NUREG–1378

PLOTnFIT: A BASIC Program for Data Plotting and Curve Fitting

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

J. O. Schiffgens

AVAILABILITY NOTICE

Availability of Reference Materials Cited in NRC Publications

Most documents cited in NRC publications will be available from one of the following sources:

1. The NRC Public Document Room, 2120 L Street, NW, Lower Level, Washington, DC 20555
2. The Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20013-7082
3. The National Technical Information Service, Springfield, VA 22161

Although the listing that follows represents the majority of documents cited in NRC publications, it is not intended to be exhaustive.

Referenced documents available for inspection and copying for a fee from the NRC Public Document Room include NRC correspondence and internal NRC memoranda; NRC Office of Inspection and Enforcement bulletins, circulars, information notices, inspection and investigation notices; Licensee Event Reports; vendor reports and correspondence; Commission papers; and applicant and licensee documents and correspondence.

The following documents in the NUREG series are available for purchase from the GPO Sales Program: formal NRC staff and contractor reports, NRC-sponsored conference proceedings, and NRC booklets and brochures. Also available are Regulatory Guides, NRC regulations in the Code of Federal Regulations, and Nuclear Regulatory Commission Issuances.

Documents available from the National Technical Information Service include NUREG series reports and technical reports prepared by other federal agencies and reports prepared by the Atomic Energy Commission, forerunner agency to the Nuclear Regulatory Commission.

Documents available from public and special technical libraries include all open literature items, such as books, journal and periodical articles, and transactions. Federal Register notices, federal and state legislation, and congressional reports can usually be obtained from these libraries.

Documents such as theses, dissertations, foreign reports and translations, and non-NRC conference proceedings are available for purchase from the organization sponsoring the publication cited.

Single copies of NRC draft reports are available free, to the extent of supply, upon written request to the Office of Information Resources Management, Distribution Section, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

Copies of industry codes and standards used in a substantive manner in the NRC regulatory process are maintained at the NRC Library, 7920 Norfolk Avenue, Bethesda, Maryland, and are available there for reference use by the public. Codes and standards are usually copyrighted and may be purchased from the originating organization or, if they are American National Standards, from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

NUREG-1378

PLOTnFIT: A BASIC Program for Data Plotting and Curve Fitting

Manuscript Completed: July 1989
Date Published: October 1989

J. O. Schiffgens

Division of Engineering and Systems Technology
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ABSTRACT

PLOTnFIT is a BASIC program to be used with an IBM or IBM-compatible personal computer (PC) for plotting and fitting curves to measured or observed data for both extrapolation and interpolation. It uses the Least Squares method to calculate the coefficients of nth degree polynomials (e.g., up to 10th degree) of Basis Functions so that each polynomial fits the data in a Least Squares sense, then plots the data and the polynomial that a user decides best represents them.

PLOTnFIT is very versatile. It can be used to generate linear, semilog, and log-log graphs and can automatically scale the coordinate axes to suit the data. It can plot more than one data set on a graph (e.g., up to 8 data sets) and more data points than a user is likely to put on one graph (e.g., up to 225 points). A PC diskette containing (1) READIST.PNF (a summary of this NUREG), (2) INI06891.SIS and FOL06891.SIS (two data files), and (3) PLOTNFIT.4TH (the latest version of the program) may be obtained from the National Energy Software Center, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439.

TABLE OF CONTENTS

APPENDICES

PREFACE

In 1984, the U.S. Nuclear Regulatory Commission (NRC) staff wrote a program, the precursor to PLOTnFIT, to plot data, with the idea of eventually adding to it curve-fitting capabilities. The work was set aside until 1987 when a paper by William G. Hood, "Polynomial Curve Fitter" (see Reference 1), came to the staff's attention. The program described in the paper is POLYFIT.BAS, copyright 1987 by William G. Hood, Conway, Arkansas. The staff recognized that the techniques presented by Hood were ideally suited to meet its initial objective and were much simpler to incorporate and faster to execute than anything it had envisioned. Subsequently, Hood's techniques were incorporated into the original program and PLOTNFIT.1ST emerged in 1988. Since then, various useful options and safeguards have been added - not the least of which was the incorporation of the option of using Basis Functions. It is the inclusion of Basis Functions that allows for the possibility of meaningful extrapolation from complex data dependencies if you know something about how the data "should behave." The NRC staff's John Schiffgens developed PLOTnFIT and its precursor.

The description presented here specifically concerns PLOTNFIT.4TH, the fourth in a series of programs referred to generically as PLOTnFIT, each successive version being an extension of its predecessor. The program is "user friendly" (i.e., you, the user, need only follow the prompts) and has many "error traps" to keep you from entering meaningless INPUT by mistake. PLOTNFIT.4TH allows for the correction of erroneously entered data points by following simple procedures. You can choose from among five OUTPUT options, depending on the amount of detailed information you want to print.

The NRC staff is grateful to William G. Hood for permission to use portions of POLYFIT.BAS in PLOTnFIT. It is also grateful to the Literary Executor of the late Sir Ronald A. Fisher, F.R.S., to Dr. Frank Yates, F.R.S., and to the Longman Group UK Ltd., London, for permission to reprint Table IV, "Distribution of χ^2," from their book <u>Statistical Tables for Biological, Agricultural and Medical Research</u> (6th Edition, 1974).

INSTALLATION AND EXECUTION OF PLOTNFIT.4TH

This section details the hardware and software requirements and the steps involved in running PLOTNFIT.4TH on a personal computer (PC). A basic familiarity with the PC and the DOS environment is assumed. No programming experience is required to run PLOTNFIT.4TH in its present form. A file labeled READ1ST.PNF is included on the PLOTnFIT diskette along with PLOTNFIT.4TH and data files INI06891.SIS and FOL06891.SIS from the sample problem shown in Appendix A. READ1ST.PNF contains much of the information presented here, but has no additional information; it is included as a convenient reference for those occasions when you are at your PC and this report is not handy.

None of the versions of PLOTnFIT will run properly on a PC with a monochrome monitor; both a color/graphics monitor adapter and a color monitor are required. Also, it should be noted that the command BASICA alone (i.e., with defaults) will not provide sufficient memory for most jobs; to ensure sufficient memory for all jobs, you will need to use BASICA/C:0/F:1.

PLOTNFIT.4TH requires the following minimum hardware:

- IBM-PC/XT/AT or IBM-compatible PC
- color monitor and color/graphics monitor adapter
- 256K memory
- 8087 or 80287 math coprocessor (optional; noted here because it is highly recommended, although not actually required)
- 1 floppy drive
- printer (the printer must always be left on when PLOTNFIT.4TH is operating; a PLOTnFIT job always produces some printed OUTPUT)

Computer-printer communication is accomplished by PLOTnFIT using BASIC printer control codes to give Epson commands. Hence, best results are obtained with an Epson printer (e.g., FX-86e/286e) in protocol mode: ESC/P. It should be noted that there is one assembly language subroutine, VARPTR(TRRAY(1)), in PLOTnFIT. This subroutine uses the shift-print screen function to send the graphics presented on the monitor to the printer.

The following software is also required:

- DOS 3.X
- PLOTnFIT diskette
- GRAPHICS.COM (included in DOS)
- BASICA.COM (included in DOS)

PLOTNFIT.4TH may be installed on a hard disk by following the procedure given below:

```
A: C:\              switches to drive C
C:\ Copy A:*.*      copies all files from the PLOTnFIT diskette to drive C
```

All of the files from the distribution diskette will be copied onto the root directory of the hard disk by following this procedure.

To properly execute PLOTNFIT.4TH, you must load GRAPHICS before BASICA; that is,

```
A:(or C:\) GRAPHICS
A:(or C:\) BASICA/C:0/F:1.
```

GRAPHICS translates the computer instructions that refresh the graphics on the monitor screen for transmission to the printer. Without first loading GRAPHICS, you cannot produce printed copies of graphs displayed on the monitor. Once in BASICA, you can begin executing a job (e.g., the sample problem shown in Appendix A) by entering the following commands after the Ok prompt:

either

```
Ok
LOAD" A:(or C:\)PLOTNFIT.4TH
Ok
RUN
```

or

```
Ok
RUN A:(or C:\)PLOTNFIT.4TH.
```

Of course, you may also execute and run PLOTNFIT.4TH while in DOS through the initial BASIC command as follows:

```
A:(or C:\) BASICA PLOTNFIT.4TH/C:0/F:1.
```

After the RUN command, or the above equivalent, simply follow the prompts provided by PLOTNFIT.4TH. INPUT may be entered either from the keyboard or from a diskette file. It is a good bookkeeping procedure to have a diskette in drive A or B, or a subdirectory on drive C, <u>just</u> for data files (i.e., you tend to generate many small files using PLOTnFIT), and to do all reading from it and writing to it.

It is often desirable to create data files where measurements are made (i.e., in the laboratory, in the field, out in the plant, etc.), perhaps using a "lap-top" IBM or IBM-compatible PC, and then analyze the data when you return to your office. For this reason the following description has been included of the OUTPUT format required in any program to produce a data file that PLOTnFIT can read; this is the same format used by PLOTNFIT.4TH to save data for further analysis at a later time:

```
OPEN [storage]device:filename FOR OUTPUT AS #i
WRITE #i, dataIDname[<31 characters], ndp[# of data points]
FOR J = 0 to NDP - 1
WRITE #i, x(J)[independent variable], y(J)[dependent variable],
      w(J)[weighting factor]
NEXT J
     [Repeat these four statements, perhaps in a FOR...NEXT loop, for each
     data set that you want to include in "filename." You must keep track
     of the number of data sets (ndsf) included in filename. A simple
     procedure suggested by PLOTnFIT for keeping track of the number of
     data sets in a file is described in Section 2.3.]
CLOSE #i
```

During a job, PLOTnFIT asks if your data will be INPUT from the keyboard or from a stored file. If you answer "from a stored file," PLOTnFIT will request the "[storage]device:filename" and the "# of data sets, ndsf," in the file, then step through the file and read in, sequentially, those data sets you choose to use. The total number of data points per job (from all data sets) must not exceed 225.

1 DESCRIPTION OF PLOTnFIT

1.1 Introduction

This program is a tool to help with understanding and interpreting numerical data. Because of uncertainties, typical data never exactly fit the model used to describe them, even when that model is correct (i.e., the "true model"). In analyses, therefore, it is generally not important for the model or curve to pass through each point; it need only come close to be of value. PLOTnFIT is useful for the analysis of such inexact data (i.e., data subject to measurement errors). In applications where there are no uncertainties in the data and the curve must pass exactly through the data points, you should use methods other than those incorporated in PLOTnFIT, such as "spline functions."

1.2 Some Basic Assumptions

Perhaps the basic assumption made, implicitly or explicitly, when technical, quantitative measurements or observations of the effect of changes in one quantity (the independent variable, x) on another (the dependent variable, y) are recorded, is that there is a true model that relates the quantities measured. That is, there is a direct physical relation between the independent and dependent variables that can be expressed mathematically. You, as an evaluator of data, want to be able to identify such models so as to improve your understanding of phenomena under investigation and your ability to predict results. Although understanding phenomena and predicting results are not independent, the former tends to focus on interpolation (i.e., describing within the range of the data analyzed) and the latter on extrapolation (i.e., going beyond the data analyzed). How you use PLOTnFIT depends on your focus.

Similarly, another basic assumption is that for any given (finite) set of such measurements there is an infinite parent distribution, of which the set is a sample, and that the set is actually the most probable set of measurements. This is the principle of maximum likelihood. The problem is that frequently we do not know, at least initially, even an approximate model, let alone the true model, or the parent distribution or all the independent variables that can have an effect on the dependent variable, let alone control them all. Furthermore, we are never able to fully eliminate errors from measurements, though we strive to eliminate systematic errors or make corrections for them (and must assume that we succeed, if we are to value our data).

The task then is to try models of y as a function of x, P(x), incorporating into them as much knowledge as we have of the phenomena being analyzed, until we find one that, in our judgment, best describes the data (i.e., best correlates all the points in the data set). Suppose we are fitting m data points (x_i, y_i), $i = 1,\ldots,m$, to a model that has n+1 adjustable parameters C_k, $k = 1,\ldots n+1$; that is, suppose

$$y \sim P(x;C_1,C_2,\ldots,C_{n+1}).$$

We may ask the question: Given a particular set of parameters, what is the probability that this data set could have occurred, plus or minus some fixed delta y on each data point? We may then intuitively identify the probability of the data given the parameters as the likelihood of the parameters given the data. In any case, we assume that the measurements, y_i, contain only random errors [generally, each with a different parent distribution and corresponding standard deviation, $(\text{sigma})_i$], and that the x_i contain no errors (i.e., that the neglected uncertainty in x_i, which would be otherwise assumed random, is effectively included as a contributing component to the total uncertainty in y_i). For a good and easy to read discussion of experimental errors and how to treat them, see Reference 2.

1.3 Theory

To be genuinely useful, a fitting procedure should allow for modeling flexibility and the incorporation of data uncertainties, as well as yield model parameters and a statistical measure of goodness-of-fit. PLOTNFIT.4TH is so written as to be genuinely useful.

For our purposes, in order to determine model parameters and to estimate how well a model correlates the data, we define a set of "observation equations," the deviations

$$d_i = y_i - P[X(x_i)],$$

where $P[X(x)]$ is an nth degree polynomial chosen to model measurements of the dependent variable y_i as a function of x_i. The polynomial is linear relative to its coefficients and taken to be a function of $X(x)$, referred to as a Basis Function (see Reference 3), so that at any x_i

$$P[X(x_i)] = C(1)[X(x_i)]^{(n)} + C(2)[X(x_i)]^{(n-1)} + \ldots + C(k)[X(x_i)]^{(n-k+1)} + \ldots + C(n)X(x_i) + C(n+1).$$

On a graph, the deviation d_i is the vertical distance between the data point (x_i, y_i) and the point on the curve $(x_i, P[X(x_i)])$. Since we assume that the set of measurements is the most probable set of measurements, the proper model to choose is that which gives the largest possible value to the probability of having $P[X(x_i)]$ fall within an interval dy of y_i for all m points (i.e., we apply the "principle of maximum likelihood" to d_i).

Least Squares fitting is a maximum likelihood estimation of the polynomial coefficients $C(k)$ if the measurement errors are independently random and normally distributed with a constant standard deviation. That is, for the set of observations (x_i, y_i), the method of Least Squares selects a curve [i.e., chooses $C(k)$ values] that maximizes the probability that $P[X(x)]$ will describe the data by minimizing the sum of the squares of the vertical distances

$$\text{SUM}[d_i]^2 = \text{SUM}(y_i - P[X(x_i)])^2.$$

This is referred to as the maximum likelihood estimator, where SUM symbolizes the sum over i from 1 to m. If the errors are not normally distributed, then the Least Squares estimations of the C(k) coefficients are not maximum likelihood, but may still be useful in a practical sense.

The method can also be used when the observations are not all from the same parent distribution. For example, if different observations were made by different observers, made using different instruments, or are suspect for some reason (i.e., perhaps some of the observations were made under less than optimal conditions), "outliers" may result. The problem with outliers is that they can readily render a Least Squares fit, on otherwise adequate data, worthless, because their probability of occurrence in an assumed Gaussian distribution is so small that the maximum likelihood estimator is likely to distort the whole model or curve by trying to take them, mistakenly, into account (see Reference 3). To handle the problem, the deviation for each point is weighted inversely as the variance [i.e., the square of the uncertainty or standard deviation, $(\text{sigma})_i^2$] of its parent distribution, which is assumed Gaussian, where the variance of each point is assumed to be that of its parent distribution. The quantity to be minimized then is

$$\text{SUM}[(y_i - P[X(x_i)])/(\text{sigma})_i]^2,$$

which is called the Chi-square.

To minimize a function of n+1 variables, we take the partial derivative of the function with respect to each of the variables in turn, and set each derivative equal to zero. Therefore, to minimize the weighted sum of the squares of the vertical distances, we set

$$\text{Partial derivative w.r.t. } C(k) \text{ of } \text{SUM}(w_i[d_i]^2) = 0,$$

for k from 1 to n+1, where the ith weighting factor is

$$w_i = 1/(\text{variance})_i = 1/(\text{sigma})_i^2.$$

The derivatives are evaluated to obtain n+1 equations, which are solved simultaneously to find the C(k). With this more general formulation, if the measurement errors are not known, they may all be set to the constant value, $\text{sigma}_i = 1$ (i.e., for i = 1 to m, $w_i = 1$ may be input to PLOTnFIT or the w_i may be ignored and PLOTnFIT will set them equal to 1).

The procedure incorporated in PLOTnFIT uses a linear combination of orthogonal polynomials so as to avoid "ill-conditioning" and to perform the task of curve fitting with single-precision arithmetic (see Reference 1). PLOTnFIT not only produces the best approximation in the Least Squares sense, but also produces a solution whose parameters C(k) tend to be as small as possible. That is, when some combination of Basis Functions is irrelevant to the fit, that combination is driven down to a small value rather than pushed up to create very large, delicately canceling quantities.

After P[X(x)] is fit to the data, PLOTnFIT calculates the statistic "residual variance"

$$RV = [1/(m-n-1)][SUM(w_i[d_i]^2)]$$

$$= [1/(m-n-1)][SUM(w_i[y_i - P[X(x_i)]]^2)],$$

where m-n-1 is the degree of freedom NU (n+1 being the number of coefficients in the polynomial determined by the data) that can be used to determine which polynomial gives the best fit. Generally, the smaller the RV the better the fit, at least when the polynomial degree, n, is much smaller than the number of data points, m. It is almost always desirable, however, to keep n as low as possible, consistent with a small RV, so as to keep the fitted curve free of meaningless, non-physical oscillations and to keep the model simple.

If each point has its own standard deviation $(sigma)_i$, then the statistic of interest is Chi-square; that is,

$$CHI^2 = SUM(w_i[d_i]^2) = (m-n-1) \cdot RV = NU \cdot RV.$$

Clearly, if the measured data agree with the model exactly, then $CHI^2 = 0$; but as mentioned earlier, this is very unlikely, even if the sample is taken from the assumed parent distribution. In any case, the larger CHI^2 is, the more the data and the model disagree. The appropriate question to be answered then becomes: How large a value of CHI^2 is reasonable for the model to be considered representative of the data?

The probability distribution for different values of CHI^2 at its minimum can be derived analytically and is the Chi-square distribution for NU degrees of freedom. The probability that the CHI^2 should exceed a particular value by chance Q, or the probability that it should fail to exceed a particular value by chance P, where P is the complement of Q (i.e., P = 1 - Q), is frequently tabulated in appendices to statistics books [a table of $Q = f(NU,CHI^2)$ is presented in Appendix B]. For example, for NU = 10 the probability that CHI^2 will (1) exceed 2.558 is Q = 0.99, (2) exceed 9.342 is Q = 0.50, and (3) exceed 29.588 is Q = 0.001. This means that if the model "fits" the data, there is a 99 percent chance that CHI^2 will be 2.558 or larger because of random fluctuations, but only a 0.1 percent chance that it will be larger than 29.558. If we calculate $CHI^2 = 7$, the differences are probably due to chance; whereas if we calculate $CHI^2 = 35$, then it is very unlikely that the differences are due to chance.

If $Q \leq 0.001$ either (1) the model is not a good one, (2) the sizes of the measurement errors $(sigma)_i$ are incorrect (i.e., were underestimated), or (3) the measurement errors are not normally distributed (i.e., there is an abundance of outlier points). If Q > 0.1 for a model, it is generally considered believable. However, if Q is too near to 1, most likely the measurement errors were overestimated, or perhaps the data were altered to fit the model. As a rule of thumb, a "typical" value of CHI^2 for a "moderately" good fit is about NU; that is, for large NU, CHI^2 becomes normally distributed with a mean of NU and a standard deviation equal to the square root of 2·NU (see Reference 3).

It should be noted that when the individual measurement errors are not known, RV is no longer an independent assessment of goodness of fit, rather, it is only a quantity that can be used to estimate the uncertainty in the data provided the model P[X(x)] is "known" to be close to the true model. If you do not know the individual measurement errors $(sigma)_i$, you may set the $(sigma)_i$ equal to 1 and take the square root of RV as the standard deviation of the data with respect to the curve P[X(x)]; that is,

$$[SIGMA] = [[1/(m-n-1)]SUM(w_i[y_i - P[X(x_i)]]^2)]^{1/2},$$

provided the deviations are due to measurement errors that are independently random and normally distributed [i.e., this assumes all $(sigma)_i$ = SIGMA].

Accordingly, the measurements y_i fall within + or - SIGMA, 2·SIGMA, and 3·SIGMA of $P[X(x_i)]$, 68 percent, 95 percent, and 99.7 percent of the time, respectively.

The program also calculates another statistic, the "coefficient of determination"

$$CD = 1 - WD/WY,$$

where

$$WD = SUM(w_i[d_i]^2)$$

and

$$WY = SUM(w_i[y_i]^2) - [(SUM[w_i y_i])^2]/[SUM(w_i)],$$

which can be used as a measure of how much of the variation in the values y_i can be attributed to changes in the values x_i (i.e., if y_i are independent of x_i, then the curve is just a horizontal straight line and CD = 0, while if the curve fits the data perfectly, CD = 1). Suppose, for example, that CD is 0.91. You can then attribute 91 percent of the weighted sum of the deviations squared to changes in x. Furthermore, to the extent that P[X(x)] is close to the true model, 9 percent of the weighted sum of the deviations squared would be due to random error (see Reference 1).

2 USE OF PLOTnFIT

2.1 Introduction

For ease in making changes during execution of the program, PLOTnFIT has two categories of INPUT: (1) plotting instructions and (2) data and data identification. It is possible to do more than one task (i.e., analyze more than one data set or analyze a data set more than once) during a given job; simply follow the "prompts."

(1) With regard to plotting instructions, the quantities (numbers and strings) that appear in parentheses are the variable values currently in the computer memory [Note: N(2) refers to the second element in the N array; N(=2) refers to the value of the variable N currently in the computer memory]. If you do not want to make a change at a variable prompt, simply press the ENTER key.

(2) With regard to data and data identification, the quantities entered for one job can be readily saved for reanalysis in a later job. Data may be entered from the computer keyboard or from a disk file. Data are INPUT from the keyboard or disk file until a specified number of data points are read.

(3) Data are changed easily by writing to a file (e.g., "filesave") those data sets that you are interested in saving from a job, starting a new job (without exiting PLOTnFIT, if you like), entering the data from "filesave," and then making the desired changes (i.e., keyboard additions, deletions, or corrections).

As previously stated, the portion of this program that fits curves to data is based on the method described by W. G. Hood (see Reference 1), which involves finding the coefficients of an nth degree polynomial, P[X(x)], so that it fits a set of data points in a Least Squares sense. When the number of data points equals n+1, the plot of the polynomial will pass exactly through each point, although some meaningless, non-physical oscillations that are not wanted may occur. Generally, the most meaningful results are obtained when the number of data points far exceeds the degree of the polynomial (by at least a factor of 3 for large n), in which case the curve would probably not pass through any of the points but would be smooth (i.e., "wiggle free") within the range of the data. A common sense rule of thumb for a good fit is that "the curve should not be straining toward individual data points."

Typically, many calculations are required for intelligent interpretation of curve-fitting results, particularly when you are fitting for extrapolation. PLOTnFIT and your PC do the calculations and plot the results quickly and accurately, but in the final analysis curve fitting is an art and it is your good judgment and skill that determine the value of the results and whether PLOTnFIT was appropriately and satisfactorily used.

2.2 INPUT

You begin by identifying the job with a string of 17 characters or less. The job may consist of up to eight tasks, where each task is a separate analysis of a data set. You then provide a brief description of the job with a string of less than 256 characters, including blanks. Next you specify a series of plotting instructions; this involves responding to essentially the following questions:

(1) Do you want your graph to be linear, semilog, or log-log?

(2) What color combinations do you want for the curves, data points, and axes and labels shown on the monitor?

(3) What labels do you want for the graph title (up to 30 characters), horizontal or x-axis (up to 22 characters), x-axis units (up to 5 characters), vertical or y-axis (up to 16 characters), and y-axis units (up to 5 characters)?

(4) Do you want to establish coordinate ranges and marking intervals yourself, or do you want to let PLOTnFIT do it for you?

These plotting instructions apply to all the tasks in a job. PLOTnFIT may be instructed to make a set of graphs for each task and/or make one graph for the job containing the main result of each task. It is a good idea to let PLOTnFIT establish coordinate ranges and marking intervals until you become familiar with the program.

After entering the plotting instructions, you then identify and INPUT the data you want to analyze; this involves responding to essentially the following questions or instructions:

(1) How many data sets do you want to analyze (although you may enter no more than eight per job, you may INPUT the same set eight times)?

(For each data set:)

(2) Will the data come from the keyboard or from a stored file?

(3) Identify the data (a string of less than 31 characters).

(4) Enter each data point and weighting factor and make desired data changes.

(5) Choose a Basis Function (from the list provided), and <u>specify the constant coefficients in the function</u>.

(6) What is the lowest degree polynomial you want to consider, and how many successively higher degree polynomial fits do you want to try?

(7) Choose a symbol to represent the data points.

Repeat steps 2 through 7 until all data are entered.

The model, P[X(x)], which in PLOTnFIT has the form of a polynomial in X(x), may consist of a linear combination of <u>any</u> specified function of x, X(x), where linear refers to the model's dependence on its initially unknown coefficients, C(k). Although in theory the model could be any combination of functions, if it were nonlinear in its unknown coefficients, solving for them would be very difficult. The arbitrary function X(x), which is called the Basis Function, may be quite nonlinear in x, but may contain only known coefficients, whether estimated from the data set (or some other data set) or determined theoretically. The list of Basis Functions provided for you to choose from is as follows:

(1) $X(x) = CS1 + x$

(2) $X(x) = CS1 + EXP(CO1 \cdot x)/(CD1 + x)$

(3) $X(x) = (CS1 + CO1 \cdot x + CD1 \cdot x^2) \cdot LOG(x)$

(4) $X(x) = CS1/x + CO1 \cdot LOG(x) + x \cdot LOG(CD1 \cdot x + 2.71828)$

(5) $X(x) = CS1 + CO1 \cdot x^{CD1} + CE1/(CF1 + x^{CG1})$

(6) $X(x) = CS1 \cdot EXP(CO1 \cdot x^{CD1}) + CE1 \cdot EXP(CF1 \cdot x^{CG1})$

(7) $X(x) = CS1 \cdot EXP(CO1 \cdot x) + CD1 \cdot EXP(CE1 \cdot x) + CF1 \cdot EXP(CG1 \cdot x)$

(8) $X(x) = CS1 \cdot (CO1 + x)^{CD1} + CE1 \cdot (CF1 + x)^{CG1}$

(9) $X(x) = EXP(CS1 \cdot x) \cdot (CO1 + x)^{CD1} + EXP(CE1 \cdot x) \cdot (CF1 + x)^{CG1}$

(10) $X(x) = CS1 \cdot x \cdot SIN(CO1 + CD1 \cdot x) + [CE1/(CD1 + x)] \cdot SIN(CF1 + CG1 \cdot x)$

(11) $X(x) = EXP(CS1 \cdot x) \cdot SIN(CO1 + CD1 \cdot x) + CE1 \cdot SIN(CF1 + CG1 \cdot x)$

This list contains most of the functions you are apt to need. But remember, you must provide values for the constants (i.e., CS1, CO1, CD1, CE1, CF1, and CG1) in the function you choose. Note, for Basis Functions containing arg^c terms, c must be an integer when arg is expected to have negative values.

