shipping Instructions

If your application card requires service, ship it to the above address and:

❶ Call Sparcom for a Return Merchandise Authorization (RMA) number.

❷ Package your application card in protective packaging adequate to prevent damage. Include your return address and a description of the problem. If the warranty has not expired, include a proof of purchase. If the warranty has expired, include a purchase order and a check or credit card number and expiration date, to cover the service charge. Insuring the shipment is recommended, as shipping damage is not covered by the warranty.

❸ Ship to Sparcom at the above address, postage prepaid, with the RMA number clearly indicated on the package. Shipping damage is not covered by the warranty, so insuring the shipment is recommended. Application cards are usually serviced and re-shipped within five working days.

Environmental Limits

The reliability of an application card depends upon the following temperature and humidity limits:

❶ Operating Temperature: 0 to 45° C (32 to 113° F).

❷ Storage Temperature: –20 to 60° C (–4 to 140° F).

❸ Operating and Storage Humidity: 90% relative humidity at 40° C (104° F) maximum.

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Sparcom

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call: (503) 757-8416 or FAX (503) 753-7821