Tektronix
4050D05

PLOT 50 Statistics:
Nonlinear Estimation

**Product
Support
Bulletin**

Overview

PLOT 50 Statistics: Nonlinear Estimation is the fourth of a new generation of statistical software products.
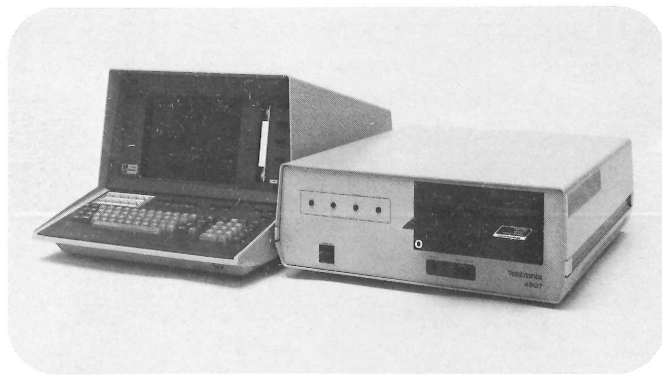

Figure 1. The product

Figure 2. Required equipment

Insert the autoload tape in any 4050 Series desktop computer tape drive and press the autoload key. Place the overlay over the system's user-definable keys. Mount the disk in a 4907 File Manager, and you are ready to start.

After the disk is mounted, **PLOT 50 Statistics: Nonlinear Estimation** automatically displays a main menu containing 14 statistical and data handling programs (see Figure 3).
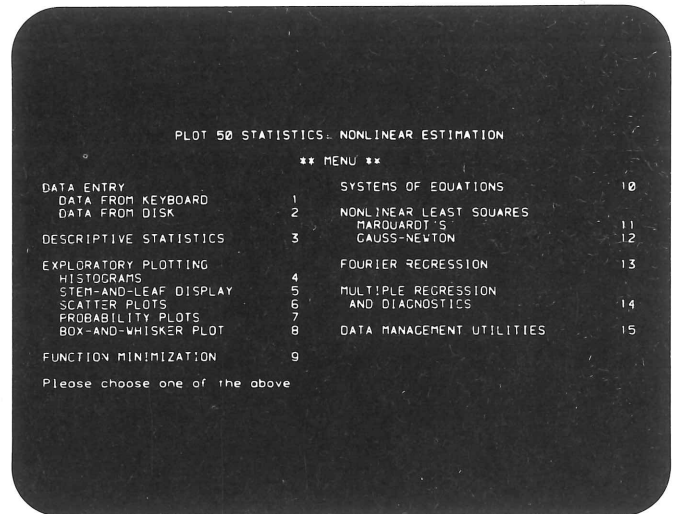

Figure 3. The statistics menu

The Nonlinear Estimation software creates an interactive environment in which a user responds to a system prompts in a specified way. Prompts may require a yes or no answer, allow a user to select an item from a submenu, or may require a word entry.

Most of the PLOT 50 Statistics: Nonlinear Estimation programs start by requesting whatever information they need to do their computations. Some begin by displaying a submenu of routines for you to choose from. Many programs also have options giving you additional statistical routines.

These options are accessed by pressing the **Options** key, which is one of the 18 special function keys featured by the product. The function keys give you greater flexibility over the program execution. The function key names are printed on the overlay (See Figure 4) and described in Section 4 of the users manual.
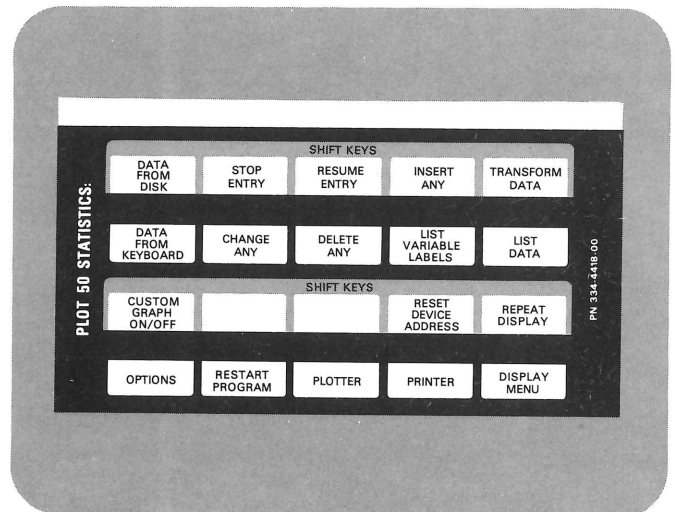