If the Basis Function coefficients (i.e., constants) are not known initially, you may choose them by trial and error to give you a good fit to the data. However, you should keep in mind that PLOTnFIT gives you a best fit in terms of the chosen Basis Function in x, including the chosen Basis Function coefficients, not (except for Basis Function # 1) in terms of x. Note that if you choose the Basis Function coefficients to fit the data, you should include these coefficients in determining the degrees of freedom (except, of course, for those coefficients set merely to get the functional form desired).

The advantage of allowing for the use of a Basis Function [other than just X(x) = x] is that if you know something about "how the data go," for example, that they tend to be periodic (harmonic or damped harmonic) or logarithmic or exponential, etc., from theory, previous observation, or intuition, you can incorporate this knowledge into the model. Although X(x) = x can generally give a satisfactory fit for interpolation, it tends to be unsatisfactory for extrapolation from complex data dependencies, especially when polynomials of greater than 3rd degree are required for a good fit. In general, you need to know something about the data you are plotting (i.e., you need to be able to choose a suitable Basis Function) if you hope to extrapolate satisfactorily.

It is important to remember that once all plotting instructions and data have been INPUT, you are given an opportunity to make changes before PLOTnFIT begins to analyze and plot the data. Therefore, although mistakes may be made while entering plotting instructions (e.g., you may choose log-log when you really want your graphs to be semilog) or data sets (e.g., you may enter incorrect coordinates or weighting factors for some of the data points), you should always continue to INPUT and not try to abort the job, because before the analysis begins you can go back and make corrections.

2.3 OUTPUT

You will find PLOTnFIT OUTPUT neat, well organized, and easy to read and understand. Care was taken to arrange and group data for printing so as to provide reasonable flexibility in choosing an amount of detailed information for printing that is in keeping with the level of the analysis. For example, when doing exploratory analyses, you may choose to print as little OUTPUT as possible. For each job, by default, PLOTnFIT provides at least a one-page summary for each task and a one-page job summary.

Each task summary identifies (1) the data set, (2) the degree range investigated, (3) the Basis Function used, (4) the polynomial degree chosen by PLOTnFIT as that which best correlates the data within the set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated), and (5) your choice of the degree that best fits the data (i.e., the "best polynomial/best fit").

The job summary page (1) identifies the job and the date and time of the analyses; (2) describes the job; (3) completely characterizes the comparative plot (described below) if one was made, and if not, it shows a summary of plotting instructions; (4) lists, for each task, the task number, data identification, the degree of the "best polynomial/best fit," the type of symbol used to represent the data points, the number of data points, and the source of the data set; and (5) identifies the data sets saved (if any data are saved from the job) and the file in which they are stored.

As you begin to zero in on a satisfactory model, you will most likely want to print more and more OUTPUT (i.e., to see more of the details). You are given five options from which to select the level of detail desired in the printed OUTPUT; they are as follows:

(1) You may print the polynomial coefficients C(k), the residual variance (RV), and the coefficient of determination (CD) for each of the curves fit to each data set, as well as the coordinates and weighting factor for each data point (x_i,y_i,w_i), the corresponding $P[X(x_i)]$ value and deviation d_i, and either the root-residual variance (standard deviation SIGMA) or the CHI^2.

(2) For each data set you may print a set of graphs containing plots of all polynomials fit to the data set. The first graph will show a plot of the lowest degree polynomial considered, the second graph will show plots of the lowest and next higher degree polynomial considered, and so on. Such graphs show the evolution of a model as you proceed to a higher and higher polynomial degree.

(3) You may print a graph containing plots of all data sets, each set with or without a corresponding "best polynomial/best fit" curve. Since this is the most significant graph, if you choose to print it, it is placed on the job summary page (which, as described above, always contains the complete identification of the information presented on this graph, whether the graph is printed or not).

(4) You may print values of key program variables needed to help you select coordinate ranges and marking intervals should you anticipate making additional graphs of the same data at a later time and not have PLOTnFIT do the selecting for you. The program parameters listed pertain to coordinate information (except for TNDP); each parameter that refers to the x-axis has a counterpart that refers to the y-axis. Hence, it is sufficient here to define only those parameters pertaining to the x-axis (except where otherwise noted).

TNDP : Total number of data points from all data sets (TNDP must ≤ 225).

XMIN : Minimum x-coordinate from among all job data, when you default to PLOTnFIT (or you may choose some other value for XMIN).

XMAX : Maximum x-coordinate from among all job data, when you default to PLOTnFIT (or you may choose some other value for XMAX).

DEX : Length of a marking interval (i.e., distance between small hashmarks) in units of the data (you may choose the value for DEX).

LJX : Number of marking intervals between large hashmarks.

LIX : Number of large hashmarks considered minus one (and number of values of x to be printed along the x-axis); all may not be used.

CX : Initial estimate of the maximum number of marking intervals needed.

[The next three parameters refer to x-coordinates of points on the monitor screen (where the x-, y-coordinates of the upper-left-most point are 0,0 and of the lower-right-most point are 319,199).]

XS : Lowest horizontal point on the graph.

XE : Highest horizontal point on the graph.

XO : Horizontal point (sometimes not on the graph) at which the x-data-coordinate would be zero.

NXS : Lowest value on the x-axis (initially XMIN), as shown on the graph, divided by DEX.

NXE : Highest value on the x-axis (initially XMAX), as shown on the graph, divided by DEX.

NXT : Total number of x-axis marking intervals (small hashmarks) on the graph [where NXT = NXE - NXS must initially be ≤ 36 (Note: similarly, NYT must initially be ≤ 27), otherwise, DEX (and/or DEY) must be increased].

[The following five parameters, including XLL and XUL, have significance only when the x- (or y-) coordinate axis is presented on a log scale.]

IXLL : Exponent of the lowest value of x (i.e., XLL) shown on the x-axis (with one figure to the left of the decimal).

IXUL : Exponent of the highest value of x (i.e., XUL) shown on the x-axis (with one figure to the left of the decimal).

NXC : Number of cycles on the x-axis [NCX must be ≦ 9 (Note: similarly, NYC must be ≦ 9)].

UX(I) : Array containing values of x printed along the x-axis.

SX(I) : Array containing character locations (columns, 1-40) of the first digit in the corresponding UX(I) [Note: similarly, SY(I) contains locations of rows (1-24) for values stored in corresponding UY(I)].

This option also provides, for each data set, a table containing some or all of the points that fall on each "best polynomial/best fit" curve (as shown on your monitor screen, in both units of the data x, P[X(x)] and units of the monitor XPI,YPI), the derivative at each point, and the integral from the point on the curve just below XMIN up to each point, where each total integral covers the entire data range for all sets analyzed (up to just above XMAX). For Basis Function # 1, X(x) = x + CS1, PLOTnFIT analytically calculates the derivative and integral and presents the coefficients of two new polynomials, one for the derivative and the other for the integral, should you want to plot them at a later time. For all other Basis Functions, PLOTnFIT analytically calculates the derivative, but numerically calculates the integral; the last column (IT) shows the number of intervals, between successive points on the curve as shown on your monitor screen, used in a simple "trapezoidal rule" algorithm. Differences between analytical and numerical integrations, by PLOTnFIT, of the same function tend to be less than 0.1 percent. (IT is zero for Basis Function # 1.)

(5) For illustration you may choose to make a plot of a polynomial with any Basis Function from the list provided specifying all coefficients for presentation on the graph described under option 3; this plot is to be for comparison purposes only and appears as a dashed curve.

PLOTnFIT can also be directed to send data OUTPUT to a disk file for later use. Since entering coordinate data is the tedious aspect of using PLOTnFIT, it is recommended that you save all the data you analyze on the chance that you may want to reanalyze it at a later time. PLOTnFIT prepares a default "filename" for data you want to save; the name itself provides a convenient method for keeping track of the number of data sets in the file, as well as a clue as to what job first analyzed the data and when it did so. The default "filename" format used by PLOTnFIT is as follows:

AAAMMYY#.ZZZ

AAA : The first three characters from Job Identification.
MMYY : The month (MM) and year (YY) the file was made.
: The number of data sets in the file, ndsf.
ZZZ : The last three characters from Job Identification.

You, of course, have the option of choosing some other "filename" if you like.

3 REFERENCES

1. William G. Hood, "Polynomial Curve Fitter," Byte, p. 155, June 1987.

2. Hugh D. Young, Statistical Treatment of Experimental Data, McGraw-Hill Book Company, Inc., New York, 1962.

3. William H. Press et al., Numerical Recipes: The Art of Scientific Computing, Cambridge University Press, Cambridge, MA, 1986.

APPENDIX A

SAMPLE PROBLEM

SAMPLE PROBLEM

As a sample problem, to give you an idea of how PLOTNFIT.4TH can be used, we present a three-part analysis of some Charpy data. These real data are taken to be from a fictitious company identified by the acronym RC-2. We will assume that the company claims an uncertainty for its Charpy energy measurements of + or - 5 ft-lb. It should be noted that, for regulatory purposes, the NRC staff is not recommending the specific procedure followed here for the analysis of Charpy data nor does it suggest or imply that this sample problem should be used as a model analysis for such purposes.

Part 1. To get a feel for the data given below, we will fit curves to them, using Basis Function # 1, X(x) = CS1 + x, with CS1 = 0, for polynomial degrees n = 1 through 6:

Data Point (#)	Temperature (deg F)	Charpy Energy (ft-lb)
1	-19.0	25.0
2	-16.5	17.0
3	8.5	21.5
4	11.5	18.0
5	35.5	21.5
6	46.0	30.5
7	54.0	19.0
8	72.0	40.5
9	80.0	28.5
10	98.0	41.5
11	98.0	46.0
12	109.5	55.5
13	122.0	64.5
14	136.5	58.0
15	150.0	65.0
16	162.5	66.5
17	191.5	64.5
18	207.5	68.5

Part 2. To get rid of the negative values of the independent variable and decrease its magnitude, we modify the data by converting the temperature units to the Rankine scale (i.e., deg R = deg F + 459.67 deg F) and normalize (i.e., Normalized Temperature = deg R/459.67 deg F), as shown below:

Data Point (#)	Normalized Temperature (R/459.67 F)	Charpy Energy (ft-lb)
1	0.9587	25.0
2	0.9641	17.0
3	1.0185	21.5
4	1.0250	18.0

Data Point (#)	Normalized Temperature (R/459.67 F)	Charpy Energy (ft-lb)
5	1.0772	21.5
6	1.1001	30.5
7	1.1175	19.0
8	1.1566	40.5
9	1.1740	28.5
10	1.2132	41.5
11	1.2132	46.0
12	1.2382	55.5
13	1.2654	64.5
14	1.2970	58.0
15	1.3263	65.0
16	1.3535	66.5
17	1.4166	64.5
18	1.4514	68.5

We will then fit curves to the modified data a) using the Basis Function # 1, $X_a(x) = CS1 + x$, with CS1 = 0, for polynomial degrees n = 3 through 5, and b) using the Basis Function # 6, $X_b(x) = CS1 \cdot EXP(CO1 \cdot x^{CD1}) + CE1 \cdot EXP(CF1 \cdot x^{CG1})$, with CS1 = 0, CO1 = 0, CD1 = 0, and CE1 = 1, for polynomials of degree n = 1, while varying the parameters CF1 and CG1 so as to match the value of $P[X_a(x)]$ at the inflection point x_{ip} [i.e., we arbitrarily chose the point where $dP[X(x)]/dx$ is maximum as a "pinning point" for the purpose of comparing curves; $P[X_a(x_{ip})] = P[X_b(x_{ip})]$] and approximate the shape of the data. The reason we chose to continue our analysis with the function $X_b(x)$, Basis Function # 6, is that either term in the sum can be used to produce a monotonic transition curve, of essentially any desired slope, between two plateaus, which from experience we know is characteristic of Charpy energy versus temperature data. Finally, c) we will refine the results obtained in b).

Part 3. a) To check the sensitivity of the results of Part 2.c) to the specific values of parameters used in the Basis Function, we will repeat the process of curve fitting using the Basis Function of Part 2.b) with the same values for the parameters CS1, CO1, CD1, and CE1, while varying CF1 and CG1 around the values that gave the best fit in Part 2.c). b) We will make a final plot of the data with the "best polynomial/best fit" curve from Part 3.a), considering higher order polynomials, and compare the results with the "best polynomial/best fit" from Part 2.a).

Part 1 INPUT

Remember, when you see no apparent response to a prompt, it is because the ENTER key was used to enter a negative response or accept the default. In this part of the analysis, we will fit polynomials of degree n = 1 through 6, with Basis Function # 1, to the data. At this time we want to produce the minimum printed OUTPUT. We will enter the uncertainties (sigma)$_i$ later.

```
LOAD"a:plotnfit.rec
O
RUN
                        PLOTnFIT  /  NUREG - ####

   PLOTnFIT was prepared for an agency of United States Government.
   Neither the United States Government nor any agency thereof, nor any of
   their employees, makes any warranty, expressed or implied, or assumes
   any legal liability or responsibility for any third party's use, or
   the results of such use, of any protion of this program or represents
   that its use by such third party would not infringe privately owned
   rights.

      This version of PLOTnFIT (i.e., PLOTNFIT.4TH) will not run
      properly on a PC with a monochrome monitor.  If this PC does
      not have a color/graphics card or this is not a color monitor,
      type yes or y at the EXIT (y/n)? prompt, otherwise type no or n
      and continue (NOTE: If GRAPHICS.COM was not loaded before
      BASICA.COM, HARD COPIES of graphs can not be made.  Now is the
      time to EXIT this job and reload if it is desirable to print
      graphs and GRAPHICS.COM has not been pre-loaded.).
      THE PRINTER MUST BE KEPT ON WHILE PLOTNFIT IS OPERATING.

   EXIT (y/n)?

   Number of Bits not being used at the START of this job = 10486

   For default purposes, what Disk Drive (e.g., A:) would you most likely
   want to WRITE to (include subdirectory if applicable - e.g., C:\SUBDIR\)
? A:

          ****************************************************
          *                                                  *
          *                    PLOTnFIT                      *
          *                                                  *
          *     A US NRC Program for Plotting and Analyzing  *
          *     (i.e., Curve Fitting) Data Interactively     *
          *     with an IBM or IBM Compatible Personal       *
          *     Computer (PC) (using DOS 2.1 and BASICA 3.0) *
          *                                                  *
          *                    May 1989                      *
          *                                                  *
          ****************************************************

 IF YOU ARE `NOT' ALREADY FAMILIAR WITH THIS PROGRAM, you should probably
 ENTER yes at the `EXIT (y/n)?' prompt, and run the program `READ1ST.PNF'.

   Exit (y/n)?


 Identify your job (INITIAL ANALYSIS):
     FORMAT - a string of less than 18 characters (where BASIC
     filename rules apply to first 3 and last 3 characters) -

 Describe your job (This analysis is to get a `feel' for the data.):
     FORMAT - a `comma-less' string of less than 256 characters -
```

PLOTTING INSTRUCTIONS

```
What kind of graphs would you like to generate:
     1. LINEAR
     2. SEMI-LOG (Y-axis,LOG; X-axis,LINEAR)
     3. LOG-LOG
NT(= 1 )=

     What palette do you want:
          FOR NP=1   FOR NP=2        FOR NOP=1               FOR NOP=2
          GREEN       MAGENTA        'CURVES'                'CURVES'
          RED         CYAN           'DATA POINTS'           'DATA FIELD'
          BROWN       WHITE          'AXES AND LABELS'       'DATA POINTS,AXES,
                                                              AND LABELS'
     NP(= 1 )=

          Regardless of the NOP value you enter here, if you later
          choose to make HARD COPIES of the data and curves plotted
          on the screen, PLOTnFIT will automatically make NOP=1.
     NOP(= 2 )=

     What background color do you want:
          1. BLACK
          2. GRAY
          3. LIGHT BLUE
          4. WHITE
          5. LIGHT CYAN
          6. LIGHT MAGENTA
     NQ(= 2 )= 4

Would you like graph labels different from those shown in ()?
     (TITLE )               - 30 characters maximum -    (y/n):
     (X-AXIS) Horizontal - 22 characters maximum -    (y/n):
     (units ) for x-axis -  5 characters maximum -    (y/n):
     (Y-AXIS) Vertical   - 16 characters maximum -    (y/n):
     (units ) for y-axis -  5 characters maximum -    (y/n):

What scaling procedure (NS) would you like to use?
     1. SPECIFY COORDINATE RANGES AND MARKING INTERVALS FOR
        THE AXES (USE ONLY AFTER EXPERIENCE WITH 'PLOTnFIT')
     2. ALLOW 'PLOTnFIT' TO ESTABLISH COORDINATE RANGES AND
        MARKING INTERVALS BASED ON THE DATA RANGES
NS(= 2 )=

                    DATA AND DATA IDENTIFICATION

How many Tasks will there be in this job (1<=NDS<=8)? NDS(= 1 )=

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 1 ?
          1. The KEYBOARD
          2. A STORED FILE
     NE(= 1 )=

     What identification name would you like for the Data in Task # 1 ?
          FORMAT - a string of less than 31 char. - CHARPY DATA from CRC-2

     The number of Data Points is NDP( 1 )= 18

          Is the data to be weighted (y/n)?
 1             x, and y =-19.0,25.0
 2             x, and y =-16.5,17.0
 3             x, and y =8.5,21.5
 4             x, and y =11.5,18.0
 5             x, and y =35.5,21.5
```

```
 6            x, and y =46.0,30.5
 7            x, and y =54.0,19.0
 8            x, and y =72.040.5
?Redo from start
        x, and y =72.0,40.5
 9            x, and y =80.0,28.5
 10            x, and y =98.0,41.5
 11            x, and y =98.0,46.0
 12            x, and y =109.5.55.5
?Redo from start
        x, and y =1019.5,55.5
 13            x, and y =122.0,64.5
 14            x, and y =136.5,58.0
 15            x, and y =150.0,65.0
 16            x, and y =162.5,6645
 17            x, and y =191.5,64.5
 18            x, and y =207.5,68.5

     Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

   1.  X(x)=CS1+x
   2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
   3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
   4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
   5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
   6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
   7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
   8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
   9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
  10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
  11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 1 )=
      CS1(= 0 )=
            For each Data Set in the job, the program starts with
            the lowest degree polynomial you want to consider and
            fits it to the data points; the program then fits,
            sequentially and in assending order, as many higher
            degree polynomials as you specify (the current degree
            limit is 10).

      What is the lowest degree polynomial (LDP) you want to consider
      for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

      How many polynomial fits (NPF) do you want to
      try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)= 6

           What symbol (M) would you like to use to represent
           the Data for Task # 1 ?
                1.   I                          5. DIAMOND
                2. CROSS                        6. TRIANGLE - UP
                3.   X                          7. TRIANGLE - DOWN
                4.   H                          8. SQUARE
           M(= 1 )=

           What symbol size (MM) would you like?
                1. small
                2. LARGE
           MM(= 1 )=
```

ALL PLOTTING INSTRUCTIONS AND DATA HAVE BEEN ENTERED

Would you like to make changes in your Plotting Instructions; values currently in the computer appear in parenthesis (y/n)?

Would you like to make a few changes in one or more of your Data Sets [most useful when most data are from the KEYBOARD] (y/n)? y

YOU MUST STORE YOUR DATA - END THE JOB - THEN CHANGE THE DATA WHEN THEY ARE READ INTO A NEW JOB

How many Data Sets will you save (0<=DSS<= 1)? DSS=1

Do you want other than the default Location and Name for the FILE containing these (weighted) coordinate data (A:INI06891.SIS) (y/n)?

Do you want to save data from Task # 1 (y/n)? y

Number of Bits not being used at the END of this job = 0

Do you want to do another job and plot other graphs using ALL or SOME of the data and/or instructions in memory (y/n)?

y

Identify your job (INITIAL ANALYSIS):
FORMAT - a string of less than 18 characters (where BASIC filename rules apply to first 3 and last 3 characters) -

Describe your job (This analysis is to get a 'feel' for the data.):
FORMAT - a 'comma-less' string of less than 256 characters -

PLOTTING INSTRUCTIONS

What kind of graphs would you like to generate:
1. LINEAR
2. SEMI-LOG (Y-axis,LOG; X-axis,LINEAR)
3. LOG-LOG

NT(= 1)=

What palette do you want:

FOR NP=1	FOR NP=2	FOR NOP=1	FOR NOP=2
GREEN	MAGENTA	'CURVES'	'CURVES'
RED	CYAN	'DATA POINTS'	'DATA FIELD'
BROWN	WHITE	'AXES AND LABELS'	'DATA POINTS,AXES, AND LABELS'

NP(= 1)=

Regardless of the NOP value you enter here, if you later choose to make HARD COPIES of the data and curves plotted on the screen, PLOTnFIT will automatically make NOP=1.

NOP(= 2)=

What background color do you want:
1. BLACK
2. GRAY
3. LIGHT BLUE
4. WHITE
5. LIGHT CYAN
6. LIGHT MAGENTA

NQ(= 2)= 4

```
Would you like graph labels different from those shown in ()?
     TITLE                                   (TITLE )(y/n): y
What is your choice? DETERMINATION of RTndt
     X-AXIS                                  (X-AXIS)(y/n): y
What is your choice? Temperature
     units                                   (units )(y/n): y
What is your choice? deg F
     Y-AXIS                                  (Y-AXIS)(y/n): y
What is your choice? Charpy Energy
     units                                   (units )(y/n): y
What is your choice? ft-lb

What scaling procedure (NS) would you like to use?
     1. SPECIFY COORDINATE RANGES AND MARKING INTERVALS FOR
        THE AXES (USE ONLY AFTER EXPERIENCE WITH 'PLOTnFIT')
     2. ALLOW 'PLOTnFIT' TO ESTABLISH COORDINATE RANGES AND
        MARKING INTERVALS BASED ON THE DATA RANGES
NS(= 2 )=
```

DATA AND DATA IDENTIFICATION

```
How many Tasks will there be in this job (1<=NDS<=8)? NDS(= 1 )=

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 1 ?
          1. The KEYBOARD
          2. A STORED FILE
     NE(= 1 )= 2

     What is the location and name of the FILE containing Data for Task # 1 ?
          FORMAT - (storage)device:filename - a:ini06891.sis

     How many Data Sets are in this FILE?
          NDSF(= 1 )=


     Do you want to INPUT Data Set # 1 from FILE a:ini06891.sis
     [i.e., that identified as : CHARPY DATA from RC-2;
     with (NDP=) 18 data points] (y/n)? y

     Do you want to INPUT the stored weighting factors (y/n)?

     Do you want to change ANY data in this Data Set (y/n)? y

     Do you want to change ONLY weighting factors (y/n)?

     What identification name would you like for this Data in Task # 1
     (FOR EACH VARIABLE, PRESS ENTER FOR NO CHANGE)?
          FORMAT - a string of less than 31 chr. -

     Do you want to change the number of Data Points, NDP (y/n)?
i= 1          x=-19          y= 25 Change (y/n)?
i= 2          x=-16.5        y= 17 Change (y/n)?
i= 3          x= 8.5         y= 21.5 Change (y/n)?
i= 4          x= 11.5        y= 18 Change (y/n)?
i= 5          x= 35.5        y= 21.5 Change (y/n)?
i= 6          x= 46          y= 30.5 Change (y/n)?
i= 7          x= 54          y= 19 Change (y/n)?
i= 8          x= 72          y= 40.5 Change (y/n)?
i= 9          x= 80          y= 28.5 Change (y/n)?
i= 10         x= 98          y= 41.5 Change (y/n)?
i= 11         x= 98          y= 46 Change (y/n)?
i= 12         x= 109.5       y= 55.5 Change (y/n)?
i= 13         x= 122         y= 64.5 Change (y/n)?
i= 14         x= 136.5       y= 58 Change (y/n)?
i= 15         x= 150         y= 65 Change (y/n)?
i= 16         x= 162.5       y= 665 Change (y/n)? y
```

```
  Delete (y/n)?
      x, y =162.5,66.5
i= 17           x= 181.5        y= 64.5 Change (y/n)?
i= 18           x= 207.5        y= 68.5 Change (y/n)?
```

Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

```
 1.  X(x)=CS1+x
 2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
 3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
 4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
 5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
 6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
 7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
 8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
 9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)
```

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

```
  BF(= 1 )=
      CS1(= 0 )=
```

For each Data Set in the job, the program starts with the lowest degree polynomial you want to consider and fits it to the data points; the program then fits, sequentially and in assending order, as many higher degree polynomials as you specify (the current degree limit is 10).

What is the lowest degree polynomial (LDP) you want to consider for this Data Set (1 <= LDP <= 10)? LDP(=1)=

How many polynomial fits (NPF) do you want to try - including the LDP - (1 <= NPF <= 10)? NPF(=1)= 6

What symbol (M) would you like to use to represent the Data for Task # 1 ?

```
     1.   I                          5. DIAMOND
     2. CROSS                        6. TRIANGLE - UP
     3.   X                          7. TRIANGLE - DOWN
     4.   H                          8. SQUARE
M(= 1 )=
```

What symbol size (MM) would you like?

```
     1. small
     2. LARGE
MM(= 1 )=
```

ALL PLOTTING INSTRUCTIONS AND DATA HAVE BEEN ENTERED

Would you like to make changes in your Plotting Instructions; values currently in the computer appear in parenthesis (y/n)?

Would you like to make a few changes in one or more of your Data Sets [most useful when most data are from the KEYBOARD] (y/n)?

Would you like to completely RE-INPUT your Coordinate Data [most useful when most data are from STORED FILES] (y/n)?

Number of Bits not being used at this time, for this job = 3110

Would you like to PRINT values of the Polynomial Coefficients for all the curves fit to each Data Set, along with the corresponding Residual Variances and Coefficients of Determination (y/n)?

Would you like to make HARD COPIES of graphs of ALL the Data Sets, one set of graphs for each Data Set, showing ALL the polynomial curves fit to EACH Data Set (y/n)?

Would you like to make 'a' HARD COPY graph containing ALL the Data Sets, each Data Set with it's corresponding 'BEST POLYNOMIAL/BEST FIT' curve (y/n)? y

Would you like to PRINT values of key program variables and a Table of some of the points which fall on each 'BEST POLYNOMIAL/BEST FIT' curve plotted (y/n)?

Would you like to INPUT a function to be plotted with your data (y/n)?

Would you like to save your DATA for later use (y/n)? y

How many Data Sets will you save (0<=DSS<= 1)? DSS=1

Do you want other than the default Location and Name for the FILE containing these (weighted) coordinate data (A:INI06891.SIS) (y/n)?

Do you want to save data from Task # 1 (y/n)? y

Part 1 Comments on INPUT

1. On page A-4, we neglected to enter the proper graph labels but "went back" to do so later, as shown on page A-7.

2. Note, as shown on page A-4, when INPUT format errors are made on entering data, BASIC asks you to "? Redo from start," then repeats the prompt.

3. As mentioned above, we "went back" to enter graph labels, but since we made an error when entering data (see data point 16, on page A-5) and needed to correct it, there was no need to "go back" just to change plotting instructions (see page A-6), since when you go to correct data you automatically have the opportunity to change plotting instructions (see pages A-7 and A-8).

Part 1 OUTPUT

SUMMARY OF TASK # 1

This task investigated Polynomials of degree 1 through 6 fit to the Data Set, CHARPY DATA from RC-2, using the BASIS FUNCTION: X(x) = 0 + x

The polynomial of degree 3 produces the largest fractional decrease in RV (note, its RV = 30.06752), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? n

What degree polynomial do you think best represents this Data Set?

n = 5 ,   RV = 30.58583

JOB: INITIAL ANALYSIS--06/26/89

time - 17:04:44

JOB DESCRIPTION

This analysis is to get a 'feel' for the data

EACH CURVE IS A 'BEST FIT' WITH AN nth DEGREE POLYNOMIAL

P[X(x)] = C(1)X(x)^n + C(2)X(x)^(n-1) + ... + C(n)X(x) + C(n+1)

PLOTTING INSTRUCTIONS

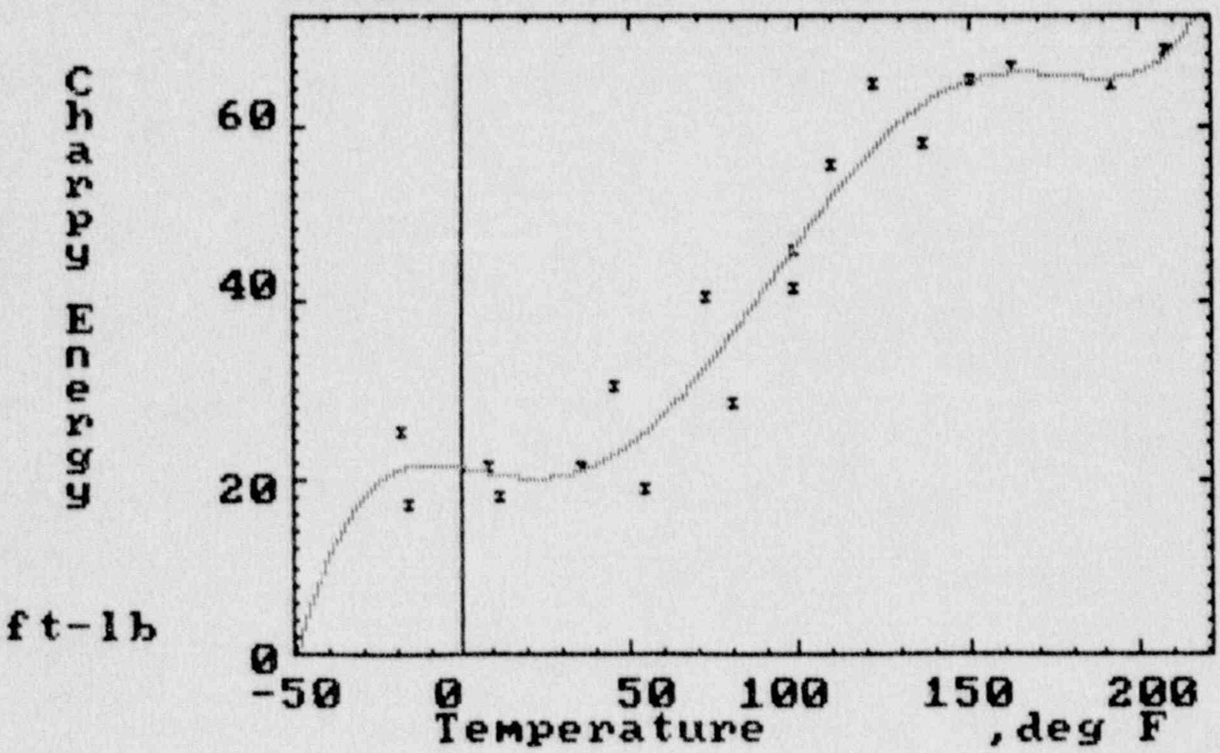
Generate (color) MEDIUM resolution, LINEAR graphs with
PLOTnFIT DETERMINED COORDINATE RANGES AND MARKING INTERVALS

***** DATA *****

TASK#	IDENTIFICATION	n	SYMBOL	NDP	SOURCE
1*	CHARPY DATA from RC-2	5	small I	18	FILE ini06891.sis

* These DATA SETS were OUTPUT to file A:INI06891.SIS.

DETERMINATION of RTndt



Part 1 Comments on OUTPUT

1. PLOTnFIT suggests that degree n = 3 produces the "best polynomial/best fit" curve (see page A-11). We chose the polynomial of degree n = 5, although it produces a slightly "less good" fit (RV = 30.59 compared with 30.07), since, within the data range, it suggests the existence of plateaus or shelves (i.e., "lower shelf" and "upper shelf" energies), which from experience we know are associated with such data (see page A-12).

2. If our model is at all close to the true model, the company's claim of + or - 5 ft-lb data uncertainty is not unreasonable (i.e., the square root of RV is about 5.5).

3. The job summary page, A-12, shows that the data came from file INI06891.SIS rather than from the keyboard. The reason for this is that after initial data entry, the data were saved in this file then re-entered for correction before the job was completed. Note also that the corrected data were saved under the same "filename."

Part 2.a) INPUT

We will enter the data directly from the keyboard - although we could have, perhaps just as easily, entered the data by reading in data saved from Part 1 (i.e., the data in file INI06891.SIS) and then changed the x-coordinates and entered the weighting factor (w_i) [i.e., $1/(\text{sigma})_i^2 = 1/5^2 = 0.04$ for all points]. From Part 1 OUTPUT, the polynomial of degree n = 5, with Basis Function # 1, was taken as the "best polynomial/best fit." In this part of the analysis, we will fit polynomials of degrees 3 through 6, with Basis Function # 1, to the data and increase the amount of OUTPUT, since we not only want the polynomial coefficients for later use (i.e., for making comparative plots), but we also want a table of all the values plotted so that we can estimate the "lower shelf" and "upper shelf" energies (in a generally definable way) and identify the inflection point accurately for use in Part 2.b) (although there is actually nothing sacred about the inflection point for curve-fitting purposes).

```
    RUN
                              PLOTnFIT  /  NUREG - ####

     PLOTnFIT was prepared for an agency of United States Government.
     Neither the United States Government nor any agency thereof, nor any of
     their employees, makes any warranty, expressed or implied, or assumes
     any legal liability or responsibility for any third party's use, or
     the results of such use, of any protion of this program or represents
     that its use by such third party would not infringe privately owned
     rights.

          This version of PLOTnFIT (i.e., PLOTNFIT.4TH) will not run
          properly on a PC with a monochrome monitor.  If this PC does
          not have a color/graphics card or this is not a color monitor,
          type yes or y at the EXIT (y/n)? prompt, otherwise type no or n
          and continue (NOTE: If GRAPHICS.COM was not loaded before
          BASICA.COM, HARD COPIES of graphs can not be made.  Now is the
          time to EXIT this job and reload if it is desirable to print
          graphs and GRAPHICS.COM has not been pre-loaded.).
          THE PRINTER MUST BE KEPT ON WHILE PLOTNFIT IS OPERATING.

     EXIT (y/n)?

     Number of Bits not being used at the START of this job = 10486

     For default purposes, what Disk Drive (e.g., A:) would you most likely
     want to WRITE to (include subdirectory if applicable - e.g., C:\SUBDIR\)
 ? A:

          ****************************************************
          *                                                  *
          *                    PLOTnFIT                      *
          *                                                  *
          *    A US NRC Program for Plotting and Analyzing   *
          *    (i.e., Curve Fitting) Data Interactively      *
          *    with an IBM or IBM Compatible Personal        *
          *    Computer (PC) (using DOS 2.1 and BASICA 3.0)  *
          *                                                  *
          *                    May 1989                      *
          *                                                  *
          ****************************************************

   IF YOU ARE 'NOT' ALREADY FAMILIAR WITH THIS PROGRAM, you should probably
   ENTER yes at the 'EXIT (y/n)?' prompt, and run the program 'READ1ST.PNF'.

     Exit (y/n)?
```

```
Identify your job (INITIAL ANALYSIS):
     FORMAT - a string of less than 18 characters (where BASIC
     filename rules apply to first 3 and last 3 characters) - FOLLOWUP ANALYSIS

Describe your job (This analysis is to get a 'feel' for the data.):
     FORMAT - a 'comma-less' string of less than 256 characters -
This is a follow-up to job 'INITIAL ANALYSIS--06/26/89.' This analysis will use the dat
be expressed in normalized Rankine units - R/459.67F).


                          PLOTTING INSTRUCTIONS

What kind of graphs would you like to generate:
     1. LINEAR
     2. SEMI-LOG (Y-axis,LOG; X-axis,LINEAR)
     3. LOG-LOG
NT(= 1 )=

     What palette do you want:
          FOR NP=1    FOR NP=2        FOR NOP=1              FOR NOP=2
          GREEN        MAGENTA        'CURVES'               'CURVES'
          RED          CYAN           'DATA POINTS'          'DATA FIELD'
          BROWN        WHITE          'AXES AND LABELS'      'DATA POINTS,AXES,
                                                                AND LABELS'
     NP(= 1 )= 3
The value(s) INPUT for this (these) variable(s) is (are) not
within an allowable range. Try again, please.
     NP(= 1 )= 2

          Regardless of the NOP value you enter here, if you later
          choose to make HARD COPIES of the data and curves plotted
          on the screen, PLOTnFIT will automatically make NOP=1.
     NOP(= 2 )=

     What background color do you want:
          1. BLACK
          2. GRAY
          3. LIGHT BLUE
          4. BROWN
          5. YELLOW
          6. LIGHT GREEN
     NQ(= 3 )= 4


Would you like graph labels different from those shown in ()?
     (TITLE )              - 30 characters maximum -    (y/n): y
What is your choice? DETERMINATION of RTndt
     (X-AXIS) Horizontal - 22 characters maximum -    (y/n): y
What is your choice? Normalized Temperature
     (units ) for x-axis -  5 characters maximum -    (y/n): y
What is your choice? R/460
     (Y-AXIS) Vertical    - 16 characters maximum -    (y/n): y
What is your choice? Charpy Energy
     (units ) for y-axis -  5 characters maximum -    (y/n): y
What is your choice? ft-lb

What scaling procedure (NS) would you like to use?
     1. SPECIFY COORDINATE RANGES AND MARKING INTERVALS FOR
        THE AXES (USE ONLY AFTER EXPERIENCE WITH 'PLOTnFIT')
     2. ALLOW 'PLOTnFIT' TO ESTABLISH COORDINATE RANGES AND
        MARKING INTERVALS BASED ON THE DATA RANGES
NS(= 2 )=
```

DATA AND DATA IDENTIFICATION

```
How many Tasks will there be in this job (1<=NDS<=8)? NDS(= 1 )=

      What INPUT device (NE) would you like to use to
      enter your Data for Task # 1 ?
           1. The KEYBOARD
           2. A STORED FILE
      NE(= 1 )=

      What identification name would you like for the Data in Task # 1 ?
           FORMAT - a string of less than 31 char. - Mod. CHARPY DATA from RC-2

      The number of Data Points is NDP( 1 )= 18

           Is the data to be weighted (y/n)? y
 1        x, y, and w =.9587,25.0,0.04
 2        x, y, and w =96.9641,17.0,0.04
 3        x, y, and w =1.0185,21.5,0.04
 4        x, y, and w =1.0250,18.0,0.04
 5        x, y, and w =1.0772,21.5,0.04
 6        x, y, and w =1.1001,30.5,0.04
 7        x, y, and w =1.1175,19.0,0.04
 8        x, y, and w =1.1566,40.5,0.04
 9        x, y, and w =1.1740,28.5,0.04
 10       x, y, and w =1.2132,41.5,0.04
 11       x, y, and w =1.2132,46.0,0.04
 12       x, y, and w =1.2382,55.5,0.04
 13       x, y, and w =1.2654,64.5,0.04
 14       x, y, and w =1.2970,58.0,0.04
 15       x, y, and w =1.3263,65.0,0.04
 16       x, y, and w =1.3535,66.5,0.04
 17       x, y, and w =1.4166,64.5,0.04
 18       x, y, and w =1.4514,68.5,0.04

      Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

   BF(= 1 )=
      CS1(= 0 )=

           For each Data Set in the job, the program starts with
           the lowest degree polynomial you want to consider and
           fits it to the data points; the program then fits,
           sequentially and in assending order, as many higher
           degree polynomials as you specify (the current degree
           limit is 10).

      What is the lowest degree polynomial (LDP) you want to consider
      for this Data Set (1 <= LDP <= 10 )?  LDP(=1)= 3
```

How many polynomial fits (NPF) do you want to
try - including the LDP - (1 <= NPF <= 8)? NPF(=1)= 3

What symbol (M) would you like to use to represent
the Data for Task # 1 ?

1. I	5. DIAMOND
2. CROSS	6. TRIANGLE - UP
3. X	7. TRIANGLE - DOWN
4. H	8. SQUARE

M(= 1)= 2

What symbol size (MM) would you like?
1. small
2. LARGE

MM(= 1)=

ALL PLOTTING INSTRUCTIONS AND DATA HAVE BEEN ENTERED

Would you like to make changes in your Plotting Instructions;
values currently in the computer appear in parenthesis (y/n)?

Would you like to make a few changes in one or more of your Data
Sets [most useful when most data are from the KEYBOARD] (y/n)?

Would you like to completely RE-INPUT your Coordinate Data
[most useful when most data are from STORED FILES] (y/n)?

Number of Bits not being used at this time, for this job = 3184

Would you like to PRINT values of the Polynomial
Coefficients for all the curves fit to each Data Set,
along with the corresponding Residual Variances and
Coefficients of Determination (y/n)? y

Would you like to make HARD COPIES of graphs of ALL
the Data Sets, one set of graphs for each Data Set,
showing ALL the polynomial curves fit to EACH Data
Set (y/n)?

Would you like to make 'a' HARD COPY graph containing
ALL the Data Sets, each Data Set with it's corresponding
'BEST POLYNOMIAL/BEST FIT' curve (y/n)? y

Would you like to PRINT values of key program variables
and a Table of some of the points which fall on each
'BEST POLYNOMIAL/BEST FIT' curve plotted (y/n)? y

...a Table of 'all' the points (y/n)? y

Would you like to INPUT a function to be plotted
with your data (y/n)?

Would you like to save your DATA for later use (y/n)? y

How many Data Sets will you save (0<=DSS<= 1)? DSS=1

Do you want other than the default Location and Name
for the FILE containing these (weighted) coordinate data
(A:FOL06891.SIS) (y/n)?

Do you want to save data from Task # 1 (y/n)? y

Part 2.a) Comments on INPUT

1. Note the comment on page A-14, "Number of Bits not being used at the START of this job = 10486." To be confident that you have sufficient "available" computer memory for your jobs, you should keep this quantity larger than 10000.

2. Concerning "error traps" on INPUT variables with a specific range [e.g., NP(= 1) where 1 is the default value and the variable can only take values 1 or 2], if you enter a value outside the range [in this example, say NP(= 1) = 3], PLOTnFIT will reject the value and repeat the prompt, as shown on page A-15.

3. Note the comment on page A-17, "Number of Bits not being used at this time, for this job = 3184." If, after plotting instructions and data have been entered, the number of bits not being used drops below about 1000, you could encounter problems with exceeding available computer memory; this is most likely to occur when entering a second job without exiting PLOTnFIT after the first.

Part 2.a) OUTPUT

PLOTnFIT.4th

JOB: FOLLOWUP ANALYSIS-06/26/89

time - 17:29:03

THE FOLLOWING ARE DATA RESULTING FROM FITTING POLYNOMIALS
TO THE VARIOUS DATA SETS

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 3
BASIS FUNCTION: X(x) = 0 + x
Coefficient of Determination, CD = .934965
Residual Variance, RV = 1.202892

4 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-1800.705 C(2)= 6868.957 C(3)=-8071.413
C(4)= 3121.686

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	22.12012	2.879883	.04
2	.9641	17	21.39502	-4.39502	.04
3	1.0185	21.5	18.25342	3.246582	.04
4	1.025	18	18.33399	-.3339844	.04
5	1.0772	21.5	21.85523	-.3552246	.04
6	1.1001	30.5	24.7461	5.753907	.04
7	1.1175	19	27.36694	-8.366943	.04
8	1.1566	40.5	34.26392	6.236084	.04
9	1.174	28.5	37.64258	-9.142578	.04
10	1.2132	41.5	45.55127	-4.05127	.04
11	1.2132	46	45.55127	.4487305	.04
12	1.2382	55.5	50.55908	4.940918	.04
13	1.2654	64.5	55.7312	8.768799	.04
14	1.297	58	61.07959	-3.07959	.04
15	1.3263	65	65.10669	-.1060895	.04
16	1.3535	66.5	67.78516	-1.285156	.04
17	1.4166	64.5	68.77344	-4.273438	.04
18	1.4514	68.5	65.38428	3.115723	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 16.84049 .

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 4
BASIS FUNCTION: X(x) = 0 + x
Coefficient of Determination, CD = .935174
Residual Variance, RV = 1.29126

5 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)= 844.7538 C(2)=-5958.323 C(3)= 14127.81
C(4)=-13802.83 C(5)= 4806.809

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	22.43897	2.561035	.04
2	.9641	17	21.59277	-4.592774	.04
3	1.0185	21.5	17.85693	3.643067	.04
4	1.025	18	17.92627	7.373047E-02	.04
5	1.0772	21.5	21.60547	-.1054688	.04
6	1.1001	30.5	24.6377	5.862305	.04
7	1.1175	19	27.36768	-8.367676	.04
8	1.1566	40.5	34.46729	6.032715	.04
9	1.174	28.5	37.90283	-9.402832	.04
10	1.2132	41.5	45.82862	-4.328614	.04
11	1.2132	46	45.82862	.1713867	.04
12	1.2382	55.5	50.77051	4.729492	.04
13	1.2654	64.5	55.81006	8.689941	.04
14	1.297	58	60.95655	-2.956543	.04
15	1.3263	65	64.79053	.2094727	.04
16	1.3535	66.5	67.33594	-.8359375	.04
17	1.4166	64.5	68.52295	-4.022949	.04
18	1.4514	68.5	65.81495	2.685059	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 16.78637 .

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 5
BASIS FUNCTION: X(x) = 0 + x
Coefficient of Determination, CD = .943212
Residual Variance, RV = 1.225407

6 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)= 43618.66 C(2)=-261180.2 C(3)= 620427.2
C(4)=-730689.8 C(5)= 426694.9 C(6)=-98849.59

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.83594	4.164063	.04
2	.9641	17	21.14844	-4.148438	.04
3	1.0185	21.5	20.46094	1.039063	.04
4	1.025	18	20.26563	-2.265625	.04
5	1.0772	21.5	20.90625	.59375	.04
6	1.1001	30.5	22.96094	7.539063	.04
7	1.1175	19	25.29688	-6.296875	.04
8	1.1566	40.5	32.69531	7.804688	.04
9	1.174	28.5	36.6875	-8.1875	.04
10	1.2132	41.5	46.14844	-4.648438	.04
11	1.2132	46	46.14844	-.1484375	.04
12	1.2382	55.5	51.97657	3.523438	.04
13	1.2654	64.5	57.59375	6.90625	.04
14	1.297	58	62.34375	-4.34375	.04
15	1.3263	65	64.90625	.09375	.04
16	1.3535	66.5	65.66406	.8359375	.04
17	1.4166	64.5	65.07813	-.578125	.04
18	1.4514	68.5	67.85156	.6484375	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.70488 .

SUMMARY OF TASK # 1

This task investigated Polynomials of degree 3 through 5 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the BASIS FUNCTION: X(x) = 0 + x

The polynomial of degree 3 produces the largest fractional decrease in RV (note, its RV = 1.202892), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? ? n
n

What degree polynomial do you think best represents this Data Set?

? n = 5 , RV = 1.225407

PLOTnFIT.4th

JOB: FOLLOWUP ANALYSIS-06/26/89

time - 17:32:41

KEY PROGRAM PARAMETERS AND OUTPUT DATA

TNDP= 18

XMIN= .9587		XMAX= 1.4514		DEX= .02
YMIN= 17		YMAX= 68.5		DEY= 2
LJX= 10		LIX= 4		CX= 80
LJY= 10		LIY= 4		CY= 40
XS= 75		XE= 315		XO=-207
YS= 12		YE= 162		YO= 162
NXS= 40		NXE= 74		NXT= 34
NYS= 0		NYE= 36		NYT= 36
IYLL= 0	IYUL= 0	NYC= 0	YLL= 0	YUL= 0
IXLL= 0	IXUL= 0	NXC= 0	XLL= 0	XUL= 0
I= 0	UX= .8	SX= 9	UY= 0	SY= 21
I= 1	UX= 1	SX= 18	UY= 20	SY= 16
I= 2	UX= 1.2	SX= 27	UY= 40	SY= 10
I= 3	UX= 1.4	SX= 35	UY= 60	SY= 5
I= 4	UX= 1.6	SX= 0	UY= 80	SY= 0

TASK # 1
Every Point On The Best Polynomial Curve
Best Fit To 'Mod. CHARPY DATA from RC-2':

Coefficients of the Derivative:

C(1)= 218093.3	C(2)=-1044721	C(3)= 1861282
C(4)=-1461380	C(5)= 426694.9	C(6)= 0

Coefficients of the Integral:

C(1)= 7269.777	C(2)=-52236.05	C(3)= 155106.8
C(4)=-243563.3	C(5)= 213347.4	C(6)=-98849.59

XPI	x	P[X(x)]	YPI	dP[X(x)]/dx	Int P[X(x)]dx	IT
75	.799	-166.2031	508	3287.969	0	0
76	.8018334	-157.0313	489	3167.906	0	0
77	.8046667	-148.25	470	3050.813	0	0
78	.8075	-139.7578	453	2936.813	0	0
79	.8103334	-131.5938	436	2825.719	0	0
80	.8131667	-123.7422	419	2717.531	0	0
81	.8160001	-116.1875	404	2612.219	0	0
82	.8188334	-108.9375	388	2509.688	0	0
83	.8216667	-101.9688	374	2409.938	0	0
84	.8245	-95.3125	360	2312.938	0	0
85	.8273333	-88.875	347	2218.594	0	0
86	.8301667	-82.71875	334	2126.906	0	0
87	.833	-76.82813	322	2037.688	0	0
88	.8358334	-71.14844	310	1951.188	0	0
89	.8386667	-65.75	298	1867.031	0	0
90	.8415001	-60.59375	288	1785.406	0	0
91	.8443334	-55.65625	277	1706.188	0	0
92	.8471667	-50.89063	268	1629.406	0	0
93	.85	-46.35938	258	1554.906	0	0
94	.8528334	-42.10157	249	1482.656	0	0
95	.8556667	-37.97656	241	1412.719	0	0
96	.8585	-34.09375	233	1345	0	0
97	.8613334	-30.35156	225	1279.375	0	0
98	.8641667	-26.8125	217	1215.969	0	0
99	.8670001	-23.45313	210	1154.531	0	0
100	.8698334	-20.29688	204	1095.219	0	0
101	.8726667	-17.28125	198	1037.969	0	0
102	.8755	-14.39844	191	982.6875	0	0
103	.8783334	-11.69531	186	929.2188	0	0
104	.8811667	-9.125	181	877.75	0	0
105	.8840001	-6.726563	176	828.0313	0	0
106	.8868334	-4.421875	171	780.2188	0	0
107	.8896667	-2.289063	166	734.1563	0	0
108	.8925001	-.28125	16[illegible]	689.7813	0	0
109	.8953334	1.617188	15[illegible]	647.2188	0	0
110	.8981667	3.367188	155	606.25	0	0
111	.901	5.0625	152	566.9375	0	0
112	.9038334	6.617188	149	529.2813	0	0
113	.9066667	8.046875	146	493.1563	0	0
114	.9095	9.390625	143	458.5938	0	0
115	.9123334	10.64844	140	425.5	0	0
116	.9151667	11.79688	138	393.8438	0	0
117	.9180001	12.89844	136	363.5938	0	0
118	.9208334	13.86719	134	334.7813	0	0
119	.9236667	14.78125	132	307.375	0	0
120	.9265	15.60156	130	281.2188	0	0
121	.9293334	16.375	128	256.3438	0	0
122	.9321667	17.05469	127	232.9063	0	0
123	.9350001	17.69531	126	210.4688	0	0
124	.9378334	18.26563	124	189.3438	0	0