Figure 4. The function key overlay

In addition to statistical routines, Nonlinear Estimation software provides 13 utility programs that allow you to manipulate data files. **Data Management Utilities** (Program 15) lists the Utility menu (See Figure 5) and brings the Utility operating system into memory.

Figure 5. The utilities menu

The Statistics Programs

Before doing a Nonlinear Estimation analysis, you must bring a data file into the system's memory by entering data through the keyboard or retrieving a file from the disk.

To enter a file through the keyboard, run **Data From Keyboard** (Program 1). This program begins by asking you questions about how the file is to be labeled. After you specify such things as a file name, title, observation labels, and variable labels, the program allows you to enter data.

Once entered, the data is automatically stored on the disk as a PLOT 50 Standard File. PLOT 50 Standard Files are used to communicate data between various PLOT 50 Standard File compatible products such as PLOT 50 Statistics: Tests and Distributions, Analysis of Variance, Multiple Linear Regression or Presentation Aids I, Business Planning and Analysis Volume 2 and others. This means that you may use PLOT 50 Statistics: Nonlinear Estimation to analyze data generated by another PLOT 50 product or transfer your data to another PLOT 50 product.

To retrieve an existing data file from the disk, run **Data From Disk** (Program 2). Once a file has been identified, you may select a program from the Statistics menu to analyze data and produce statistical tables and graphs.

Run **Descriptive Statistics** to list 11 statistics including central tendency and dispersion statistics. (See Figure 6)

Figure 6. Descriptive statistics

Run **Histograms** to display frequency and relative frequency histograms (See Figures 7-9). You may specify the number of cells and the cell interval size by pressing the **Custom Graph** function key.
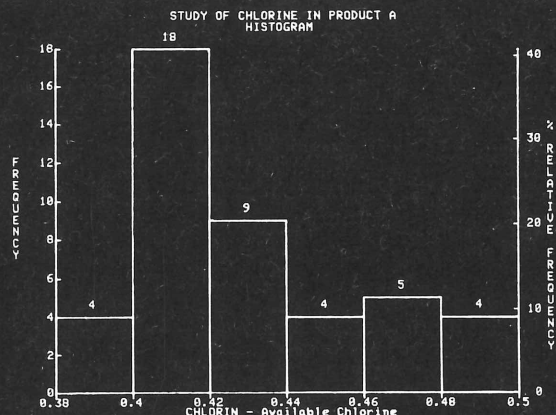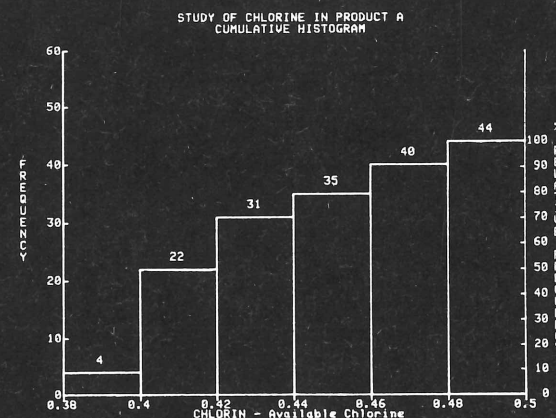

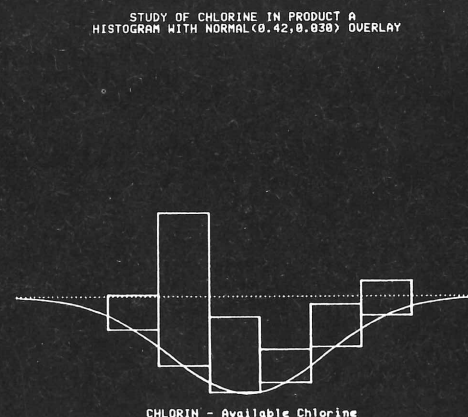Figure 7. Regular histogram

Figure 8. Cumulative histogram

Figure 9. Suspended histogram

In Figure 9, the distance of the cells from the zero line indicates the deviation of the sample distribution from a normal distribution.