125	.9406667	18.79688	123	169.4688	0	0
126	.9435001	19.21875	122	150.5625	0	0
127	.9463334	19.64844	122	132.8438	0	0
128	.9491667	20	121	116.1875	0	0
129	.952	20.28125	120	100.5938	0	0
130	.9548334	20.57031	120	86.09375	0	0
131	.9576667	20.78125	119	72.46875	0	0
132	.9605	20.97656	119	59.84375	7.617188E-02	0
133	.9633334	21.13281	118	48.15625	.1269531	0
134	.9661668	21.23438	118	37.4375	.1835938	0
135	.9690001	21.32813	118	27.53125	.25	0
136	.9718334	21.42188	118	18.59375	.2988281	0
137	.9746667	21.45313	118	10.25	.3671875	0
138	.9775	21.47656	118	2.84375	.4199219	0
139	.9803334	21.46875	118	-3.84375	.484375	0
140	.9831667	21.42969	118	-9.6875	.5605469	0
141	.9860001	21.40625	118	-14.90625	.5976563	0
142	.9888334	21.35156	118	-19.4375	.6542969	0
143	.9916667	21.3125	118	-23.21875	.7226563	0
144	.9945001	21.23438	118	-26.40625	.7871094	0
145	.9973334	21.14063	118	-28.9375	.8671875	0
146	1.000167	21.07031	119	-31	.9179688	0
147	1.003	20.97656	119	-32.40625	.9648438	0
148	1.005833	20.875	119	-33.25	1.017578	0
149	1.008667	20.77344	119	-33.59375	1.089844	0
150	1.0115	20.67188	119	-33.34375	1.144531	0
151	1.014333	20.61719	120	-32.71875	1.220703	0
152	1.017167	20.47656	120	-31.65625	1.275391	0
153	1.02	20.40625	120	-30.125	1.314453	0
154	1.022833	20.35156	120	-28.03125	1.375	0
155	1.025667	20.25	120	-25.78125	1.4375	0
156	1.0285	20.21875	120	-22.96875	1.5	0
157	1.031333	20.14063	121	-19.96875	1.5625	0
158	1.034167	20.10156	121	-16.5625	1.595703	0
159	1.037	20.03125	121	-12.78125	1.65625	0
160	1.039833	20	121	-8.6875	1.714844	0
161	1.042667	19.96875	121	-4.375	1.771484	0
162	1.0455	19.97656	121	.15625	1.828125	0
163	1.048333	20.00781	121	4.9375	1.896484	0
164	1.051167	20.02344	121	9.875	1.947266	0
165	1.054	20.02344	121	15.21875	1.992188	0
166	1.056833	20.07813	121	20.5625	2.072266	0
167	1.059667	20.16406	120	26.25	2.117188	0
168	1.0625	20.25	120	31.90625	2.181641	0
169	1.065333	20.33594	120	37.75	2.230469	0
170	1.068167	20.45313	120	43.8125	2.28711	0
171	1.071	20.58594	120	49.78125	2.353516	0
172	1.073833	20.75781	119	56.03125	2.410156	0
173	1.076667	20.875	119	62.28125	2.470703	0
174	1.0795	21.07813	119	68.59375	2.513672	0
175	1.082333	21.28125	118	74.90625	2.563985	0
176	1.085167	21.53906	118	81.21875	2.642578	0
177	1.088	21.76563	117	87.71875	2.720703	0
178	1.090833	22.01563	117	94.03125	2.785156	0
179	1.093667	22.3125	116	100.5938	2.841797	0
180	1.0965	22.57031	115	107	2.902344	0
181	1.099333	22.90625	115	113.3438	2.978516	0
182	1.102167	23.19531	114	119.5625	3.015625	0
183	1.105	23.5625	113	125.875	3.083985	0
184	1.107833	23.94531	113	132.0313	3.16211	0
185	1.110667	24.32031	112	138.1563	3.236328	0
186	1.1135	24.71875	111	144.1875	3.289063	0
187	1.116333	25.13281	110	150.1563	3.369141	0
188	1.119167	25.57031	109	155.9063	3.449219	0
189	1.122	26.02344	108	161.6563	3.511719	0
190	1.124833	26.45313	107	167.1875	3.611328	0

191	1.127667	26.96875	106	172.5313	3.679688	0
192	1.1305	27.50781	105	177.9375	3.740235	0
193	1.133333	28	104	182.9688	3.820313	0
194	1.136167	28.50781	103	188.0938	3.90625	0
195	1.139	29.0625	102	192.7188	3.978516	0
196	1.141833	29.60156	101	197.4063	4.074219	0
197	1.144667	30.14844	100	201.9063	4.15[illegible]391	0
198	1.1475	30.70313	99	206.0938	4.253907	0
199	1.150333	31.34375	97	210.1875	4.328125	0
200	1.153167	31.96875	96	214.125	4.435547	0
201	1.156	32.55469	95	217.8438	4.511719	0
202	1.158833	33.1875	93	221.125	4.589844	0
203	1.161667	33.83594	92	224.4688	4.69336	0
204	1.1645	34.46875	91	227.4375	4.779297	0
205	1.167333	35.07031	89	230.1875	4.871094	0
206	1.170167	35.75	88	232.6875	4.984375	0
207	1.173	36.36719	87	235.125	5.091797	0
208	1.175833	37.07031	85	237.2813	5.210938	0
209	1.178667	37.70313	84	239.0938	5.292969	0
210	1.1815	38.45313	82	240.6563	5.408203	0
211	1.184333	39.09375	81	242.0313	5.513672	0
212	1.187167	39.83594	80	243.3438	5.63086	0
213	1.19	40.49219	78	244.0313	5.75	0
214	1.192833	41.14063	77	244.8125	5.853516	0
215	1.195667	41.86719	75	245.0938	5.966797	0
216	1.1985	42.57813	74	245.1563	6.09375	0
217	1.201333	43.27344	72	245.0625	6.228516	0
218	1.204167	43.98438	71	244.7813	6.359375	0
219	1.207	44.59375	70	244.25	6.484375	0
220	1.209833	45.35938	68	243.4063	6.609375	0
221	1.212667	46.03125	67	242.4063	6.734375	0
222	1.2155	46.75	65	240.9375	6.859375	0
223	1.218333	47.4375	64	239.5	7	0
224	1.221167	48.07813	62	237.625	7.134766	0
225	1.224	48.76563	61	235.6563	7.28711	0
226	1.226833	49.42969	60	233.3125	7.410157	0
227	1.229667	50.03907	58	230.75	7.542969	0
228	1.2325	50.71875	57	228.0938	7.6875	0
229	1.235334	51.39063	55	225.1563	7.830078	0
230	1.238167	52.02344	54	222.0938	7.970703	0
231	1.241	52.60157	53	218.5	8.125	0
232	1.243833	53.23438	52	215	8.291016	0
233	1.246667	53.89063	50	211.2813	8.445312	0
234	1.2495	54.38282	49	207.375	8.578125	0
235	1.252333	55	48	203.1563	8.75	0
236	1.255167	55.58594	47	198.75	8.880859	0
237	1.258	56.21875	45	194.1563	9.050781	0
238	1.260833	56.71875	44	189.4375	9.214844	0
239	1.263667	57.28907	43	184.7188	9.373047	[illegible]
240	1.2665	57.76563	42	179.5938	9.546875	[illegible]
241	1.269333	58.25	41	174.4063	9.710938	[illegible]
242	1.272167	58.70313	40	169	9.867188	0
243	1.275	59.25782	39	163.8125	10.02148	0
244	1.277833	59.61719	38	158.0625	10.19531	0
245	1.280667	60.09375	37	152.4688	10.38477	0
246	1.2835	60.57032	36	146.6875	10.53125	0
247	1.286333	60.91407	36	140.7813	10.71289	0
248	1.289167	61.32032	35	134.875	10.89649	0
249	1.292	61.6875	34	128.75	11.0625	0
250	1.294833	62.125	33	122.8125	11.25977	0
251	1.297667	62.375	33	116.625	11.41797	0
252	1.3005	62.74219	32	110.5313	11.59375	0
253	1.303333	63.02344	31	104.2188	11.77734	0
254	1.306167	63.30469	31	98.03125	11.94727	0
255	1.309	63.60157	30	91.90625	12.13281	0
256	1.311833	63.82813	30	85.65625	12.32227	0

257	1.314667	64.03906	29	79.5625	12.48242	0
258	1.3175	64.35156	28	73.34375	12.6582	0
259	1.320333	64.5	28	67.40625	12.8418	0
260	1.323167	64.60156	28	61.40625	13.05664	0
261	1.326	64.78906	28	55.46875	13.19727	0
262	1.328833	65.02344	27	49.65625	13.44141	0
263	1.331667	65.15625	27	44.15625	13.60742	0
264	1.3345	65.21875	27	38.3125	13.77734	0
265	1.337334	65.3125	26	33.15625	13.97461	0
266	1.340167	65.39063	26	27.65625	14.1875	0
267	1.343	65.54688	26	22.71875	14.34766	0
268	1.345833	65.54688	26	17.71875	14.50781	0
269	1.348667	65.53906	26	12.96875	14.69336	0
270	1.3515	65.59375	26	8.71875	14.92774	0
271	1.354333	65.58594	26	4.5	15.05469	0
272	1.357167	65.72656	26	.78125	15.27344	0
273	1.36	65.625	26	-3.125	15.42578	0
274	1.362833	65.61719	26	-6.40625	15.63672	0
275	1.365667	65.60938	26	-9.4375	15.8418	0
276	1.3685	65.58594	26	-11.84375	15.99805	0
277	1.371333	65.57813	26	-14.21875	16.20703	0
278	1.374167	65.5	26	-16.03125	16.37695	0
279	1.377	65.48438	26	-17.53125	16.58984	0
280	1.379833	65.4375	26	-18.78125	16.75	0
281	1.382667	65.39063	26	-19.25	16.92774	0
282	1.3855	65.28125	26	-19.4375	17.125	0
283	1.388333	65.25	27	-18.9375	17.30859	0
284	1.391167	65.17969	27	-18.21875	17.51953	0
285	1.394	65.16406	27	-16.75	17.66016	0
286	1.396833	65.07031	27	-14.71875	17.83984	0
287	1.399667	65.07031	27	-12.25	18.06641	0
288	1.4025	65.00781	27	-8.78125	18.22656	0
289	1.405333	64.96875	27	-5.3125	18.41406	0
290	1.408167	64.92188	27	-.46875	18.59961	0
291	1.411	65.03125	27	4.5625	18.80859	0
292	1.413833	65.0625	27	10.53125	18.98438	0
293	1.416667	65.04688	27	16.96875	19.15625	0
294	1.4195	65.16406	27	24.53125	19.3457	0
295	1.422333	65.25	27	32.71875	19.49024	0
296	1.425167	65.25781	27	41.625	19.71875	0
297	1.428	65.47656	26	51.4375	19.90625	0
298	1.430833	65.65625	26	62.03125	20.06641	0
299	1.433667	65.83594	25	73.8125	20.24024	0
300	1.4365	66.04688	25	86.09375	20.46094	0
301	1.439334	66.34375	24	99.625	20.66211	0
302	1.442167	66.59375	24	114.0313	20.81055	0
303	1.445	66.9375	23	129.375	21.01172	0
304	1.447833	67.33594	22	146.0938	21.21485	0
305	1.450667	67.82813	21	163.4688	21.4043	0
306	1.4535	68.17188	20	182.3438	21.5918	0
307	1.456333	68.85156	19	202.1563	21.5918	0
308	1.459167	69.46094	18	223.0938	21.5918	0
309	1.462	70.10156	16	244.9688	21.5918	0
310	1.464833	70.74219	15	268.6563	21.5918	0
311	1.467667	71.60156	13	292.9063	21.5918	0
312	1.4705	72.5	11	318.9688	21.5918	0
313	1.473333	73.46094	9	346.25	21.5918	0
314	1.476167	74.38281	8	374.75	21.5918	0
315	1.479	75.5	5	404.6875	21.5918	0

The Total Integral Of P[X(x)]dx is From .9576667 To 1.4535
and the Constant of Intergration is -18925.81 .

JOB: FOLLOWUP ANALYSIS-06/26/89

time - 17:38:20

JOB DESCRIPTION

This is a follow-up to job 'INITIAL ANALYSIS--06/26/89.' This analysis will use the data (in modified form) from that job (i.e. the temperature will be expressed in normalized Rankine units - R/459.67F).

EACH CURVE IS A 'BEST FIT' WITH AN nth DEGREE POLYNOMIAL
P[X(x)] = C(1)X(x)^n + C(2)X(x)^(n-1) + ... + C(n)X(x) + C(n+1)

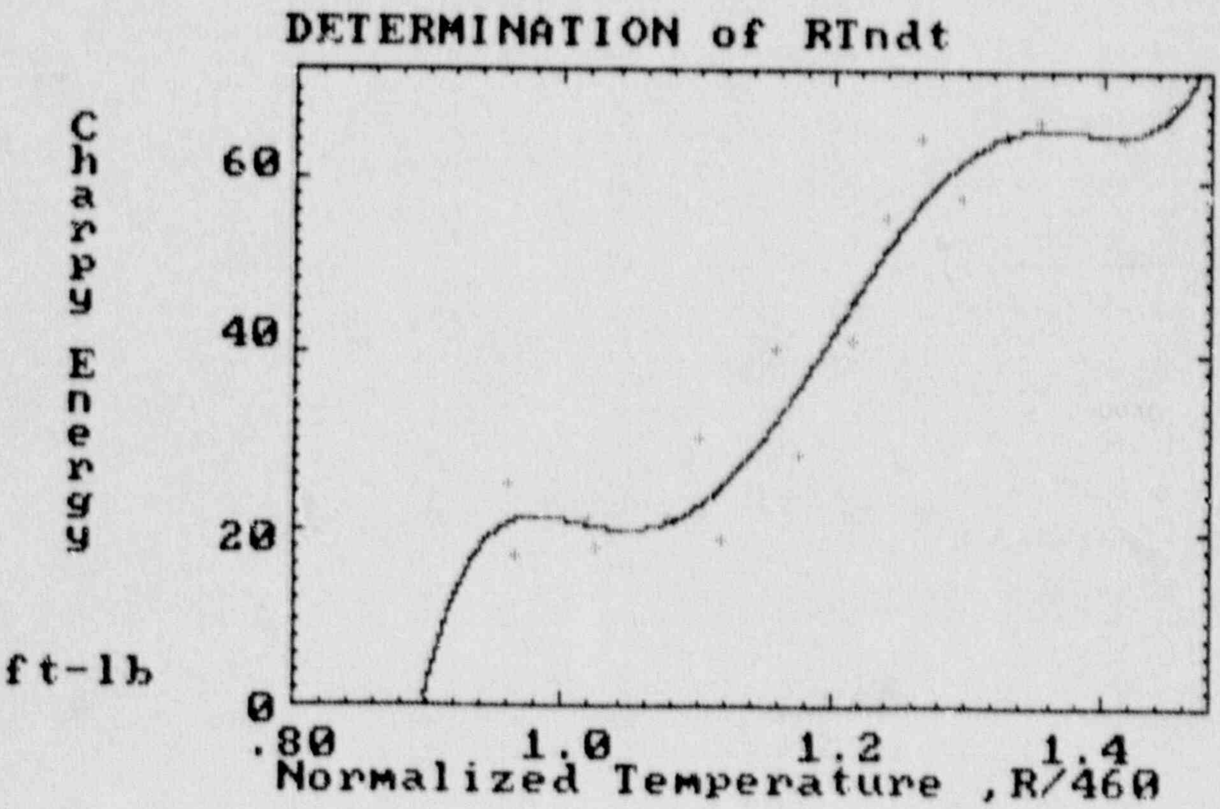
PLOTTING INSTRUCTIONS

Generate (color) MEDIUM resolution, LINEAR graphs with PLOTnFIT DETERMINED COORDINATE RANGES AND MARKING INTERVALS

***** DATA *****

TASK#	IDENTIFICATION	n	SYMBOL	NDP	SOURCE
1*	Mod. CHARPY DATA from RC-2	5	small CROSS	18	KEYBOARD

* These DATA SETS were OUTPUT to file A:FOL06891.SIS.



Part 2.a) Comments on OUTPUT

1. The CHI^2 is 14.705 for the polynomial of degree n = 5 (for which RV is 1.2254; see page A-20). Interpolating the Chi-square distribution table in Appendix B, with the degrees of freedom NU = 18 - 6 = 12, we see that, if the model is approximately "correct," there is about a 26 percent chance that CHI^2 will be 14.7 or larger because of random fluctuations. Hence, we can say that the differences between the data points (x_i, y_i) and the curve $(x_i, P[X(x_i)])$ are probably due to chance and that the model gives a reasonably good correlation of the data in this data set.

2. From the table showing x, P[X(x)], and dP[X(x)]/dx (see pages A-22 through A-25), we see that the inflection point is at x_{ip} = 1.1985 and $P[X(x_{ip})]$ = 42.57813 (from experience we know that the inflection points associated with "lower shelf" and "upper shelf" energies have no physical significance but, rather, are merely the result of the limited number of data points in each region and the nature of the Basis Function used).

3. From the same table referred to above, we can estimate the lower and upper shelf energies by calculating the average P[X(x)] over the maximum to minimum of curve "wiggle" in each range (i.e., over the ranges, $0.9775 \leq x \leq 1.0455$ and $1.357 \leq x \leq 1.411$) to obtain 20.7 ft-lb and 65.3 ft-lb, respectively.

Part 2.b) INPUT

From Part 2.a) OUTPUT, the inflection point was found to be at x_{ip} = 1.1985 and $P[X(x_{ip})]$ = 42.57813. To estimate the combination of coefficients CF1 and CG1 that produce a curve of desired shape, we assumed that as x approaches relatively large values, $P[X_b(x)]$ approaches 65.3 ft-lb (the "upper shelf" energy) and as x approaches very small values, $P[X_b(x)]$ approaches 20.7 ft-lb (the "lower shelf" energy). We then solved the equation (65.3 - 42.57813)/(65.3 - 20.7) = 0.50946 = $EXP[CF1 \cdot (1.1985)^{CG1}]$ for values of CG1 = 5, 10, 15, 20, 25, and 30 to obtain values of CF1 = -0.273, -0.110, -0.0446, -0.0180, -0.00729, and -0.00295, respectively.

In the job for this part of the analysis, we will fit polynomials of degree n = 1 to the modified data using Basis Function # 6 (with CS1 = 0, CO1 = 0, CD1 = 0, and CE1 = 1) in six tasks, where a different combination of coefficients CG1:CF1 taken from the above list is used in each task. It should be noted that although approximate "upper shelf" and "lower shelf" energies were used to obtain the relation between CF1 and CG1 at the "pinning point" (i.e., the inflection point), PLOTnFIT will, with this Basis Function and n = 1, calculate new polynomial coefficients that are directly related to the "upper shelf" energy, C(2), and the "lower shelf" minus the "upper shelf" energies, C(1), so as to give a best fit to all the data points for the given CF1:CG1 combination.

```
RUN

                    PLOTnFIT  /  NUREG - ####

     PLOTnFIT was prepared for an agency of United States Government.
     Neither the United States Government nor any agency thereof, nor any of
     their employees, makes any warranty, expressed or implied, or assumes
     any legal liability or responsibility for any third party's use, or
     the results of such use, of any protion of this prograr or represents
     that its use by such third party would not infringe privately owned
     rights.

          This version of PLOTnFIT (i.e., PLOTNFIT.4TH) will not run
          properly on a PC with a monochrome monitor.  If this PC does
          not have a color/graphics card or this is not a color monitor,
          type yes or y at the EXIT (y/n)? prompt, otherwise type no or n
          and continue (NOTE: If GRAPHICS.COM was not loaded before
          BASICA.COM, HARD COPIES of graphs can not be made.  Now is the
          time to EXIT this job and reload if it is desirable to print
          graphs and GRAPHICS.COM has not been pre-loaded.).
          THE PRINTER MUST BE KEPT ON WHILE PLOTNFIT IS OPERATING.

     EXIT (y/n)?

     Number of Bits not being used at the START of this job = 10486

     For default purposes, what Disk Drive (e.g., A:) would you most likely
     want to WRITE to (include subdirectory if applicable - e.g., C:\SUBDIR\)
? A:

          ****************************************************
          *                                                  *
          *                    PLOTnFIT                      *
          *                                                  *
          *    A US NRC Program for Plotting and  Analyzing  *
          *    (i.e.,  Curve  Fitting) Data  Interactively   *
          *    with  an  IBM  or  IBM  Compatible  Personal  *
          *    Computer (PC) (using DOS 2.1 and BASICA 3.0)  *
          *                                                  *
          *                    May 1988                      *
          *                                                  *
          ****************************************************

   IF YOU ARE 'NOT' ALREADY FAMILIAR WITH THIS PROGRAM, you should probably
   ENTER yes at the 'EXIT (y/n)?' prompt, and run the program 'README1ST.PNF'.

     Exit (y/n)?


Identify your job (INITIAL ANALYSIS):
     FORMAT - a string of less than 18 characters (where BASIC
     filename rules apply to first 3 and last 3 characters) - CHARPYA RC-2 CONT I

Describe your job (This analysis is to get a 'feel' for the data.):
     FORMAT - a 'comma-less' string of less than 256 characters -
Tihis is a continuation of the analysis begun with job 'INITIAL ANALYSIS --06/26/
689.'  tHThis job will use Basis Function #6 in the polynomial fit to the modidi

                    PLOTTING INSTRUCTIONS

What kind of graphs would you like to generate:
     1. LINEAR
     2. SEMI-LOG (Y-axis,LOG; X-axis,LINEAR)
     3. LOG-LOG
NT(= 1 )=
```

```
What palette do you want:
     FOR NP=1    FOR NP=2         FOR NOP=1                FOR NOP=2
     GREEN        MAGENTA         'CURVES'                 'CURVES'
     RED          CYAN            'DATA POINTS'            'DATA FIELD'
     BROWN        WHITE           'AXES AND LABELS'        'DATA POINTS,AXES,
                                                            AND LABELS'
NP(= 1 )=

     Regardless of the NOP value you enter here, if you later
     choose to make HARD COPIES of the data and curves plotted
     on the screen, PLOTnFIT will automatically make NOP=1.
NOP(= 2 )=

What background color do you want:
     1. BLACK
     2. GRAY
     3. LIGHT BLUE
     4. WHITE
     5. LIGHT CYAN
     6. LIGHT MAGENTA
NQ(= 2 )= 5

Would you like graph labels different from those shown in ()?
     (TITLE )              - 30 characters maximum -    (y/n): Y
What is your choice? DETERMINATION of RTndt
     (X-AXIS) Horizontal - 22 characters maximum -    (y/n): y
What is your choice? Normalized Temperature
     (units ) for x-axis -  5 characters maximum -    (y/n): y
What is your choice? R/460
     (Y-AXIS) Vertical    - 16 characters maximum -    (y/n): y
What is your choice? Charpy Energy
     (units ) for y-axis -  5 characters maximum -    (y/n): y
What is your choice? ft-lb

What scaling procedure (NS) would you like to use?
     1. SPECIFY COORDINATE RANGES AND MARKING INTERVALS FOR
        THE AXES (USE ONLY AFTER EXPERIENCE WITH 'PLOTnFIT')
     2. ALLOW 'PLOTnFIT' TO ESTABLISH COORDINATE RANGES AND
        MARKING INTERVALS BASED ON THE DATA RANGES
NS(= 2 )=

                         DATA AND DATA IDENTIFICATION

How many Tasks will there be in this job (1<=NDS<=8)? NDS(= 1 )= 6

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 1 ?
          1. The KEYBOARD
          2  A STORED FILE
     NE(= 1 )= 2

     What is the location and name of the FILE containing Data for Task # 1 ?
          FORMAT - (storage)device:filename - a:fol06891.sis

     How many Data Sets are in this FILE?
          NDSF(= 1 )=


     Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
     [i.e., that identified as : Mod. CHARPY DATA from RC-2;
     with (NDP=) 18 data points] (y/n)? y

     Do you want to INPUT the stored weighting factors (y/n)? y

     Do you want to change ANY data in this Data Set (y/n)?

     Do you want to fit curves to your Data Points (y/n)? y
```

Which of the following BASIS FUNCTIONS do you want to use for this Data Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

```
 1.  X(x)=CS1+x
 2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
 3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
 4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
 5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
 6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
 7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
 8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
 9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)
```

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

```
BF(= 1 )= 6
   CS1(= 0 )=
   CO1(= 0 )=
   CD1(= 0 )=
   CE1(= 0 )=1.
   CF1(= 0 )=-0.273
   CG1(= 0 )=5
```

For each Data Set in the job, the program starts with the lowest degree polynomial you want to consider and fits it to the data points; the program then fits, sequentially and in assending order, as many higher degree polynomials as you specify (the current degree limit is 10).

What is the lowest degree polynomial (LDP) you want to consider for this Data Set (1 <= LDP <= 10)? LDP(=1)=

How many polynomial fits (NPF) do you want to try - including the LDP - (1 <= NPF <= 10)? NPF(=1)=

What symbol (M) would you like to use to represent the Data for Task # 1 ?

```
     1.   I                       5. DIAMOND
     2. CROSS                     6. TRIANGLE - UP
     3.   X                       7. TRIANGLE - DOWN
     4.   H                       8. SQUARE
M(= 1 )= 3
```

What symbol size (MM) would you like?

```
     1. small
     2. LARGE
MM(= 1 )=
```

What INPUT device (NE) would you like to use to enter your Data for Task # 2 ?

```
     1. The KEYBOARD
     2. A STORED FILE
NE(= 2 )=
```

What is the location and name of the FILE containing Data for Task # 2 ?
FORMAT - (storage)device:filename (a:fo106891.sis) -

How many Data Sets are in this FILE?
NDSF(= 1)=

```
Do you want to INPUT Data Set # 1 from FILE a:fo106891.sie
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1*x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 0 )=1.
     CF1(= 0 )=-0.110
     CG1(= 0 )=10.
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

     What is the lowest degree polynomial (LDP) you want to consider
     for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

     How many polynomial fits (NPF) do you want to
     try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 2 ?
               1.   I                          5. DIAMOND
               2. CROSS                        6. TRIANGLE - UP
               3.   X                          7. TRIANGLE - DOWN
               4.   H                          8. SQUARE
          M(= 4 )= 3

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 3 ?
          1. The KEYBOARD
          2. A STORED FILE
     NE(= 2 )=
```

```
What is the location and name of the FILE containing Data for Task # 3 ?
     FORMAT - (storage)device:filename (a:fol06891.sis) -

How many Data Sets are in this FILE?
     NDSF(= 1 )=


Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 0 )=1.
     CF1(= 0 )=-0.4460446
     CG1(= 0 )=15.
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in ascending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

     What is the lowest degree polynomial (LDP) you want to consider
     for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

     How many polynomial fits (NPF) do you want to
     try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 3 ?
               1.   I                          5. DIAMOND
               2. CROSS                        6. TRIANGLE - UP
               3.   X                          7. TRIANGLE - DOWN
               4.   H                          8. SQUARE
          M(= 4 )= 3

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=
```

```
What INPUT device (NE) would you like to use to
enter your Data for Task # 4 ?
     1. The KEYBOARD
     2. A STORED FILE
NE(= 2 )=

What is the location and name of the FILE containing Data for Task # 4 ?
     FORMAT - (storage)device:filename (a:fo106891.sis) -

How many Data Sets are in this FILE?
     NDSF(= 1 )=


Do you want to INPUT Data Set # 1 from FILE a:fo106891.sis
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 0 )=1.
     CF1(= 0 )=-0.0180
     CG1(= 0 )=20.
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

     What is the lowest degree polynomial (LDP) you want to consider
     for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

     How many polynomial fits (NPF) do you want to
     try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=
```

```
        What symbol (M) would you like to use to represent
        the Data for Task # 4 ?
             1.   I                              5. DIAMOND
             2. CROSS                            6. TRIANGLE - UP
             3.   X                              7. TRIANGLE - DOWN
             4.   H                              8. SQUARE
        M(= 4 )= 3

        What symbol size (MM) would you like?
             1. small
             2. LARGE
        MM(= 1 )=

   What INPUT device (NE) would you like to use to
   enter your Data for Task # 5 ?
        1. The KEYBOARD
        2. A STORED FILE
   NE(= 2 )=

   What is the location and name of the FILE containing Data for Task # 5 ?
        FORMAT - (storage)device:filename (a:fol06891.sis) - y

   How many Data Sets are in this FILE?
        NDSF(= 1 )=

          ***  ERROR  ***

        File Not Found

   What is the location and name of the FILE containing Data for Task # 5 ?
        FORMAT - (storage)device:filename (y) - a:fol06891.sis

   How many Data Sets are in this FILE?
        NDSF(= 1 )=


   Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
   [i.e., that identified as : Mod. CHARPY DATA from RC-2;
   with (NDP=) 18 data points] (y/n)? y

   Do you want to INPUT the stored weighting factors (y/n)? y

   Do you want to change ANY data in this Data Set (y/n)?

   Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.
```

```
BF(= 6 )=
   CS1(= 0 )=
   CO1(= 0 )=
   CD1(= 0 )=
   CE1(= 0 )=1.
   CF1(= 0 )=-0.00729
   CG1(= 0 )=25.
        For each Data Set in the job, the program starts with
        the lowest degree polynomial you want to consider and
        fits it to the data points; the program then fits,
        sequentially and in assending order, as many higher
        degree polynomials as you specify (the current degree
        limit is 10).

   What is the lowest degree polynomial (LDP) you want to consider
   for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

   How many polynomial fits (NPF) do you want to
   try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

        What symbol (M) would you like to use to represent
        the Data for Task # 5 ?
             1.   I                                5. DIAMOND
             2. CROSS                              6. TRIANGLE - UP
             3.   X                                7. TRIANGLE - DOWN
             4.   H                                8. SQUARE
        M(= 4 )= 3

        What symbol size (MM) would you like?
             1. small
             2. LARGE
        MM(= 1 )=

   What INPUT device (NE) would you like to use to
   enter your Data for Task # 6 ?
        1. The KEYBOARD
        2. A STORED FILE
   NE(= 2 )=

   What is the location and name of the FILE containing Data for Task # 6 ?
        FORMAT - (storage)device:filename (a:fol06891.sis) -

   How many Data Sets are in this FILE?
        NDSF(= 1 )=

   Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
   [i.e., that identified as : Mod. CHARPY DATA from RC-2;
   with (NDP=) 18 data points] (y/n)? y

   Do you want to INPUT the stored weighting factors (y/n)? y

   Do you want to change ANY data in this Data Set (y/n)?

   Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
```

```
 9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CF1/(CD1+x))*SIN(CF1+CG1*x)
11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)
```

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

```
  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 0 )=1.
     CF1(= 0 )=-0.00295
     CG1(= 0 )=30.
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

     What is the lowest degree polynomial (LDP) you want to consider
     for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

     How many polynomial fits (NPF) do you want to
     try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 6 ?
               1.   I                          5. DIAMOND
               2. CROSS                        6. TRIANGLE - UP
               3.   X                          7. TRIANGLE - DOWN
               4.   H                          8. SQUARE
          M(= 4 )= 3

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=

          ALL PLOTTING INSTRUCTIONS AND DATA HAVE BEEN ENTERED

     Would you like to make changes in your Plotting Instructions;
     values currently in the computer appear in parenthesis (y/n)?

     Would you like to make a few changes in one or more of your Data
     Sets [most useful when most data are from the KEYBOARD] (y/n)?

Number of Bits not being used at this time, for this job = 2884

          Would you like to PRINT values of the Polynomial
          Coefficients for all the curves fit to each Data Set,
          along with the corresponding Residual Variances and
          Coefficients of Determination (y/n)? y

          Would you like to make HARD COPIES of graphs of ALL
          the Data Sets, one set of graphs for each Data Set,
          showing ALL the polynomial curves fit to EACH Data
          Set (y/n)?

          Would you like to make 'a' HARD COPY graph containing
          ALL the Data Sets, each Data Set with it's corresponding
          'BEST POLYNOMIAL/BEST FIT' curve (y/n)? y

          Would you like to PRINT values of key program variables
          and a Table of some of the points which fall on each
          'BEST POLYNOMIAL/BEST FIT' curve plotted (y/n)?
```

```
        Would you like to INPUT a function to be plotted
        with your data (y/n)? y

        Your function, the dependent variable F(X), must
        be expressed as a polynomial of less than 11th
        degree (most physical - technical models can be
        expressed adequately with such a polynomial):

    F(X)=C(n+1)+C(n)*X+C(n-1)*X^2+C(n-2)*X^3+...+C(2)*X^(n-1)+C(1)*X^n


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )= 1
     CS1(= 0 )=


      What degree polynomial do you want to use, n=5
      C( 6 )= -98849.59
      C( 5 )= 426694.9
      C( 4 )= -730689.8
      C( 3 )= 620427.2
      C( 2 )= -261180.2
      C( 1 )= 43618.66

      Would you like to save your DATA for later use (y/n)?
```

Part 2.b) OUTPUT

PLOTnFIT.4th

JOB: CHARPY RC-2 ACONT-06/27/89

time - 15:14:53

THE FOLLOWING ARE DATA RESULTING FROM FITTING POLYNOMIALS TO THE VARIOUS DATA SETS

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

```
Degree of Polynomial, P[X(x)], n = 1
 BASIS FUNCTION: X(x) =  0*EXP[ 0*x^( 0)]
                                   + ( 1)*EXP[-.273*x^( 5)]
Coefficient of Determination, CD = .878124
             Residual Variance, RV = 1.972444
```

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-93.39537   C(2)= 90.16318

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	15.29356	9.706436	.04
2	.9641	17	15.76355	1.23645	.04
3	1.0185	21.5	20.91911	.5808945	.04
4	1.025	18	21.58548	-3.58548	.04
5	1.0772	21.5	27.30457	-5.804566	.04
6	1.1001	30.5	30.00529	.4947129	.04
7	1.1175	19	32.12689	-13.12689	.04
8	1.1566	40.5	37.08305	3.416954	.04
9	1.174	28.5	39.35783	-10.85783	.04
10	1.2132	41.5	44.58919	-3.089184	.04
11	1.2132	46	44.58919	1.410816	.04
12	1.2382	55.5	47.96824	7.531765	.04
13	1.2654	64.5	51.64575	12.85425	.04
14	1.297	58	55.87318	2.12682	.04
15	1.3263	65	59.70222	5.297783	.04
16	1.3535	66.5	63.13852	3.361481	.04
17	1.4166	64.5	70.48625	-5.986252	.04
18	1.4514	68.5	74.068	-5.567993	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 31.55911 .

JOB: CHARPY RC-2 ACONT-06/27/89

time - 15:15:12

SUMMARY OF TASK # 1

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the

```
BASIS FUNCTION: X(x) =  0*EXP[ 0*x^( 0)]
                         + ( 1)*EXP[-.273*x^( 5)]
```

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = 1.972444), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 2: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.11*x^(10)]
Coefficient of Determination, CD = .914854
Residual Variance, RV = 1.378004

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-58.69301 C(2)= 71.86225

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	17.25463	7.745373	.04
2	.9641	17	17.48178	-.481781	.04
3	1.0185	21.5	20.43386	1.066139	.04
4	1.025	18	20.87827	-2.878269	.04
5	1.0772	21.5	25.29375	-3.793747	.04
6	1.1001	30.5	27.74947	2.750527	.04
7	1.1175	19	29.83881	-10.83881	.04
8	1.1566	40.5	35.22374	5.276264	.04
9	1.174	28.5	37.90128	-9.401283	.04
10	1.2132	41.5	44.40884	-2.908836	.04
11	1.2132	46	44.40884	1.591164	.04
12	1.2382	55.5	48.74525	6.754757	.04
13	1.2654	64.5	53.42412	11.07588	.04
14	1.297	58	58.52567	-.5256691	.04
15	1.3263	65	62.65861	2.341389	.04
16	1.3535	66.5	65.79694	.703064	.04
17	1.4166	64.5	70.2259	-5.725891	.04
18	1.4514	68.5	71.25013	-2.750122	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 22.04806 .

JOB: CHARPY RC-2 ACONT-06/27/89

time - 15:16:23

SUMMARY OF TASK # 2

This task investigated Polynomials of degree 1 through 1 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.11*x^(10)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = 1.378004), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT s choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 4: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.018*x^(20)]
Coefficient of Determination, CD = .945029
Residual Variance, RV = .8896558

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-46.37255 C(2)= 65.57366

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	19.5588	5.441201	.04
2	.9641	17	19.60114	-2.601143	.04
3	1.0185	21.5	20.38996	1.110043	.04
4	1.025	18	20.5489	-2.548897	.04
5	1.0772	21.5	22.75152	-1.251522	.04
6	1.1001	30.5	24.49896	6.001038	.04
7	1.1175	19	26.29568	-7.295681	.04
8	1.1566	40.5	32.24603	8.253975	.04
9	1.174	28.5	35.86537	-7.365368	.04
10	1.2132	41.5	45.9281	-4.428093	.04
11	1.2132	46	45.9281	7.190705E-02	.04
12	1.2382	55.5	52.82755	2.672455	.04
13	1.2654	64.5	59.26307	5.236935	.04
14	1.297	58	63.80488	-5.804882	.04
15	1.3263	65	65.29271	-.2927094	.04
16	1.3535	66.5	65.55188	.9481201	.04
17	1.4166	64.5	65.57366	-1.073654	.04
18	1.4514	68.5	65 57366	2.926346	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.23449 .

JOB: CHARPY RC-2 ACONT-06/27/89

time - 15:18:10

SUMMARY OF TASK # 4

This task investigated Polynomials of degree 1 through 1 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.018*x^(20)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8896558), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 5: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.00729*x^(25)]
Coefficient of Determination, CD = .944909
Residual Variance, RV = .8915932

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-44.25982 C(2)= 64.5312

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.38365	4.616352	.04
2	.9641	17	20.40055	-3.400551	.04
3	1.0185	21.5	20.77868	.7213211	.04
4	1.025	18	20.86554	-2.86554	.04
5	1.0772	21.5	22.29452	-.7945213	.04
6	1.1001	30.5	23.6401	6.859902	.04
7	1.1175	19	25.16606	-6.166062	.04
8	1.1566	40.5	30.97615	9.523853	.04
9	1.174	28.5	34.92783	-6.427834	.04
10	1.2132	41.5	46.79008	-5.290077	.04
11	1.2132	46	46.79008	-.7900772	.04
12	1.2382	55.5	54.87318	.6268235	.04
13	1.2654	64.5	61.31134	3.188667	.04
14	1.297	58	64.18659	-6.186585	.04
15	1.3263	65	64.52208	.4779206	.04
16	1.3535	66.5	64.53116	1.968842	.04
17	1.4166	64.5	64.5312	-.0311966	.04
18	1.4514	68.5	64.5312	3.968804	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.26549 .

JOB: CHARPY RC-2 ACONT-06/27/89

time - 15:19:36

SUMMARY OF TASK # 5

This task investigated Polynomials of degree 1 through 1 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.00729*x^(25)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8915932), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 6: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.00295*x^(30)]
Coefficient of Determination, CD = .941253
Residual Variance, RV = .9507661

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-42.84796 C(2)= 63.82746

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	21.01515	3.984852	.04
2	.9641	17	21.02169	-4.02169	.04
3	1.0185	21.5	21.19801	.3019905	.04
4	1.025	18	21.24382	-3.243817	.04
5	1.0772	21.5	22.14013	-.6401291	.04
6	1.1001	30.5	23.13505	7.364952	.04
7	1.1175	19	24.37852	-5.378521	.04
8	1.1566	40.5	29.84824	10.65176	.04
9	1.174	28.5	34.02197	-5.521973	.04
10	1.2132	41.5	47.62161	-6.121609	.04
11	1.2132	46	47.62161	-1.621609	.04
12	1.2382	55.5	56.69396	-1.193955	.04
13	1.2654	64.5	62.45463	2.045376	.04
14	1.297	58	63.79583	-5.795826	.04
15	1.3263	65	63.82743	1.172577	.04
16	1.3535	66.5	63.82746	2.672547	.04
17	1.4166	64.5	63.82746	.6725464	.04
18	1.4514	68.5	63.82746	4.672547	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 15.21226 .

JOB: CHARPY RC-2 ACONT-06/27/89

time - 15:20:26

SUMMARY OF TASK # 6

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.00295*x^(30)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .9507661), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

JOB: CHARPY RC-2 ACONT-06/27/89

time - 15:30:00

JOB DESCRIPTION

This is a continuation of the analysis begun with job 'INITIAL ANALYSIS --06/26/89' and extended through job 'FOLLOWUP ANALYSIS -06/26/89.' This job will use Basis Function # 6 in the polynomial fit to the modified data from file FOL06891.SIS.'

EACH CURVE IS A 'BEST FIT' WITH AN nth DEGREE POLYNOMIAL

F[X(x)] = C(1)X(x)^n + C(2)X(x)^(n-1) + ... + C(n)X(x) + C(n+1)

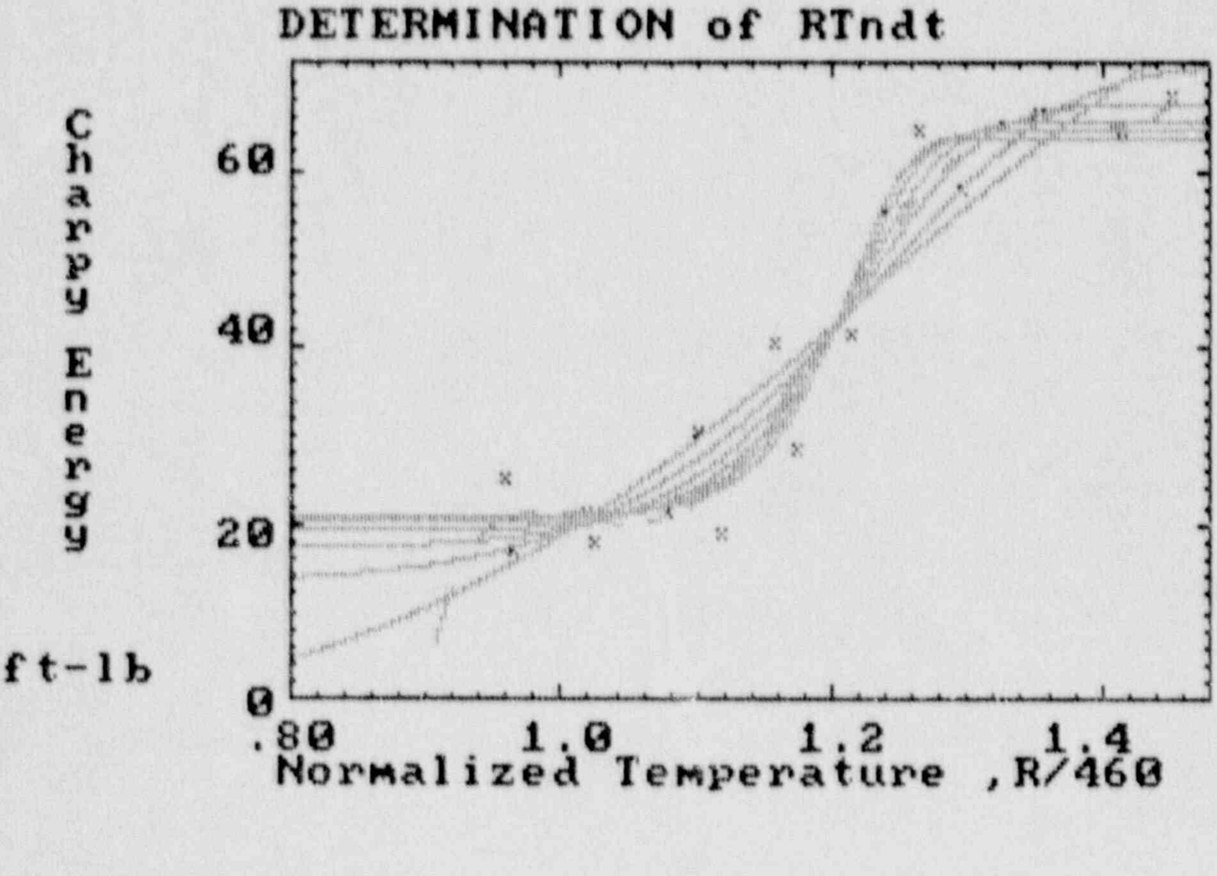
The 'Dashed Curve' is a Plot of the Function:

F(X) = [-98849.59] + [426694.9*X^ 1] + [-730689.8*X^ 2] + [620427.2*X^ 3] + [-261180.2*X^ 4] + [43618.66*X^ 5]

X(x) = 0 + x

***** DATA *****

TASK#	IDENTIFICATION	n	SYMBOL		NDP	SOURCE
1	Mod. CHARPY DATA from RC-2	1	small	X	18	FILE fol06891.sis
2	Mod. CHARPY DATA from RC-2	1	small	X	18	FILE fol06891.sis
3	Mod. CHARPY DATA from RC-2	1	small	X	18	FILE fol06891.sis
4	Mod. CHARPY DATA from RC-2	1	small	X	18	FILE fol06891.sis
5	Mod. CHARPY DATA from RC-2	1	small	X	18	FILE fol06891.sis
6	Mod. CHARPY DATA from RC-2	1	small	X	18	FILE fol06891.sis



Part 2.b) Comments on OUTPUT

1. The results of this part of the analysis suggest that the CHI^2 is minimum between CG1:CF1 = 20:(-0.0180), where RV = 0.8896, and CG1:CF1 = 25:(-0.00729), where RV = 0.8916 (see pages A-41 and A-42).

2. Over the CG1:CF1 range from 5:(-0.273) to 30:(-0.00295), the lower shelf energy:upper shelf energy varied from -3.2:90.2 ft-lb to 21.0:63.8 ft-lb.

Part 2.c) INPUT

The results of Part 2.b) suggest that for the chosen Basis Function, with polynomial degree n = 1, RV should be minimum for some CG1:CF1 values between 20:(-0.0180) and 25:(-0.00729). To refine our estimate of "good" values for CG1 and CF1, we again solve the equation $0.50946 = EXP[CF1 \cdot (1.1985)^{CG1}]$ for values of CG1 = 21, 22, 22.5, 23, and 24 to obtain values of CF1 = -0.01505, -0.01256, -0.011147, -0.01048, and -0.00874, respectively.

In the job for this part of the analysis, we will fit polynomials of degree n = 1 to the modified data using Basis Function # 6 (with CS1 = 0, CO1 = 0, CD1 = 0, and CE1 = 1) in five tasks, where a different combination of coefficients CG1:CF1, taken from the above list, is used in each task. The job was run following the job for Part 2.b) without exiting PLOTNFIT.4TH.

```
Identify your job (INITIAL ANALYSIS):
     FORMAT - a string of less than 18 characters (where BASIC
     filename rules apply to first 3 and last 3 characters) - CHARPY RC-2 BCONT

Describe your job (This analysis is to get a 'feel' for the data.):
     FORMAT - a 'comma-less' string of less than 256 characters -
This is a continuation of the analysis begun with job 'INITIAL ANALYSIS --06/26/
89' and extended through job 'CHARPY RC-2 ACONT -06/27/89.' This job will use B
asis Function # 6 in the polynomial fit to the mofified data from file 'FOL06891
.SIS.'

                              PLOTTING INSTRUCTIONS

What kind of graphs would you like to generate:
     1. LINEAR
     2. SEMI-LOG (Y-axis,LOG; X-axis,LINEAR)
     3. LOG-LOG
NT(= 1 )=

     What palette do you want:
          FOR NP=1   FOR NP=2      FOR NOP=1             FOR NOP=2
          GREEN       MAGENTA      'CURVES'              'CURVES'
          RED         CYAN         'DATA POINTS'         'DATA FIELD'
          BROWN       WHITE        'AXES AND LABELS'     'DATA POINTS,AXES,
                                                           AND LABELS'
     NP(= 1 )=


          Regardless of the NOP value you enter here, if you later
          choose to make HARD COPIES of the data and curves plotted
          on the screen, PLOTnFIT will automatically make NOP=1.
     NOP(= 2 )=

     What background color do you want:
          1. BLACK
          2. GRAY
          3. LIGHT BLUE
          4. WHITE
          5. LIGHT CYAN
          6. LIGHT MAGENTA
     NQ(= 2 )= 3


Would you like graph labels different from those shown in ()?
     TITLE              (DETERMINATION of RTndt)(y/n):
     X-AXIS             (Normalized Temperature)(y/n):
     units                              (R/460)(y/n):
     Y-AXIS                     (Charpy Energy)(y/n):
     units                              (ft-lb)(y/n):

What scaling procedure (NS) would you like to use?
     1. SPECIFY COORDINATE RANGES AND MARKING INTERVALS FOR
        THE AXES (USE ONLY AFTER EXPERIENCE WITH 'PLOTnFIT')
     2. ALLOW 'PLOTnFIT' TO ESTABLISH COORDINATE RANGES AND
        MARKING INTERVALS BASED ON THE DATA RANGES
NS(= 2 )=


                          DATA AND DATA IDENTIFICATION

How many Tasks will there be in this job (1<=NDS<=8)? NDS(= 6 )= 85

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 1 ?
          1. The KEYBOARD
          2. A STORED FILE
     NE(= 2 )=
```

What is the location and name of the FILE containing Data for Task # 1 ?
FORMAT - (storage)device:filename (a:fol06891.sis) - y

How many Data Sets are in this FILE?
NDSF(= 1)=

*** ERROR ***

File Not Found

What is the location and name of the FILE containing Data for Task # 1 ?
FORMAT - (storage)device:filename (y) - a:fol06891.sis

How many Data Sets are in this FILE?
NDSF(= 1)=

Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

```
 1.  X(x)=CS1+x
 2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
 3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
 4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
 5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
 6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
 7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
 8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
 9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)
```

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

```
  BF(= 1 )= 6
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 1 )=y
?Redo from start
)=1
     CF1(=-.273 )=-0.01505
     CG1(= 5 )=21
```

For each Data Set in the job, the program starts with the lowest degree polynomial you want to consider and fits it to the data points; the program then fits, sequentially and in ascending order, as many higher degree polynomials as you specify (the current degree limit is 10).

What is the lowest degree polynomial (LDP) you want to consider for this Data Set (1 <= LDP <= 10)? LDP(=1)=

```
How many polynomial fits (NPF) do you want to
try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

      What symbol (M) would you like to use to represent
      the Data for Task # 1 ?
            1.   I                                5. DIAMOND
            2. CROSS                              6. TRIANGLE - UP
            3.   X                                7. TRIANGLE - DOWN
            4.   H                                8. SQUARE
      M(= 3 )= 4

      What symbol size (MM) would you like?
            1. small
            2. LARGE
      MM(= 1 )=

What INPUT device (NE) would you like to use to
enter your Data for Task # 2 ?
      1. The KEYBOARD
      2. A STORED FILE
NE(= 2 )=

What is the location and name of the FILE containing Data for Task # 2 ?
      FORMAT - (storage)device:filename (a:fol06891.sis) -

How many Data Sets are in this FILE?
      NDSF(= 1 )=


Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

   1.   X(x)=CS1+x
   2.   X(x)=CS1+EXP(CO1*x)/(CD1+x)
   3.   X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
   4.   X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
   5.   X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
   6.   X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
   7.   X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
   8.   X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
   9.   X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
  10.   X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
  11.   X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 1 )=
     CF1(=-.11 )=-0.01256
     CG1(= 10 )=22
```

For each Data Set in the job, the program starts with the lowest degree polynomial you want to consider and fits it to the data points; the program then fits, sequentially and in assending order, as many higher degree polynomials as you specify (the current degree limit is 10).

What is the lowest degree polynomial (LDP) you want to consider for this Data Set (1 <= LDP <= 10)? LDP(=1)=

How many polynomial fits (NPF) do you want to try - including the LDP - (1 <= NPF <= 10)? NPF(=1)=

```
What symbol (M) would you like to use to represent
the Data for Task # 2 ?
     1.  I                              5. DIAMOND
     2. CROSS                           6. TRIANGLE - UP
     3.  X                              7. TRIANGLE - DOWN
     4.  H                              8. SQUARE
M(= 5 )= 4

What symbol size (MM) would you like?
     1. small
     2. LARGE
MM(= 1 )=
```

```
What INPUT device (NE) would you like to use to
enter your Data for Task # 3 ?
   1. The KEYBOARD
   2. A STORED FILE
NE(= 2 )=
```

What is the location and name of the FILE containing Data for Task # 3 ?
FORMAT - (storage)device:filename (a:fol06891.sis) -

How many Data Sets are in this FILE?
NDSF(= 1)=

Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis [i.e., that identified as : Mod. CHARPY DATA from RC-2; with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

```
 1.  X(x)=CS1+x
 2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
 3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
 4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
 5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
 6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
 7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
 8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
 9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)
```

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

```
BF(= 6 )=
    CS1(= 0 )=
    CO1(= 0 )=
    CD1(= 0 )=
    CE1(= 1 )=
    CF1(=-.0446 )=-0.01147
    CG1(= 15 )=22.5
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

    What is the lowest degree polynomial (LDP) you want to consider
    for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

    How many polynomial fits (NPF) do you want to
    try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 3 ?
               1.  I                                   5. DIAMOND
               2. CROSS                                6. TRIANGLE - UP
               3.   X                                  7. TRIANGLE - DOWN
               4.   H                                  8. SQUARE
          M(= 5 )= 4

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 4 ?
          1. The KEYBOARD
          2. A STORED FILE
     NE(= 2 )=

     What is the location and name of the FILE containing Data for Task # 4 ?
          FORMAT - (storage)device:filename (a:fol06891.sis) -

     How many Data Sets are in this FILE?
          NDSF(= 1 )=


     Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
     [i.e., that identified as : Mod. CHARPY DATA from RC-2;
     with (NDP=) 18 data points] (y/n)? y

     Do you want to INPUT the stored weighting factors (y/n)? y

     Do you want to change ANY data in this Data Set (y/n)?

     Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

   1.  X(x)=CS1+x
   2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
   3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
   4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
   5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
   6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
   7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
   8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
```

9. X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10. X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11. X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

```
BF(= 6 )=
    CS1(= 0 )=
    CO1(= 0 )=
    CD1(= 0 )=
    CE1(= 1 )=
    CF1(=-.018 )=-0.01048
    CG1(= 20 )=23
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

    What is the lowest degree polynomial (LDP) you want to consider
    for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=



    How many polynomial fits (NPF) do you want to
    try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 4 ?
               1.   I                              5. DIAMOND
               2. CROSS                            6. TRIANGLE - UP
               3.   X                              7. TRIANGLE - DOWN
               4.   H                              8. SQUARE
          M(= 5 )= 4

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=

    What INPUT device (NE) would you like to use to
    enter your Data for Task # 5 ?
          1. The KEYBOARD
          2. A STORED FILE
    NE(= 2 )=

    What is the location and name of the FILE containing Data for Task # 5 ?
          FORMAT - (storage)device:filename (a:fol06891.sis) -

    How many Data Sets are in this FILE?
          NDSF(= 1 )=


    Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
    [i.e., that identified as : Mod. CHARPY DATA from RC-2;
    with (NDP=) 18 data points] (y/n)? y

    Do you want to INPUT the stored weighting factors (y/n)? y

    Do you want to change ANY data in this Data Set (y/n)?

    Do you want to fit curves to your Data Points (y/n)? y
```

```
Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

   1.  X(x)=CS1+x
   2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
   3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
   4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
   5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
   6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
   7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
   8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
   9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
  10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
  11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 1 )=
     CF1(=-.00729 )=-0.00874
     CG1(= 25 )=24
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

     What is the lowest degree polynomial (LDP) you want to consider
     for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

     How many polynomial fits (NPF) do you want to
     try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 5 ?
               1.   I                                 5. DIAMOND
               2. CROSS                               6. TRIANGLE - UP
               3.   X                                 7. TRIANGLE - DOWN
               4.   H                                 8. SQUARE
          M(= 5 )= 4

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=

          ALL PLOTTING INSTRUCTIONS AND DATA HAVE BEEN ENTERED

     Would you like to make changes in your Plotting Instructions;
     values currently in the computer appear in parenthesis (y/n)?

     Would you like to make a few changes in one or more of your Data
     Sets [most useful when most data are from the KEYBOARD] (y/n)?

     Would you like to completely RE-INPUT your Coordinate Data
     [most useful when most data are from STORED FILES] (y/n)?
```

Number of Bits not being used at this time, for this job = 1312

Would you like to PRINT values of the Polynomial Coefficients for all the curves fit to each Data Set, along with the corresponding Residual Variances and Coefficients of Determination (y/n)? y

Would you like to make HARD COPIES of graphs of ALL the Data Sets, one set of graphs for each Data Set, showing ALL the polynomial curves fit to EACH Data Set (y/n)?