Run **Probability Plot** to compare the theoretical distribution (normal or log-normal) to the empirical distribution of the data (See Figure 10).

Run **Stem-and-Leaf** to display the frequency distribution of data and to determine if any values are extremely high or low (See Figure 11). Each data value is split into a stem (its initial digits) and a leaf (the trailing digits).
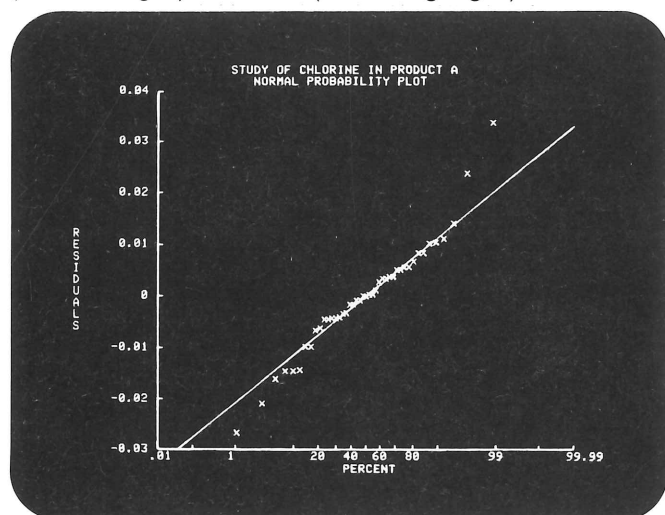

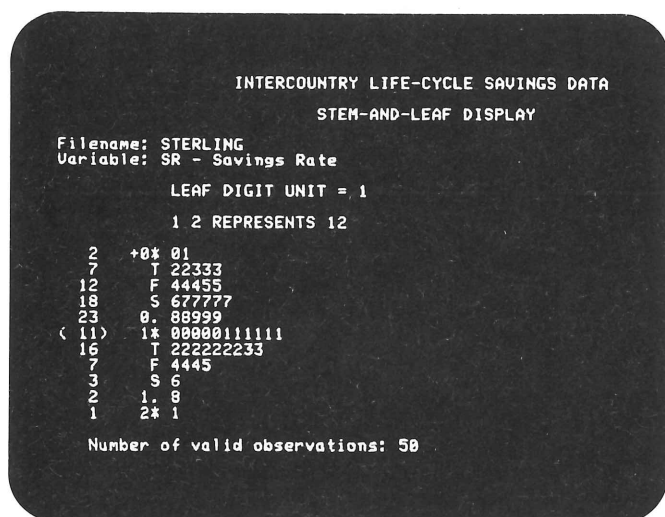**Figure 10. Probability plot**

Figure 11. Stem-and-leaf display

Run **Box-and-Whisker Plots** to display boxplots which show how data is distributed and identifies "outliers" (See Figure 12). You may display notched or unnotched boxplots. Notched boxplots are especially useful in comparing two groups because two groups whose notched intervals do not overlap are significantly different at roughly the 5% level.

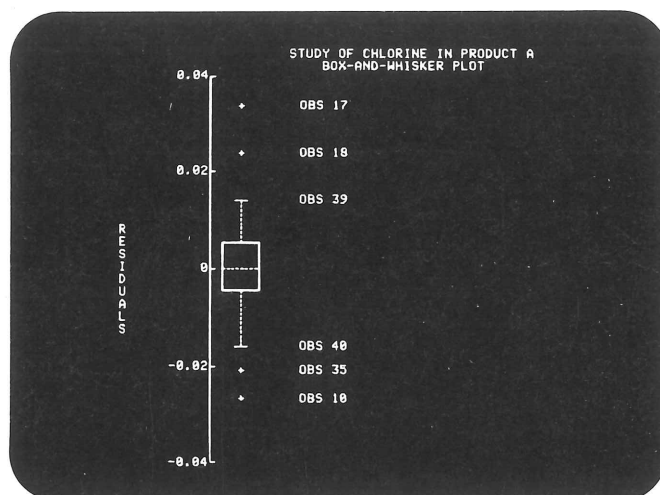Run **Scatter Plot** to examine the relationship between two variables (See Figure 13).