Would you like to make 'a' HARD COPY graph containing ALL the Data Sets, each Data Set with it's corresponding 'BEST POLYNOMIAL/BEST FIT' curve (y/n)? y

Would you like to PRINT values of key program variables and a Table of some of the points which fall on each 'BEST POLYNOMIAL/BEST FIT' curve plotted (y/n)?

Would you like to INPUT a function to be plotted with your data (y/n)?

Would you like to save your DATA for later use (y/n)?

Part 2.c) OUTPUT

PLOTnFIT.4th

JOB: CHARPY RC-2 BCONT-06/27/89

time - 15:50:31

THE FOLLOWING ARE DATA RESULTING FROM FITTING POLYNOMIALS TO THE VARIOUS DATA SETS

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01505*x^(21)]
Coefficient of Determination, CD = .945367
Residual Variance, RV = .884177

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.86022 C(2)= 65.31018

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	19.73373	5.26627	.04
2	.9641	17	19.76914	-2.769135	.04
3	1.0165	21.5	20.4531	1.046902	.04
4	1.025	18	20.59467	-2.594673	.04
5	1.0772	21.5	22.62473	-1.124725	.04
6	1.1001	30.5	24.29217	6.207836	.04
7	1.1175	19	26.04044	-7.040436	.04
8	1.1566	40.5	31.99003	8.509976	.04
9	1.174	28.5	35.68834	-7.188339	.04
10	1.2132	41.5	46.11997	-4.619972	.04
11	1.2132	46	46.11997	-.1199722	.04
12	1.2382	55.5	53.26623	2.233772	.04
13	1.2654	64.5	59.75123	4.748772	.04
14	1.297	58	63.98258	-5.982582	.04
15	1.3263	65	65.15088	-.1508789	.04
16	1.3535	66.5	65.30233	1.19767	.04
17	1.4166	64.5	65.31018	-.8101807	.04
18	1.4514	68.5	65.31018	3.189819	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.14683 .

JOB: CHARPY RC-2 BCONT-06/27/89

time - 15:50:49

SUMMARY OF TASK # 1

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01505*x^(21)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .884177), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 2: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01256*x^(22)]
Coefficient of Determination, CD = .945506
Residual Variance, RV = .8819332

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.4019 C(2)= 65.08533

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	19.90834	5.091656	.04
2	.9641	17	19.93784	-2.93784	.04
3	1.0185	21.5	20.52897	.971035	.04
4	1.025	18	20.65462	-2.654617	.04
5	1.0772	21.5	22.5191	-1.019096	.04
6	1.1001	30.5	24.10438	6.395619	.04
7	1.1175	19	25.79945	-6.79945	.04
8	1.1566	40.5	31.72988	8.770122	.04
9	1.174	28.5	35.49898	-6.998982	.04
10	1.2132	41.5	46.29232	-4.792313	.04
11	1.2132	46	46.29232	-.2923126	.04
12	1.2382	55.5	53.68161	1.81839	.04
13	1.2654	64.5	60.19575	4.304257	.04
14	1.297	58	64.10375	-6.103752	.04
15	1.3263	65	64.99922	7.781983E-04	.04
16	1.3535	66.5	65.0828	1.417198	.04
17	1.4166	64.5	65.08533	-.5853271	.04
18	1.4514	68.5	65.08533	3.414673	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.11093 .

JOB: CHARPY RC-2 BCONT-06/27/89 time - 15:51:36

SUMMARY OF TASK # 2

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01256*x^(22)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8819332), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 3: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01147*x^(22.5)]
Coefficient of Determination, CD = .945509
Residual Variance, RV = .8818857

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.18971 C(2)= 64.9832

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	19.99371	5.006287	.04
2	.9641	17	20.02062	-3.020615	.04
3	1.0185	21.5	20.56969	.9303131	.04
4	1.025	18	20.68795	-2.687946	.04
5	1.0772	21.5	22.47306	-.9730606	.04
6	1.1001	30.5	24.01719	6.482811	.04
7	1.1175	19	25.68455	-6.684551	.04
8	1.1566	40.5	31.60011	8.899891	.04
9	1.174	28.5	35.40219	-6.902191	.04
10	1.2132	41.5	46.37454	-4.874535	.04
11	1.2132	46	46.37454	-.3745346	.04
12	1.2382	55.5	53.88362	1.616379	.04
13	1.2654	64.5	60.40347	4.096535	.04
14	1.297	58	64.1452	-6.145203	.04
15	1.3263	65	64.92122	7.878113E-02	.04
16	1.3535	66.5	64.98184	1.518166	.04
17	1.4166	64.5	64.9832	-.4832001	.04
18	1.4514	68.5	64.9832	3.5168	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.11017 .

JOB: CHARPY RC-2 BCONT-06/27/89

time - 15:53:23

SUMMARY OF TASK # 3

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01147*x^(22.5)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8818857), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 4: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01048*x^(23)]
Coefficient of Determination, CD = .94546
Residual Variance, RV = .8826718

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-44.98643   C(2)= 64.8825

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.07443	4.925572	.04
2	.9641	17	20.09897	-3.098969	.04
3	1.0185	21.5	20.60906	.8909416	.04
4	1.025	18	20.72037	-2.720368	.04
5	1.0772	21.5	22.42964	-.9296418	.04
6	1.1001	30.5	23.93367	6.56633	.04
7	1.1175	19	25.57372	-6.573723	.04
8	1.1566	40.5	31.47432	9.025684	.04
9	1.174	28.5	35.30941	-6.80941	.04
10	1.2132	41.5	46.4622	-4.962197	.04
11	1.2132	46	46.4622	-.4621964	.04
12	1.2382	55.5	54.08895	1.411057	.04
13	1.2654	64.5	60.60457	3.895435	.04
14	1.297	58	64.17286	-6.172859	.04
15	1.3263	65	64.83878	.1612244	.04
16	1.3535	66.5	64.88179	1.61821	.04
17	1.4166	64.5	64.8825	-.3824997	.04
18	1.4514	68.5	64.8825	3.6175	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.12275 .

JOB: CHARPY RC-2 BCONT-06/27/89   time - 15:54:49

SUMMARY OF TASK # 4

This task investigated Polynomials of degree 1 through 1 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01048*x^(23)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8826718), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 5: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-8.740001E-03*x^(24)]
Coefficient of Determination, CD = .94526
Residual Variance, RV = .8859224

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-44.60788 C(2)= 64.70011

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.23369	4.766316	.04
2	.9641	17	20.25406	-3.254059	.04
3	1.0185	21.5	20.69346	.8065376	.04
4	1.025	18	20.79186	-2.791859	.04
5	1.0772	21.5	22.35571	-.8557129	.04
6	1.1001	30.5	23.77942	6.720581	.04
7	1.1175	19	25.36266	-6.362664	.04
8	1.1566	40.5	31.22194	9.278061	.04
9	1.174	28.5	35.11739	-6.617394	.04
10	1.2132	41.5	46.62579	-5.125786	.04
11	1.2132	46	46.62579	-.6257858	.04
12	1.2382	55.5	54.48431	1.01569	.04
13	1.2654	64.5	60.97575	3.52425	.04
14	1.297	58	64.19867	-6.19867	.04
15	1.3263	65	64.67933	.3206711	.04
16	1.3535	66.5	64.69994	1.800064	.04
17	1.4166	64.5	64.70011	-.2001038	.04
18	1.4514	68.5	64.70011	3.799896	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.17476 .

JOB: CHARPY RC-2 BCONT-06/27/89

time - 15:58:03

SUMMARY OF TASK # 5

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-8.740001E-03*x^(24)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8859224), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

JOB: CHARPY RC-2 BCONT-06/27/89

time - 16:05:05

JOB DESCRIPTION

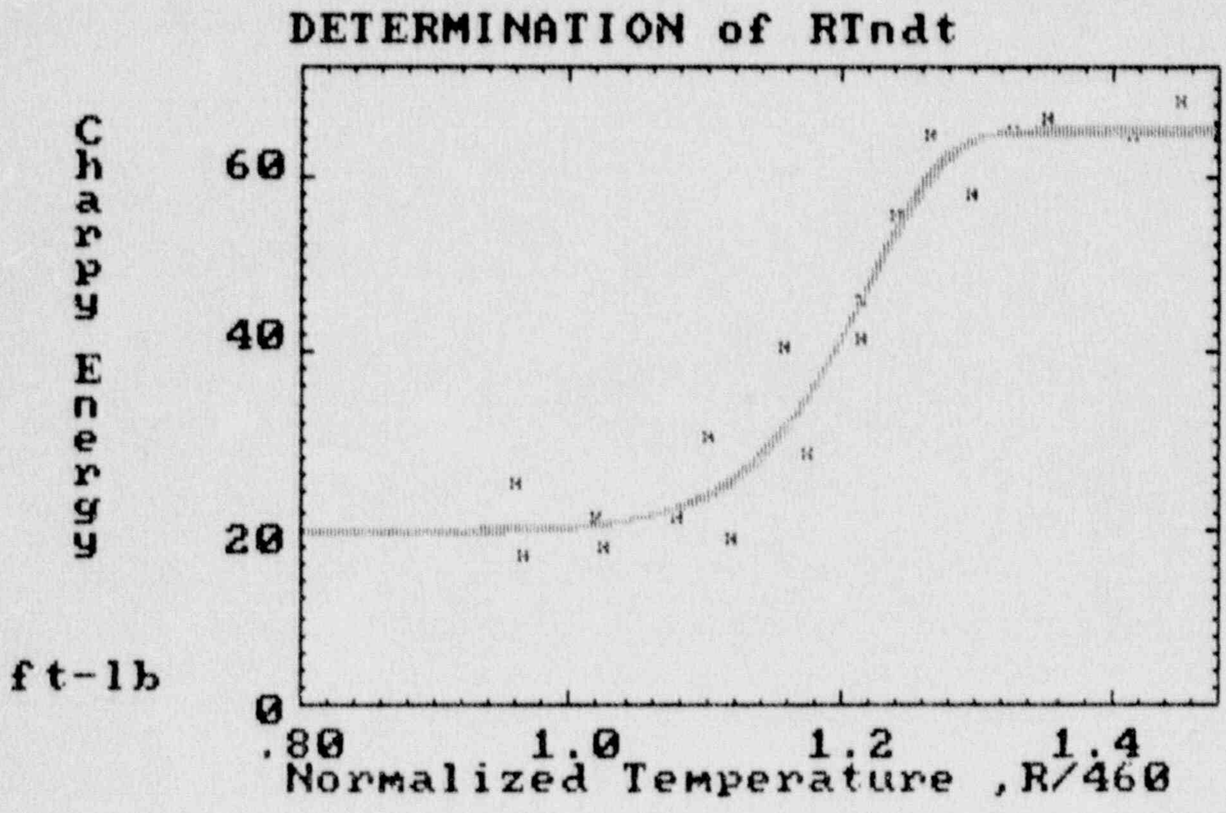
This is a continuation of the analysis begun with job 'INITIAL ANALYSIS --06/26/89' and extended through job 'CHARPY RC-2 ACONT -06/27/89.' This job will use Basis Function # 6 in the polynomial fit to the mofified data from file 'FOL06891.SIS.'

EACH CURVE IS A 'BEST FIT' WITH AN nth DEGREE POLYNOMIAL
P[X(x)] = C(1)X(x)^n + C(2)X(x)^(n-1) + ... + C(n)X(x) + C(n+1)

PLOTTING INSTRUCTIONS
Generate (color) MEDIUM resolution, LINEAR graphs with
PLOTnFIT DETERMINED COORDINATE RANGES AND MARKING INTERVALS

***** DATA *****

TASK#	IDENTIFICATION	n	SYMBOL		NDP	SOURCE
1	Mod. CHARPY DATA from RC-2	1	small	H	18	FILE fol06891.sis
2	Mod. CHARPY DATA from RC-2	1	small	H	18	FILE fol06891.sis
3	Mod. CHARPY DATA from RC-2	1	small	H	18	FILE fol06891.sis
4	Mod. CHARPY DATA from RC-2	1	small	H	18	FILE fol06891.sis
5	Mod. CHARPY DATA from RC-2	1	small	H	18	FILE fol06891.sis



Part 2.c) Comments on OUTPUT

1. The result of this part of the analysis is that the maximum variation in RV is from 0.8859 with CG1:CF1 values 24:(-0.00874) (see page A-58) to 0.8819 with CG1:CF1 values 22.5:(-0.0115) (see page A-56); hence, CG1:CF1 values that yield a reasonable good fit to the data for Basis Function # 6 (CS1 = 0, CO1 = 0, CD1 = 0, and CE1 = 1) are 22.5:(-0.01097). The corresponding CHI^2 is 14.110.

Part 3.a) INPUT

From Part 2.c) OUTPUT, the polynomial of degree n = 1, with Basis Function # 6, that seems to yield the best model had coefficients CF1 = -0.0115 and CG1 = 22.5. The job submitted for this part of the analysis will consist of eight tasks and will explore the sensitivity of the results of Part 2.c) to small changes in Basis Function parameters. The first six tasks will involve keeping CG1 = 22.5 while letting CF1 take the values, CF1 = -0.0125, -0.0115, -0.0105, -0.0100, -0.0095, and -0.0085. The next two tasks will involve keeping CF1 = -0.0115 while letting CG1 take the values, CG1 = 21 and 24.

```
Identify your job (INITIAL ANALYSIS):
     FORMAT - a string of less than 18 characters (where BASIC
     filename rules apply to first 3 and last 3 characters) - CHARPY RC-2 CCONT

Describe your job (This analysis is to get a 'feel' for the data.):
     FORMAT - a 'comma-less' string of less than 256 characters -
This is a continuation of the analysis begun with job 'INITIAL ANALYSIS --06/26/
89' and extended through job 'CHARPY RC-2 BCONT -06/27/89.' This job will use B
asis Function # 6 in the polynomial fit to the modified data from file  FOL06891
.SIS.'

                              PLOTTING INSTRUCTIONS

What kind of graphs would you like to generate:
     1. LINEAR
     2. SEMI-LOG (Y-axis,LOG; X-axis,LINEAR)
     3. LOG-LOG
NT(= 1 )=

     What palette do you want:
           FOR NP=1   FOR NP=2        FOR NOP=1              FOR NOP=2
           GREEN        MAGENTA       'CURVES'               'CURVES'
           RED          CYAN          'DATA POINTS'          'DATA FIELD'
           BROWN        WHITE         'AXES AND LABELS'      'DATA POINTS,AXES,
                                                                AND LABELS'
     NP(= 1 )= 2

           Regardless of the NOP value you enter here, if you later
           choose to make HARD COPIES of the data and curves plotted
           on the screen, PLOTnFIT will automatically make NOP=1.
     NOP(= 2 )=

     What background color do you want:
           1. BLACK
           2. GRAY
           3. LIGHT BLUE
           4. BROWN
           5. YELLOW
           6. LIGHT GREEN
     NQ(= 3 )= 4

Would you like graph labels different from those shown in ()?
     TITLE              (DETERMINATION of RTndt)(y/n):
     X-AXIS             (Normalized Temperature)(y/n):
     units                                (R/460)(y/n):
     Y-AXIS                       (Charpy Energy)(y/n):
     units                               (ft-lb)(y/n):


 What scaling procedure (NS) would you like to use?
      1. SPECIFY COORDINATE RANGES AND MARKING INTERVALS FOR
         THE AXES (USE ONLY AFTER EXPERIENCE WITH 'PLOTnFIT')
```

```
      2. ALLOW 'PLOTnFIT' TO ESTABLISH COORDINATE RANGES AND
         MARKING INTERVALS BASED ON THE DATA RANGES
NS(= 2 )=
```

DATA AND DATA IDENTIFICATION

```
How many Tasks will there be in this job (1<=NDS<=8)? NDS(= 5 )= 8

      What INPUT device (NE) would you like to use to
      enter your Data for Task # 1 ?
           1. The KEYBOARD
           2. A STORED FILE
      NE(= 2 )=

      What is the location and name of the FILE containing Data for Task # 1 ?
           FORMAT - (storage)device:filename (a:fol06891.sis) -

      How many Data Sets are in this FILE?
           NDSF(= 1 )=


      Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
      [i.e., that identified as : Mod. CHARPY DATA from RC-2;
      with (NDP=) 18 data points] (y/n)? y

      Do you want to INPUT the stored weighting factors (y/n)? y

      Do you want to change ANY data in this Data Set (y/n)?

      Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

   1.  X(x)=CS1+x
   2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
   3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
   4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
   5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
   6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
   7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
   8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
   9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
  10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
  11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

   BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 1 )=
     CF1(=-.01505 )=-0.0125
     CG1(= 21 )=22.5
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in ascending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

    What is the lowest degree polynomial (LDP) you want to consider
    for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=
```

```
How many polynomial fits (NPF) do you want to
try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

     What symbol (M) would you like to use to represent
     the Data for Task # 1 ?
          1.   I                              5. DIAMOND
          2. CROSS                            6. TRIANGLE - UP
          3.   X                              7. TRIANGLE - DOWN
          4.   H                              8. SQUARE
     M(= 4 )= 5

     What symbol size (MM) would you like?
          1. small
          2. LARGE
     MM(= 1 )=

What INPUT device (NE) would you like to use to
enter your Data for Task # 2 ?
     1. The KEYBOARD
     2. A STORED FILE
NE(= 2 )=

What is the location and name of the FILE containing Data for Task # 2 ?
     FORMAT - (storage)device:filename (a:fol06891.sis) -

How many Data Sets are in this FILE?
     NDSF(= 1 )=


Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIC FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

   1.  X(x)=CS1+x
   2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
   3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
   4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
   5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
   6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
   7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
   8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
   9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
  10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
  11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
      CS1(= 0 )=
      CO1(= 0 )=
      CD1(= 0 )=
      CE1(= 1 )=
      CF1(=-.01256 )=-0.0115
      CG1(= 22 )=22.5
```

For each Data Set in the job, the program starts with the lowest degree polynomial you want to consider and fits it to the data points; the program then fits, sequentially and in assending order, as many higher degree polynomials as you specify (the current degree limit is 10).

What is the lowest degree polynomial (LDP) you want to consider for this Data Set (1 <= LDP <= 10)? LDP(=1)=

How many polynomial fits (NPF) do you want to try - including the LDP - (1 <= NPF <= 10)? NPF(=1)=

What symbol (M) would you like to use to represent the Data for Task # 2 ?

1. I	5. DIAMOND
2. CROSS	6. TRIANGLE - UP
3. X	7. TRIANGLE - DOWN
4. H	8. SQUARE

M(= 6)= 5

What symbol size (MM) would you like?
1. small
2. LARGE

MM(= 1)=

What INPUT device (NE) would you like to use to enter your Data for Task # 3 ?
1. The KEYBOARD
2. A STORED FILE

NE(= 2)=

What is the location and name of the FILE containing Data for Task # 3 ?
FORMAT - (storage)device:filename (a:fol06891.sis) -

How many Data Sets are in this FILE?
NDSF(= 1)=

Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

1. X(x)=CS1+x
2. X(x)=CS1+EXP(CO1*x)/(CD1+x)
3. X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
4. X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
5. X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
6. X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
7. X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
8. X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
9. X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10. X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11. X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

```
BF(= 6 )=
    CS1(= 0 )=
    CO1(= 0 )=
    CD1(= 0 )=
    CE1(= 1 )=
    CF1(=-.01147 )=-0.0105
    CG1(= 22.5 )=
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

    What is the lowest degree polynomial (LDP) you want to consider
    for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

    How many polynomial fits (NPF) do you want to
    try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 3 ?
                1.   I                         5. DIAMOND
                2. CROSS                       6. TRIANGLE - UP
                3.   X                         7. TRIANGLE - DOWN
                4.   H                         8. SQUARE
          M(= 6 )= 5

          What symbol size (MM) would you like?
                1. small
                2. LARGE
          MM(= 1 )=

    What INPUT device (NE) would you like to use to
    enter your Data for Task # 4 ?
          1. The KEYBOARD
          2. A STORED FILE
    NE(= 2 )=

    What is the location and name of the FILE containing Data for Task # 4 ?
          FORMAT - (storage)device:filename (a:fol06891.sis) -

    How many Data Sets are in tl   FILE?
          NDSF(= 1 )=


    Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
    [i.e., that identified as : Mod. CHARPY DATA from RC-2;
    with (NDP=) 18 data points] (y/n)? y

    Do you want to INPUT the stored weighting factors (y/n)? y

    Do you want to change ANY data in this Data Set (y/n)?

    Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
```

9. X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10. X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11. X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

BF(= 5)=
CS1(= 0)=
CO1(= 0)=
CD1(= 0)=
CE1(= 1)=
CF1(=-.01048)=-0.0100
CG1(= 23)=22.5

For each Data Set in the job, the program starts with the lowest degree polynomial you want to consider and fits it to the data points; the program then fits, sequentially and in assending order, as many higher degree polynomials as you specify (the current degree limit is 10).

What is the lowest degree polynomial (LDP) you want to consider for this Data Set (1 <= LDP <= 10)? LDP(=1)=

How many polynomial fits (NPF) do you want to try - including the LDP - (1 <= NPF <= 10)? NPF(=1)=

What symbol (M) would you like to use to represent the Data for Task # 4 ?

1. I
2. CROSS
3. X
4. H
5. DIAMOND
6. TRIANGLE - UP
7. TRIANGLE - DOWN
8. SQUARE

M(= 6)= 5

What symbol size (MM) would you like?

1. small
2. LARGE

MM(= 1)=

What INPUT device (NE) would you like to use to enter your Data for Task # 5 ?

1. The KEYBOARD
2. A STORED FILE

NE(= 2)=

What is the location and name of the FILE containing Data for Task # 5 ?
FORMAT - (storage)device:filename (a:fol06891.sis) -

How many Data Sets are in this FILE?
NDSF(= 1)=

Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis [i.e., that identified as : Mod. CHARPY DATA from RC-2; with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

```
 1.  X(x)=CS1+x
 2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
 3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
 4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
 5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
 6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
 7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
 8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
 9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 1 )=
     CF1(=-8.740001E-03 )=-0.0095
     CG1(= 24 )=22.5
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

     What is the lowest degree polynomial (LDP) you want to consider
     for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

     How many polynomial fits (NPF) do you want to
     try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 5 ?
               1.   I                            5. DIAMOND
               2. CROSS                          6. TRIANGLE - UP
               3.   X                            7. TRIANGLE - DOWN
               4.   H                            8. SQUARE
          M(= 6 )= 5

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 6 ?
          1. The KEYBOARD
          2. A STORED FILE
     NE(= 2 )=

     What is the location and name of the FILE containing Data for Task # 6 ?
          FORMAT - (storage)device:filename (a:fol06891.sis) -

     How many Data Sets are in this FILE?
          NDSF(= 1 )=


     Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
     [i.e., that identified as : Mod. CHARPY DATA from RC-2;
     with (NDP=) 18 data points] (y/n)? y

     Do you want to INPUT the stored weighting factors (y/n)? y
```

```
Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
      CS1(= 0 )=
      CO1(= 0 )=
      CD1(= 0 )=
      CE1(= 1 )=
      CF1(=-.00295 )=-0.0085
      CG1(= 30 )=22.5
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in ascending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

      What is the lowest degree polynomial (LDP) you want to consider
      for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

      How many polynomial fits (NPF) do you want to
      try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 6 ?
               1.   I                              5. DIAMOND
               2. CROSS                            6. TRIANGLE - UP
               3.   X                              7. TRIANGLE - DOWN
               4.   H                              8. SQUARE
          M(= 6 )= 5

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=

      What INPUT device (NE) would you like to use to
      enter your Data for Task # 7 ?
          1. The KEYBOARD
          2. A STORED FILE
      NE(= 2 )=

      What is the location and name of the FILE containing Data for Task # 7 ?
          FORMAT - (storage)device:filename (a:fc106891.sis) -

      How many Data Sets are in this FILE?
          NDSF(= 1 )=
```

```
Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 0 )=1
     CF1(= 0 )=-0.0115
     CG1(= 0 )=?2.51
          For each Data Set in the job, the program starts with
          the lowest degree polynomial you want to consider and
          fits it to the data points; the program then fits,
          sequentially and in assending order, as many higher
          degree polynomials as you specify (the current degree
          limit is 10).

     What is the lowest degree polynomial (LDP) you want to consider
     for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

     How many polynomial fits (NPF) do you want to
     try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

          What symbol (M) would you like to use to represent
          the Data for Task # 7 ?
               1.   I                               5. DIAMOND
               2. CROSS                             6. TRIANGLE - UP
               3.   X                               7. TRIANGLE - DOWN
               4.   H                               8. SQUARE
          M(= 6 )= 5

          What symbol size (MM) would you like?
               1. small
               2. LARGE
          MM(= 1 )=

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 8 ?
          1. The KEYBOARD
          2. A STORED FILE
     NE(= 2 )=
```

```
What is the location and name of the FILE containing Data for Task # 8 ?
     FORMAT - (storage)device:filename (a:fol06891.sis) -

How many Data Sets are in this FILE?
     NDSF(= 1 )=


Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
[i.e., that identified as : Mod. CHARPY DATA from RC-2;
with (NDP=) 18 data points] (y/n)? y


Do you want to INPUT the stored weighting factors (y/n)?

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y


Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

  BF(= 6 )=
     CS1(= 0 )=
     CO1(= 0 )=
     CD1(= 0 )=
     CE1(= 0 )=1
     CF1(= 0 )=-0.0115
     CG1(= 0 )=24
         For each Data Set in the job, the program starts with
         the lowest degree polynomial you want to consider and
         fits it to the data points; the program then fits,
         sequentially and in assending order, as many higher
         degree polynomials as you specify (the current degree
         limit is 10).

   What is the lowest degree polynomial (LDP) you want to consider
   for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=

   How many polynomial fits (NPF) do you want to
   try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)=

         What symbol (M) would you like to use to represent
         the Data for Task # 8 ?
              1.  I                             5. DIAMOND
              2. CROSS                          6. TRIANGLE - UP
              3.  X                             7. TRIANGLE - DOWN
              4.  H                             8. SQUARE
         M(= 6 )= 5
```

What symbol size (MM) would you like?
1. small
2. LARGE
MM(= 1)=

ALL PLOTTING INSTRUCTIONS AND DATA HAVE BEEN ENTERED

Would you like to make changes in your Plotting Instructions;
values currently in the computer appear in parenthesis (y/n)?

Would you like to make a few changes in one or more of your Data
Sets [most useful when most data are from the KEYBOARD] (y/n)?

Would you like to completely RE-INPUT your Coordinate Data
[most useful when most data are from STORED FILES] (y/n)?

Number of Bits not being used at this time, for this job = 1223

Would you like to PRINT values of the Polynomial
Coefficients for all the curves fit to each Data Set,
along with the corresponding Residual Variances and
Coefficients of Determination (y/n)? y

Would you like to make HARD COPIES of graphs of ALL
the Data Sets, one set of graphs for each Data Set,
showing ALL the polynomial curves fit to EACH Data
Set (y/n)?

Would you like to make 'a' HARD COPY graph containing
ALL the Data Sets, each Data Set with it's corresponding
'BEST POLYNOMIAL/BEST FIT' curve (y/n)? y

Would you like to PRINT values of key program variables
and a Table of some of the points which fall on each
'BEST POLYNOMIAL/BEST FIT' curve plotted (y/n)?

Would you like to INPUT a function to be plotted
with your data (y/n)?

Would you like to save your DATA for later use (y/n)?

Part 3.a) OUTPUT

PLOTnFIT.4th

JOB: CHARPY RC-2 CCONT-06/27/89

time - 16:33:14

THE FOLLOWING ARE DATA RESULTING FROM FITTING POLYNOMIALS TO THE VARIOUS DATA SETS

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0125*x^(22.5)]
Coefficient of Determination, CD = .943408
Residual Variance, RV = .9158943

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.02924 C(2)= 64.42653

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	19.61467	5.38533	.04
2	.9641	17	19.64387	-2.643868	.04
3	1.0185	21.5	20.23953	1.260475	.04
4	1.025	18	20.36773	-2.367729	.04
5	1.0772	21.5	22.29922	-.7992173	.04
6	1.1001	30.5	23.9641	6.5359	.04
7	1.1175	19	25.75554	-6.755535	.04
8	1.1566	40.5	32.05436	8.445644	.04
9	1.174	28.5	36.0511	-7.551094	.04
10	1.2132	41.5	47.30398	-5.803978	.04
11	1.2132	46	47.30398	-1.303978	.04
12	1.2382	55.5	54.67646	.8235436	.04
13	1.2654	64.5	60.71103	3.788971	.04
14	1.297	58	63.84284	-5.842835	.04
15	1.3263	65	64.39236	.6076431	.04
16	1.3535	66.5	64.426	2.074005	.04
17	1.4166	64.5	64.42653	7.347107E-02	.04
18	1.4514	68.5	64.42653	4.073471	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.65431 .

JOB: CHARPY RC-2 CCONT-06/27/89

time - 16:33:33

SUMMARY OF TASK # 1

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0125*x^(22.5)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .9158943), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? ? y

TASK # 2: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0115*x^(22.5)]
Coefficient of Determination, CD = .945468
Residual Variance, RV = .8825512

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.18515 C(2)= 64.9664

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	19.98197	5.018029	.04
2	.9641	17	20.00894	-3.008938	.04
3	1.0185	21.5	20.55938	.9406242	.04
4	1.025	18	20.67793	-2.677925	.04
5	1.0772	21.5	22.46734	-.9673424	.04
6	1.1001	30.5	24.01503	6.484974	.04
7	1.1175	19	25.68607	-6.686066	.04
8	1.1566	40.5	31.6131	8.886902	.04
9	1.174	28.5	35.42114	-6.921135	.04
10	1.2132	41.5	46.40274	-4.902741	.04
11	1.2132	46	46.40274	-.4027405	.04
12	1.2382	55.5	53.90863	1.591377	.04
13	1.2654	64.5	60.41447	4.085537	.04
14	1.297	58	64.13718	-6.137177	.04
15	1.3263	65	64.90549	9.451294E-02	.04
16	1.3535	66.5	64.96508	1.534927	.04
17	1.4166	64.5	64.9664	-.4664002	.04
18	1.4514	68.5	64.9664	3.5336	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.12082 .

JOB: CHARPY RC-2 CCONT-06/27/89

time - 16:34:42

SUMMARY OF TASK # 2

This task investigated Polynomials of degree 1 through 1 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0115*x^(22.5)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8825512), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 3: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]
Coefficient of Determination, CD = .946064
Residual Variance, RV = .8729078

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.33264 C(2)= 65.54778

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.39904	4.60096	.04
2	.9641	17	20.42376	-3.42376	.04
3	1.0185	21.5	20.92846	.5715408	.04
4	1.025	18	21.03723	-3.037232	.04
5	1.0772	21.5	22.68216	-1.182163	.04
6	1.1001	30.5	24.10975	6.390255	.04
7	1.1175	19	25.65639	-6.656388	.04
8	1.1566	40.5	31.19042	9.309586	.04
9	1.174	28.5	34.79054	-6.290543	.04
10	1.2132	41.5	45.42569	-3.92569	.04
11	1.2132	46	45.42569	.5743103	.04
12	1.2382	55.5	53.00938	2.490624	.04
13	1.2654	64.5	59.9722	4.527802	.04
14	1.297	58	64.36998	-6.36998	.04
15	1.3263	65	65.4392	-.4391938	.04
16	1.3535	66.5	65.54448	.9555206	.04
17	1.4166	64.5	65.54778	-1.047775	.04
18	1.4514	68.5	65.54778	2.952225	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 13.96653 .

JOB: CHARPY RC-2 CCONT-06/27/89

time - 16:35:53

SUMMARY OF TASK # 3

This task investigated Polynomials of degree 1 through 1 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8729078), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 4: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01*x^(22.5)]
Coefficient of Determination, CD = .94568
Residual Variance, RV = .8791269

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.40218   C(2)= 65.85591

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.62917	4.370835	.04
2	.9641	17	20.65274	-3.652744	.04
3	1.0185	21.5	21.13439	.3656159	.04
4	1.025	18	21.23822	-3.23822	.04
5	1.0772	21.5	22.80999	-1.309994	.04
6	1.1001	30.5	24.17641	6.323593	.04
7	1.1175	19	25.65932	-6.659317	.04
8	1.1566	40.5	30.9886	9.511402	.04
9	1.174	28.5	34.4772	-5.977204	.04
10	1.2132	41.5	44.90824	-3.408241	.04
11	1.2132	46	44.90824	1.091759	.04
12	1.2382	55.5	52.50573	2.994274	.04
13	1.2654	64.5	59.68578	4.814224	.04
14	1.297	58	64.45236	-6.452362	.04
15	1.3263	65	65.71097	-.710968	.04
16	1.3535	66.5	65.85071	.649292	.04
17	1.4106	64.5	65.85591	-1.355911	.04
18	1.4514	68.5	65.85591	2.644089	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.06603 .

JOB: CHARPY RC-2 CCONT-06/27/89

time - 16:37:30

SUMMARY OF TASK # 4

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.01*x^(22.5)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8791269), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 5: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0095*x^(22.5)]
Coefficient of Determination, CD = .944755
Residual Variance, RV = .894097

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.46839 C(2)= 66.17696

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.87549	4.124512	.04
2	.9641	17	20.89793	-3.897926	.04
3	1.0185	21.5	21.35637	.1436272	.04
4	1.025	18	21.45524	-3.455238	.04
5	1.0772	21.5	22.95324	-1.453243	.04
6	1.1001	30.5	24.25775	6.242253	.04
7	1.1175	19	25.67589	-6.675888	.04
8	1.1566	40.5	30.79481	9.705192	.04
9	1.174	28.5	34.16664	-5.666641	.04
10	1.2132	41.5	44.37148	-2.871475	.04
11	1.2132	46	44.37148	1.628525	.04
12	1.2382	55.5	51.96351	3.536495	.04
13	1.2654	64.5	59.34938	5.15062	.04
14	1.297	58	64.5045	-6.504502	.04
15	1.3263	65	65.98348	-.9834824	.04
16	1.3535	66.5	66.16876	.3312454	.04
17	1.4166	64.5	66.17696	-1.676956	.04
18	1.4514	68.5	66.17696	2.323044	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.30555 .

JOB: <u>CHARPY RC-2 CCONT-06/27/89</u>

time - 16:38:53

SUMMARY OF TASK # 5

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0095*x^(22.5)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .894097), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 6: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-8.500001E-03*x^(22.5)]
Coefficient of Determination, CD = .940966
Residual Variance, RV = .9554064

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.58938 C(2)= 66.86283

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	21.42322	3.576786	.04
2	.9641	17	21.44335	-4.443352	.04
3	1.0185	21.5	21.85504	-.3550377	.04
4	1.025	18	21.94388	-3.943874	.04
5	1.0772	21.5	23.29251	-1.792507	.04
6	1.1001	30.5	24.47094	6.029057	.04
7	1.1175	19	25.75643	-6.756424	.04
8	1.1566	40.5	30.43743	10.06257	.04
9	1.174	28.5	33.55945	-5.059445	.04
10	1.2132	41.5	43.24098	-1.740974	.04
11	1.2132	46	43.24098	2.759026	.04
12	1.2382	55.5	50.7559	4.744103	.04
13	1.2654	64.5	58.50489	5.99511	.04
14	1.297	58	64.48876	-6.488755	.04
15	1.3263	65	66.51819	-1.518189	.04
16	1.3535	66.5	66.84245	-.3424454	.04
17	1.4166	64.5	66.86283	-2.362824	.04
18	1.4514	68.5	66.86283	1.637177	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 15.2865 .

JOB: CHARPY RC-2 CCONT-06/27/89

time - 16:40:12

SUMMARY OF TASK # 6

This task investigated Polynomials of degree 1 through 1 fit to the Data Set, Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-8.500001E-03*x^(22.5)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .9554064), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 7: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0115*x^(21)]
Coefficient of Determination, CD = .9407919
Residual Variance, RV = .9582226

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-46.24303 C(2)= 67.11995

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	21.09572	3.904286	.04
2	.9641	17	21.12303	-4.123032	.04
3	1.0185	21.5	21.65184	-.1518402	.04
4	1.025	18	21.76154	-3.761536	.04
5	1.0772	21.5	23.34363	-1.843624	.04
6	1.1001	30.5	24.65643	5.843575	.04
7	1.1175	19	26.04647	-7.046471	.04
8	1.1566	40.5	30.89225	9.60775	.04
9	1.174	23.5	34.00698	-5.506981	.04
10	1.2132	41.5	43.35501	-1.855003	.04
11	1.2132	16	43.35501	2.644997	.04
12	1.2382	55.5	50.47251	5.027489	.04
13	1.2654	64.5	57.89903	6.600975	.04
14	1.297	58	64.03286	-6.03286	.04
15	1.3263	65	66.50913	-1.509132	.04
16	1.3535	66.5	67.05872	-.5587158	.04
17	1.4166	64.5	67.11995	-2.619942	.04
18	1.4514	68.5	67.11995	1.380058	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 15.33156 .

JOB: <u>CHARPY RC-2 CCONT-06/27/89</u>

time - 16:41:35

SUMMARY OF TASK # 7

This task investigated Polynomials of degree 1 through 1 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0115*x^(21)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .9582226), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 8: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0115*x^(24)]
Coefficient of Determination, CD = .932598
Residual Variance, RV = 27.27104

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-44.01487 C(2)= 62.99604

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	19.16473	5.835266	1
2	.9641	17	19.19116	-2.191158	1
3	1.0165	21.5	19.76009	1.73991	1
4	1.025	18	19.88724	-1.887241	1
5	1.0772	21.5	21.89603	-.3960266	1
6	1.1001	30.5	23.70455	6.795452	1
7	1.1175	19	25.69249	-6.692494	1
8	1.1566	40.5	32.82527	7.674729	1
9	1.174	28.5	37.35726	-8.857262	1
10	1.2132	41.5	49.58848	-8.088478	1
11	1.2132	46	49.58848	-3.588478	1
12	1.2382	55.5	56.6674	-1.167397	1
13	1.2654	64.5	61.31838	3.181618	1
14	1.297	58	62.87613	-4.876126	1
15	1.3263	65	62.99423	2.005776	1
16	1.3535	66.5	62.99604	3.503964	1
17	1.4166	64.5	62.99604	1.50396	1
18	1.4514	68.5	62.99604	5.50396	1

The Root-Residual Variance or Standard Deviation (SIGMA) is 5.222168 .

JOB: <u>CHARPY RC-2 CCONT-06/27/89</u>

time - 16:42:53

SUMMARY OF TASK # 8

This task investigated Polynomials of degree 1 through 1 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0115*x^(24)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = 27.27104), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

JOB: CHARPY RC-2 CCONT-06/27/89

time - 16:54:45

JOB DESCRIPTION

This is a continuation of the analysis begun with job 'INITIAL ANALYSIS --06/26/89' and extended through job 'CHARPY RC-2 BCONT -06/27/89.' This job will use Basis Function # 6 in the polynomial fit to the modified data from file FOL06891.SIS.

EACH CURVE IS A 'BEST FIT' WITH AN nth DEGREE POLYNOMIAL

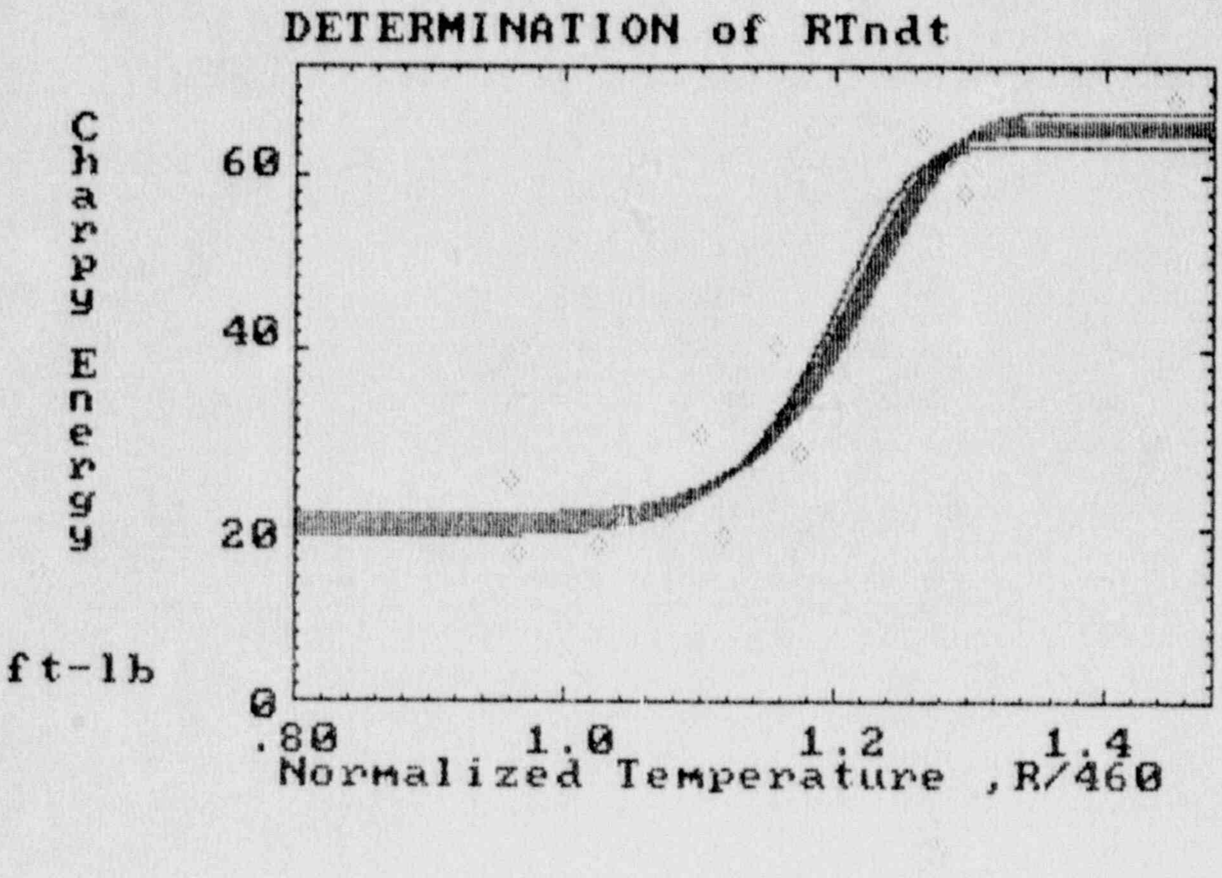
P[X(x)] = C(1)X(x)^n + C(2)X(x)^(n-1) + ... + C(n)X(x) + C(n+1)

PLOTTING INSTRUCTIONS

Generate (color) MEDIUM resolution, LINEAR graphs with PLOTnFIT DETERMINED COORDINATE RANGES AND MARKING INTERVALS

***** DATA *****

TASK#	IDENTIFICATION	n	SYMBOL	NDP	SOURCE
1	Mod. CHARPY DATA from RC-2	1	small DIAMOND	18	FILE fol06891.sis
2	Mod. CHARPY DATA from RC-2	1	small DIAMOND	18	FILE fol06891.sis
3	Mod. CHARPY DATA from RC-2	1	small DIAMOND	18	FILE fol06891.sis
4	Mod. CHARPY DATA from RC-2	1	small DIAMOND	18	FILE fol06891.sis
5	Mod. CHARPY DATA from RC-2	1	small DIAMOND	18	FILE fol06891.sis
6	Mod. CHARPY DATA from RC-2	1	small DIAMOND	18	FILE fol06891.sis
7	Mod. CHARPY DATA from RC-2	1	small DIAMOND	18	FILE fol06891.sis
8	Mod. CHARPY DATA from RC-2	1	small DIAMOND	18	FILE fol06891.sis



Part 3.a) Comments on OUTPUT

1. From among all the tasks, the lowest CHI^2 was obtained for that task with CG1:CF1 values of 22.5:(-0.0105) for which CHI^2 = 13.97 (see page A-74).

2. The results of this part of the analysis are that while CHI^2 is not very sensitive to variations in CF1 (i.e., a + or - 16 percent variation in CF1 produced less than a 5 percent variation in CHI^2), it is somewhat sensitive to changes in CG1 (i.e., a 6.7 percent variation in CG1 produced a 24 percent variation in CHI^2).

3. Note the results from Task # 8 shown on page A-79. When entering the data for Task # 8, a negative response was accidently given to the question, "Do you want to INPUT stored weighting factors (y/n)?" (see page A-70). Since for this analysis all points have the same weighting factor, the polynomial coefficients C(1) and C(2) are not affected by the error. RV can be readily corrected by multiplying the value for RV on page A-79 by 0.04 to get RV = 1.0908 with a resulting CHI^2 of 17.46.

Part 3.b) INPUT

From Part 3.a) OUTPUT, the polynomial of degree n = 1, with Basis Function # 6, that seems to yield the best model had coefficients CG1:CF1 = 22.5:(-0.0105). This part of the analysis will consist of two tasks: (i) with Basis Function # 6 (CS1 = 0, CO1 = 0, CD1 = 0, and CE1 = 1) and the above coefficients, polynomials of degree n = 1 through 4 will be fit to the data; and (ii) with Basis Function # 1 (CS1 = 0), polynomials of degree n = 3 through 6 will be fit to the data. The "best polynomial/best fit" curves will be plotted for comparison. The maximum amount of OUTPUT will be produced for this, the last part of the analysis.

```
RUN

                         PLOTnFIT  /  NUREG - ####

     PLOTnFIT was prepared for an agency of United States Government.
     Neither the United States Government nor any agency thereof, nor any of
     their employees, makes any warran :, expressed or implied, or assumes
     any legal liability or responsibility for ar; third party's use, or
     the results of such use, of any protion of this program or represents
     that its use by such third party would not infringe privately owned
     rights.

          This version of PLOTnFIT (i.e., PLOTNFIT.4TH) will not run
          properly on a PC with a monochrome monitor.  If this PC does
          not have a color/graphics card or this is not a color monitor,
          type yes or y at the EXIT (y/n)? prompt, otherwise type no or n
          and continue (NOTE: If GRAPHICS.COM was not loaded before
          BASICA.COM, HARD COPIES of graphs can not be made.  Now is the
          time to EXIT this job and reload if it is desirable to print
          graphs and GRAPHICS.COM has not been pre-loaded.).
          THE PRINTER MUST BE KEPT ON WHILE PLOTNFIT IS OPERATING.

     EXIT (y/n)?

     Number of Bits not being used at the START of this job = 10486

     For default purposes, what Disk Drive (e.g., A:) would you most likely
     want to WRITE to (include subdirectory if applicable - e.g., C:\SUBDIR\)
? a:


          ***************************************************************
          *                                                             *
          *                         PLOTnFIT                            *
          *                                                             *
          *     A US NRC Program for Plotting and  Analyzing            *
          *     (i.e.,  Curve  Fitting)  Data  Interactively            *
          *     with  an  IBM  or  IBM  Compatible  Personal            *
          *     Computer (PC) (using DOS 2.1 and BASICA 3.0)            *
          *                                                             *
          *                         May 1989                            *
          *                                                             *
          ***************************************************************

   IF YOU ARE 'NOT' ALREADY FAMILIAR WITH THIS PROGRAM, you should probably
   ENTER yes at the 'EXIT (y/n)?' prompt, and run the program 'READ1ST.PNF'.

     Exit (y/n)?

Identify your job (INITIAL ANALYSIS):
     FORMAT - a string of less than 18 characters (where BASIC
     filename rules apply to first 3 and last 3 characters) - CHARPY RC-2 DCONT

Describe your job (This analysis is to get a 'feel' for the data.):
     FORMAT - a 'comma-less' string of less than 256 characters -
This is a continuation of the analysis begun with job 'INITIAL ANALYSIS --06/26/8
27/89.'  This job will use Basis Function # 6 in the polynomial fit to the modifi

                          PLOTTING INSTRUCTIONS

What kind of graphs would you like to generate:
     1. LINEAR
     2. SEMI-LOG (Y-axis,LOG; X-axis,LINEAR)
     3. LOG-LOG
NT(= 1 )=
```

```
What palette do you want:
     FOR NP=1   FOR NP=2         FOR NOP=1                FOR NOP=2
     GREEN       MAGENTA         'CURVES'                 'CURVES'
     RED         CYAN            'DATA POINTS'            'DATA FIELD'
     BROWN       WHITE           'AXES AND LABELS'        'DATA POINTS,AXES,
                                                           AND LABELS'
NP(= 1 )= 2

     Regardless of the NOP value you enter here, if you later
     choose to make HARD COPIES of the data and curves plotted
     on the screen, PLOTnFIT will automatically make NOP=1.
NOP(= 2 )=

What background color do you want:
     1. BLACK
     2. GRAY
     3. LIGHT BLUE
     4. BROWN
     5. YELLOW
     6. LIGHT GREEN
NQ(= 3 )= 6


Would you like graph labels different from those shown in ()?
     (TITLE )              - 30 characters maximum -    (y/n): y
What is your choice? DETERMINATION of RTndt
     (X-AXIS) Horizontal - 22 characters maximum -    (y/n): y
What is your choice? Normalized Temperature
     (units ) for x-axis -  5 characters maximum -    (y/n): y
What is your choice? R/460
     (Y-AXIS) Vertical   - 16 characters maximum -    (y/n): y
What is your choice? Charpy Energy
     (units ) for y-axis -  5 characters maximum -    (y/n): y
What is your choice? ft-lb

What scaling procedure (NS) would you like to use?
     1. SPECIFY COORDINATE RANGES AND MARKING INTERVALS FOR
        THE AXES (USE ONLY AFTER EXPERIENCE WITH 'PLOTnFIT')
     2. ALLOW 'PLOTnFIT' TO ESTABLISH COORDINATE RANGES AND
        MARKING INTERVALS BASED ON THE DATA RANGES
NS(= 2 )=

                         DATA AND DATA IDENTIFICATION

How many Tasks will there be in this job (1<=NDS<=8)? NDS(= 1 )= 2

     What INPUT device (NE) would you like to use to
     enter your Data for Task # 1 ?
          1. The KEYBOARD
          2. A STORED FILE
     NE(= 1 )= 2

     What is the location and name of the FILE containing Data for Task # 1 ?
          FORMAT - (storage)device:filename - a:fol06891.sis

     How many Data Sets are in this FILE?
          NDSF(= 1 )=


     Do you want to INPUT Data Set # 1 from FILE a:fol06891.sis
     [i.e., that identified as : Mod. CHARPY DATA from RC-2;
     with (NDP=) 18 data points] (y/n)? y

     Do you want to INPUT the stored weighting factors (y/n)? y

     Do you want to change ANY data in this Data Set (y/n)?

     Do you want to fit curves to your Data Points (y/n)? y
```

```
Which of the following BASIS FUNCTIONS do you want to use for this Data
Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

  1.  X(x)=CS1+x
  2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
  3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
  4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
  5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
  6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
  7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
  8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
  9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
 10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
 11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)

If the default value of a coefficient is not zero and you wish it to be zero,
you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since
entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

   BF(= 1 )= 6
      CS1(= 0 )=
      CO1(= 0 )=
      CD1(= 0 )=
      CE1(= 0 )=1
      CF1(= 0 )=-0.0105
      CG1(= 0 )=22.5
           For each Data Set in the job, the program starts with
           the lowest degree polynomial you want to consider and
           fits it to the data points; the program then fits,
           sequentially and in assending order, as many higher
           degree polynomials as you specify (the current degree
           limit is 10).

      What is the lowest degree polynomial (LDP) you want to consider
      for this Data Set (1 <= LDP <= 10 )?  LDP(=1)=


      How many polynomial fits (NPF) do you want to
      try - including the LDP - (1 <= NPF <= 10 )?  NPF(=1)= 4

           What symbol (M) would you like to use to represent
           the Data for Task # 1 ?
                1.   I                          5. DIAMOND
                2. CROSS                        6. TRIANGLE - UP
                3.   X                          7. TRIANGLE - DOWN
                4.   H                          8. SQUARE
           M(= 1 )= 8

           What symbol size (MM) would you like?
                1. small
                2. LARGE
           MM(= 1 )= 2

      What INPUT device (NE) would you like to use to
      enter your Data for Task # 2 ?
           1. The KEYBOARD
           2. A STORED FILE
      NE(= 2 )=

      What is the location and name of the FILE containing Data for Task # 2 ?
           FORMAT - (storage)device:filename (a:fo106891.sis) -

      How many Data Sets are in this FILE?
           NDSF(= 1 )=


      Do you want to INPUT Data Set # 1 from FILE a:fc106891.sis
      [i.e., that identified as : Mod. CHARPY DATA from RC-2;
      with (NDP=) 18 data points] (y/n)? y
```

Do you want to INPUT the stored weighting factors (y/n)? y

Do you want to change ANY data in this Data Set (y/n)?