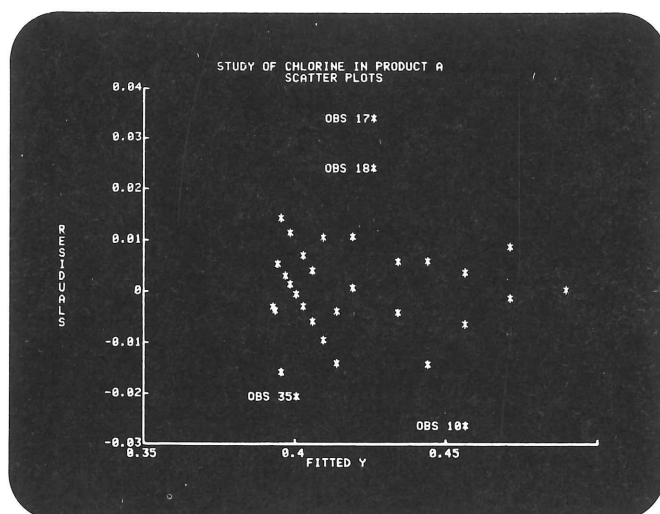**Figure 12. Box-and-whisker plot**

Figure 13. Scatter plot

You may label some or all of the observations in your scatter plot. This allows you to flag critical data points.

The next step in using PLOT 50 Statistics: Nonlinear Estimation is selecting and running one of the six Nonlinear Estimation procedures.

The **Function Minimization** program finds parameter values to minimize a nonlinear function. Many types of problems can be solved using this procedure by formulating the problem as a function to be minimized.

The **Systems of Equations** program solves a system of nonlinear equations.

The **Marquardt's Nonlinear Least Squares** program fits a nonlinear function to the data.

The **Gauss-Newton Nonlinear Least Squares** program also fits a nonlinear function to data. Some of the parameters in the function can be held constant if desired. You must specify the partial derivatives as well as the function.

The **Fourier Regression** program performs a least squares fit or a discrete Fourier series frequency decomposition on data for a Fourier series model or linear trigonometric model (See Figures 14 and 15).

The **Multiple Regression and Diagnostics** program performs a QR decomposition to compute the parameters for a multiple regression model. Residual analysis and extensive regression diagnostics are also available.

All of the regression procedures (Gauss-Newton Nonlinear Least Squares, Marquardt's Nonlinear Least Squares, Fourier Regression and Multiple Regression) store the residuals and fitted values in the current file. You may analyze the residuals and fitted values with any of the exploratory plotting programs (See Figure 16, 17, 18, and 19.

The **Data Management Utilities** deletes the Statistics operating system and displays a menu of 13 utilities. The utility programs include the following:

1. **Get**—Copies a PLOT 50 Standard File or group of files from another disk or from a data tape.
2. **Put**—Copies a PLOT 50 Standard File or group of files to another disk or to a data tape.
3. **Directory**—Lists the file directory for a disk or magnetic tape.
4. **Duplicate Disk**—Copies the entire contents of a system disk or data disk for archival purposes.

Figure 16. Anova and regression

Figure 14. Fourier regression
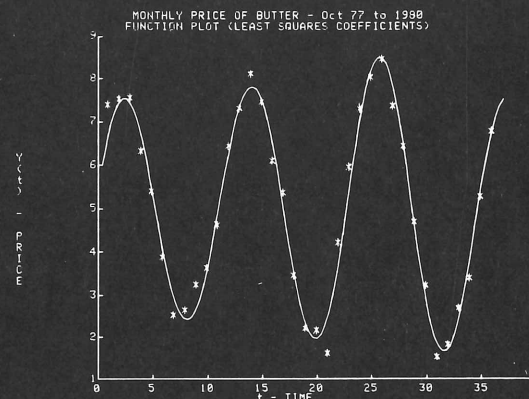
Figure 17. Partial regression plot
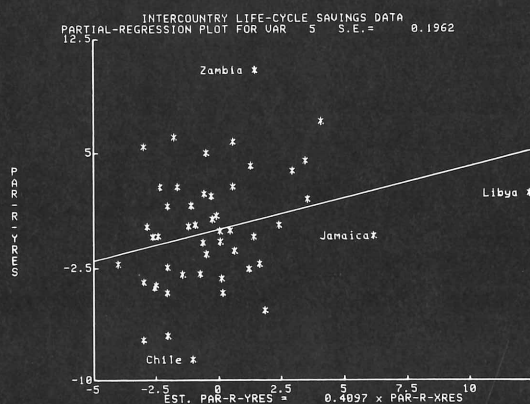
Figure 15. Fourier function plot

Figure 18. Marquardt's nonlinear least squares

STUDY OF CHLORINE IN PRODUCT A
MARQUARDT'S NONLINEAR LEAST SQUARES

Figure 19. Marquardt's nonlinear function plot

5. **Delete**—Deletes a data file from the disk.

6. **Append**—Appends data contained in one file to the bottom of another file.
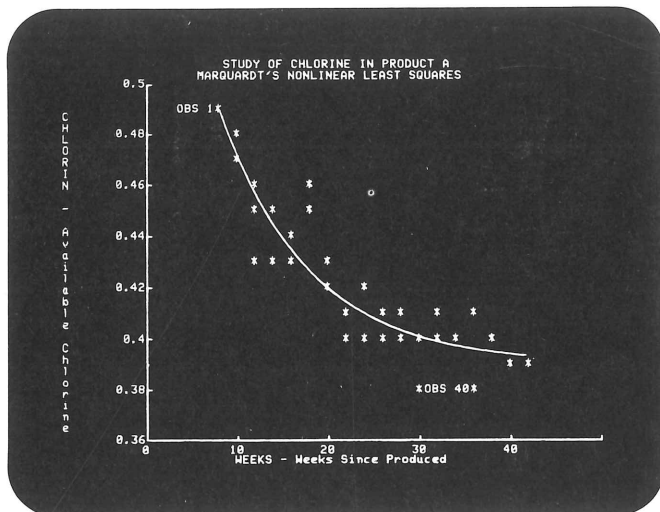
7. **List**—Lists all or part of a data file.

8. **Change Title, Change Labels**—Changes the file labeling information in a data file.

9. **Combine Files**—Creates a new file by combining variables from two other files.

10. **Sort**—Creates a new file by sorting an existing file into ascending or descending order.

11. **Rename**—Changes the name of a data file.

12. **Transform Data**—Creates a new file by doing one or a combination of the following: 1) Selecting specific variables from another file; 2) Selecting specific observations from another file; and 3) Performing mathematical transformations on data from another file. This utility offers 24 mathematical transformations, two of which you can define yourself.

13. **Change Configuration Parameters**—Changes one or more device addresses.

14. **Statistics: Nonlinear Estimation**—Brings the Statistics operating system into memory and displays the Statistics menu.

General Information

Memory Requirements
32 K bytes

Equipment Requirements
4050 Series Desktop Computer
4907 File Manager
4907 File Manager ROM Pack

Optional Equipment
4611 or 4631 Hard Copy Unit
4662 or 4663 Interactive Digital Plotter
4642 Matrix Printer
4050 Series Option 10 RS-232 Interface ROM Pack

Ordering Information
4050D05 PLOT 50 Statistics: Nonlinear Estimation

Standard Accessories
PLOT 50 Statistics: Nonlinear Estimation comes complete with a tape cartridge for initializing the system, a disk for program and data storage, an overlay for the function keys and a user's manual.

Service Policy
PLOT 50 Statistics: Nonlinear Estimation is Support Category B software and subject to services stipulated on the Tektronix Software Support Categories Addendum.

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