Do you want to fit curves to your Data Points (y/n)? y

Which of the following BASIS FUNCTIONS do you want to use for this Data Set (YOU MUST supply values for coefficients CS1, CO1, CD1, CE1, CF1 & CG1):

```
 1.  X(x)=CS1+x
 2.  X(x)=CS1+EXP(CO1*x)/(CD1+x)
 3.  X(x)=(CS1+CO1*x+CD1*x^2)*LOG(x)
 4.  X(x)=CS1/x+CO1*LOG(x)+x*LOG(CD1*x+2.718)
 5.  X(x)=CS1+CO1*x^CD1+CE1/(CF1+x^CG1)
 6.  X(x)=CS1*EXP(CO1*x^CD1)+CE1*EXP(CF1*x^CG1)
 7.  X(x)=CS1*EXP(CO1*x)+CD1*EXP(CE1*x)+CF1*EXP(CG1*x)
 8.  X(x)=CS1*(CO1+x)^CD1+CE1*(CF1+x)^CG1
 9.  X(x)=EXP(CS1*x)*(CO1+x)^CD1+EXP(CE1*x)*(CF1+x)^CG1
10.  X(x)=CS1*x*SIN(CO1+CD1*x)+(CE1/(CD1+x))*SIN(CF1+CG1*x)
11.  X(x)=EXP(CS1*x)*SIN(CO1+CD1*x)+CE1*SIN(CF1+CG1*x)
```

If the default value of a coefficient is not zero and you wish it to be zero, you must enter an insignificant, small number (perhaps, 1E-7*XMIN), since entering 0 would be interpreted by PLOTnFIT as acceptance of the default value.

BF(= 6)=1

CS1(= 0)=

For each Data Set in the job, the program starts with the lowest degree polynomial you want to consider and fits it to the data points; the program then fits, sequentially and in assending order, as many higher degree polynomials as you specify (the current degree limit is 10).

What is the lowest degree polynomial (LDP) you want to consider for this Data Set (1 <= LDP <= 10)? LDP(=1)= 3

How many polynomial fits (NPF) do you want to try - including the LDP - (1 <= NPF <= 8)? NPF(=1)= 4

What symbol (M) would you like to use to represent the Data for Task # 2 ?

```
     1.   I                         5. DIAMOND
     2. CROSS                       6. TRIANGLE - UP
     3.   X                         7. TRIANGLE - DOWN
     4.   H                         8. SQUARE
M(= 9 )= 8
```

What symbol size (MM) would you like?

```
     1. small
     2. LARGE
MM(= 2 )=
```

ALL PLOTTING INSTRUCTIONS AND DATA HAVE BEEN ENTERED

Would you like to make changes in your Plotting Instructions; values currently in the computer appear in parenthesis (y/n)?

Would you like to make a few changes in one or more of your Data Sets [most useful when most data are from the KEYBOARD] (y/n)?

Would you like to completely RE-INPUT your Coordinate Data [most useful when most data are from STORED FILES] (y/n)?

Number of Bits not being used at this time, for this job = 3039

Would you like to PRINT values of the Polynomial Coefficients for all the curves fit to each Data Set, along with the corresponding Residual Variances and Coefficients of Determination (y/n)? y

Would you like to make HARD COPIES of graphs of ALL the Data Sets, one set of graphs for each Data Set, showing ALL the polynomial curves fit to EACH Data Set (y/n)? y

Would you like to make 'a' HARD COPY graph containing ALL the Data Sets, each Data Set with it's corresponding 'BEST POLYNOMIAL/BEST FIT' curve (y/n)? y

Would you like to PRINT values of key program variables and a Table of some of the points which fall on each 'BEST POLYNOMIAL/BEST FIT' curve plotted (y/n)? y

...a Table of 'ALL' the points (y/n)?

Would you like to INPUT a function to be plotted with your data (y/n)?

Part 3.b) OUTPUT

PLOTnFIT.4th

JOB: CHARPY RC-2 DCONT-06/29/89

time - 11:27:55

THE FOLLOWING ARE DATA RESULTING FROM FITTING POLYNOMIALS
TO THE VARIOUS DATA SETS

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 1
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]
Coefficient of Determination, CD = .946064
Residual Variance, RV = .8729078

2 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-45.33264 C(2)= 65.54778

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.39904	4.60096	.04
2	.9641	17	20.42376	-3.42376	.04
3	1.0185	21.5	20.92846	.5715408	.04
4	1.025	18	21.03723	-3.037232	.04
5	1.0772	21.5	22.68216	-1.182163	.04
6	1.1001	30.5	24.10975	6.390255	.04
7	1.1175	19	25.65639	-6.656389	.04
8	1.1566	40.5	31.19042	9.309586	.04
9	1.174	28.5	34.79054	-6.290543	.04
10	1.2132	41.5	45.42569	-3.92569	.04
11	1.2132	46	45.42569	.5743103	.04
12	1.2382	55.5	53.00938	2.490624	.04
13	1.2654	64.5	59.9722	4.527802	.04
14	1.297	58	64.36998	-6.36998	.04
15	1.3263	65	65.4392	-.4391938	.04
16	1.3535	66.5	65.54448	.9555206	.04
17	1.4166	64.5	65.54778	-1.047775	.04
18	1.4514	68.5	65.54778	2.952225	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 13.96653 .

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 2
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]
Coefficient of Determination, CD = .946065
Residual Variance, RV = .9310868

3 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-.1933762 C(2)=-45.14174 C(3)= 65.53287

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.38244	4.617558	.04
2	.9641	17	20.40727	-3.407265	.04
3	1.0185	21.5	20.9141	.5858994	.04
4	1.025	18	21.02333	-3.023331	.04
5	1.0772	21.5	22.67486	-1.174862	.04
6	1.1001	30.5	24.10776	6.392243	.04
7	1.1175	19	25.65972	-6.659722	.04
8	1.1566	40.5	31.20911	9.290894	.04
9	1.174	28.5	34.81614	-6.316136	.04
10	1.2132	41.5	45.45742	-3.957417	.04
11	1.2132	46	45.45742	.5425835	.04
12	1.2382	55.5	53.03248	2.467526	.04
13	1.2654	64.5	59.97785	4.522156	.04
14	1.297	58	64.3599	-6.359902	.04
15	1.3263	65	65.42475	-.4247437	.04
16	1.3535	66.5	65.52958	.9704208	.04
17	1.4166	64.5	65.53287	-1.032867	.04
18	1.4514	68.5	65.53287	2.967133	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 13.9663 .

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 3
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]
Coefficient of Determination, CD = .946204
Residual Variance, RV = .9950166

4 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)= 10.89538 C(2)=-16.34099 C(3)=-39.52417
C(4)= 65.4034

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.59421	4.405792	.04
2	.9641	17	20.61583	-3.615833	.04
3	1.0185	21.5	21.05948	.4405251	.04
4	1.025	18	21.15561	-3.155609	.04
5	1.0772	21.5	22.63097	-1.13097	.04
6	1.1001	30.5	23.94258	6.557419	.04
7	1.1175	19	25.39382	-6.393822	.04
8	1.1566	40.5	30.80508	9.694923	.04
9	1.174	28.5	34.4677	-5.967697	.04
10	1.2132	41.5	45.59281	-4.092808	.04
11	1.2132	46	45.59281	.4071922	.04
12	1.2382	55.5	53.45199	2.048012	.04
13	1.2654	64.5	60.3153	4.184704	.04
14	1.297	58	64.36567	-6.36567	.04
15	1.3263	65	65.30864	-.3086395	.04
16	1.3535	66.5	65.40052	1.09948	.04
17	1.4166	64.5	65.4034	-.9033966	.04
18	1.4514	68.5	65.4034	3.096604	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 13.93023 .

TASK # 1: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 4
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]
Coefficient of Determination, CD = .949024
Residual Variance, RV = 1.015383

5 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-202.0862 C(2)= 422.4508 C(3)=-276.3049
C(4)= 10.48499 C(5)= 64.86556

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	19.74385	5.25615	.04
2	.9641	17	19.78814	-2.788143	.04
3	1.0185	21.5	20.66481	.835186	.04
4	1.025	18	20.84704	-2.847038	.04
5	1.0772	21.5	23.33808	-1.838078	.04
6	1.1001	30.5	25.15009	5.349915	.04
7	1.1175	19	26.82144	-7.821434	.04
8	1.1566	40.5	31.33384	9.166161	.04
9	1.174	28.5	33.90613	-5.406128	.04
10	1.2132	41.5	44.18099	-2.680985	.04
11	1.2132	46	44.18099	1.819016	.04
12	1.2382	55.5	54.38414	1.115864	.04
13	1.2654	64.5	62.71516	1.784844	.04
14	1.297	58	64.95877	-6.958771	.04
15	1.3263	65	64.8891	.1109085	.04
16	1.3535	66.5	64.86632	1.633682	.04
17	1.4166	64.5	64.86556	-.3655548	.04
18	1.4514	68.5	64.86556	3.634445	.04

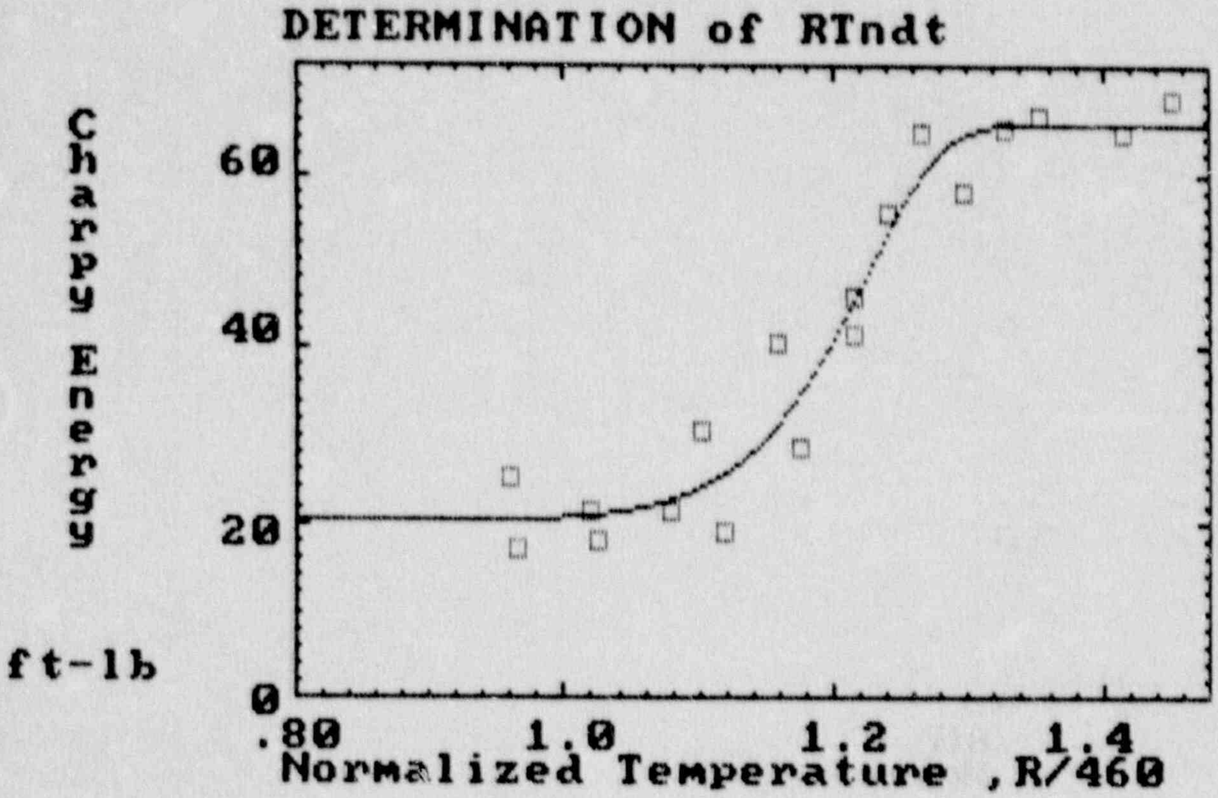
The CHI^2 (to be used with Chi-square Distribution Table) is 13.19998 .

SUMMARY OF TASK # 1

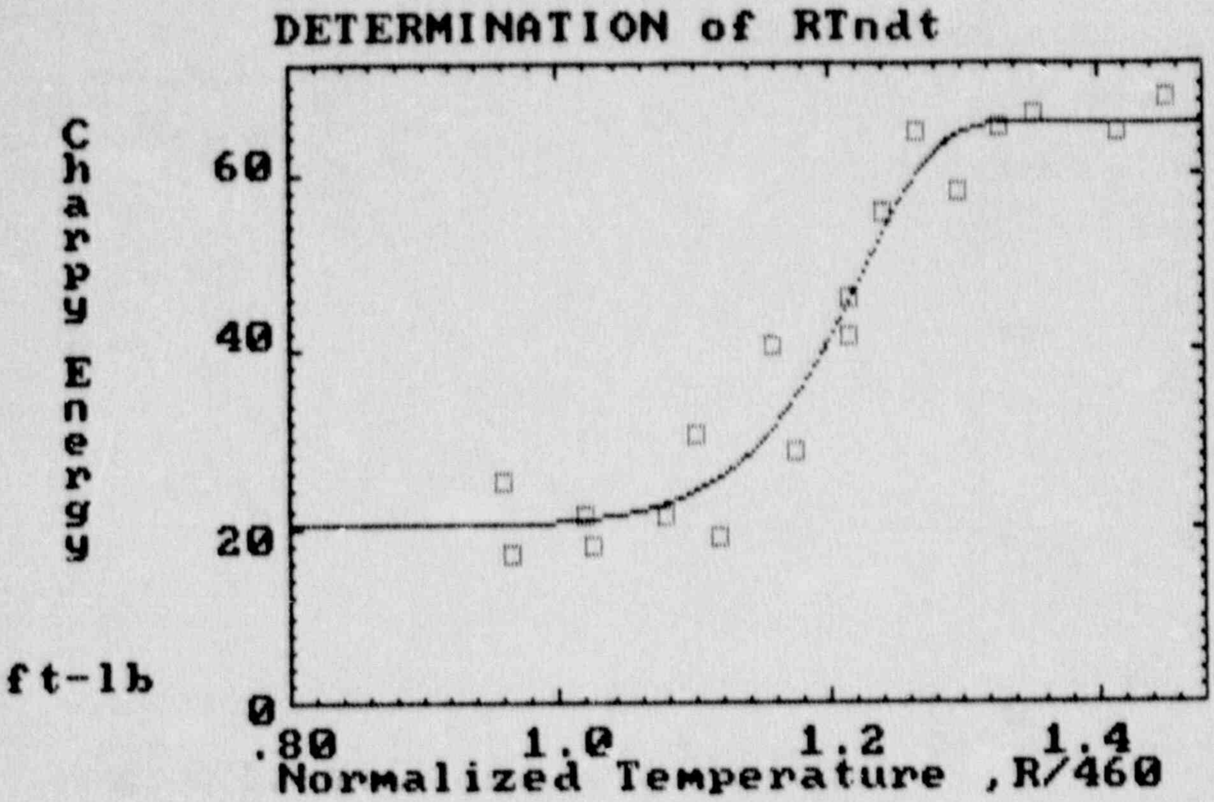
This task investigated Polynomials of degree 1 through 4 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]

The polynomial of degree 1 produces the largest fractional decrease in RV (note, its RV = .8729078), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

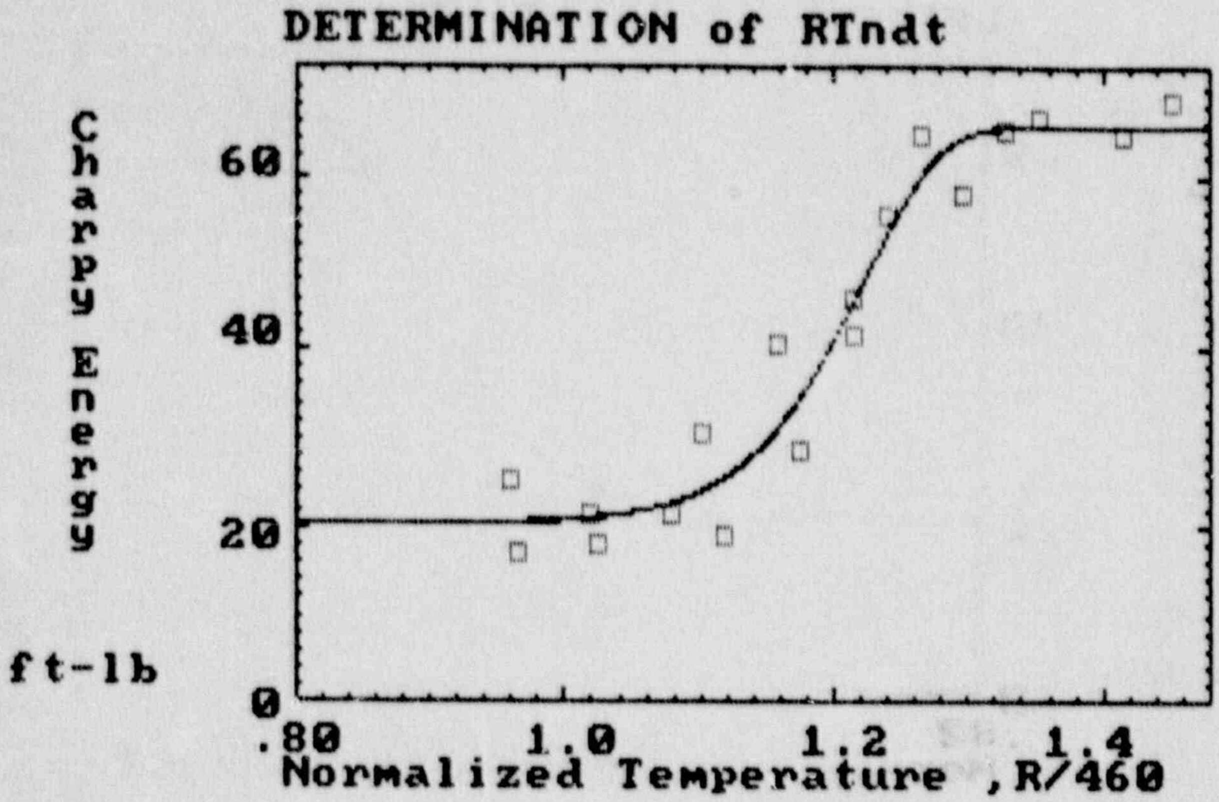
THE HIGHEST DEGREE POLYNOMIAL SHOWN IN THIS PLOT IS 1,
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]



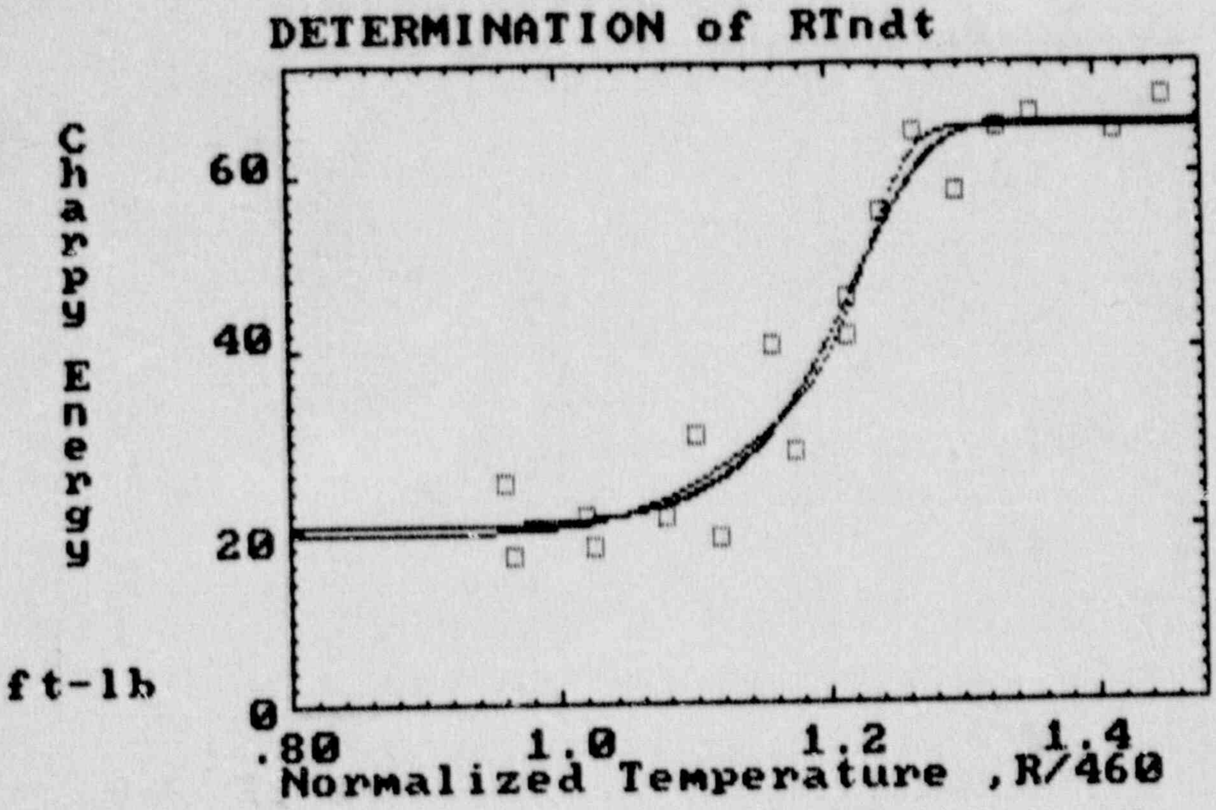
THE HIGHEST DEGREE POLYNOMIAL SHOWN IN THIS PLOT IS 2.
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]



THE HIGHEST DEGREE POLYNOMIAL SHOWN IN THIS PLOT IS 3,
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]



THE HIGHEST DEGREE POLYNOMIAL SHOWN IN THIS PLOT IS 4.
BASIS FUNCTION: X(x) = 0*EXP[0*x^(0)]
+ (1)*EXP[-.0105*x^(22.5)]



Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? y

TASK # 2: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 3
BASIS FUNCTION: X(x) = 0 + x
Coefficient of Determination, CD = .934965
Residual Variance, RV = 1.202892

4 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)=-1900.705 C(2)= 6868.957 C(3)=-8071.413
C(4)= 3121.686

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	22.12012	2.879883	.04
2	.9641	17	21.39502	-4.39502	.04
3	1.0185	21.5	18.25342	3.246582	.04
4	1.025	18	18.33399	-.3339844	.04
5	1.0772	21.5	21.85523	-.3552246	.04
6	1.1001	30.5	24.7461	5.753907	.04
7	1.1175	19	27.36694	-8.366943	.04
8	1.1566	40.5	34.26392	6.236084	.04
9	1.174	28.5	37.64258	-9.142578	.04
10	1.2132	41.5	45.55127	-4.05127	.04
11	1.2132	46	45.55127	.4487305	.04
12	1.2382	55.5	50.55908	4.940918	.04
13	1.2654	64.5	55.7312	8.768799	.04
14	1.297	58	61.07959	-3.07959	.04
15	1.3263	65	65.10669	-.1066895	.04
16	1.3535	66.5	67.78516	-1.285156	.04
17	1.4166	64.5	68.77344	-4.273438	.04
18	1.4514	68.5	65.38428	3.115723	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 16.84049 .

TASK # 2: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 4
BASIS FUNCTION: X(x) = 0 + x
Coefficient of Determination, CD = .935174
Residual Variance, RV = 1.29126

5 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)= 844.7538 C(2)=-5958.323 C(3)= 14127.81
C(4)=-13802.83 C(5)= 4806.809

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	22.43897	2.561035	.04
2	.9641	17	21.59277	-4.592774	.04
3	1.0185	21.5	17.85693	3.643067	.04
4	1.025	18	17.92627	7.373047E-02	.04
5	1.0772	21.5	21.60547	-.1054688	.04
6	1.1001	30.5	24.6377	5.862305	.04
7	1.1175	19	27.36768	-8.367676	.04
8	1.1566	40.5	34.46729	6.032715	.04
9	1.174	28.5	37.90283	-9.402832	.04
10	1.2132	41.5	45.82862	-4.328614	.04
11	1.2132	46	45.82862	.1713867	.04
12	1.2382	55.5	50.77051	4.729492	.04
13	1.2654	64.5	55.81006	8.689941	.04
14	1.297	58	60.95655	-2.956543	.04
15	1.3263	65	64.79053	.2094727	.04
16	1.3535	66.5	67.33594	-.8359375	.04
17	1.4166	64.5	68.52295	-4.022949	.04
18	1.4514	68.5	65.81495	2.685059	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 16.78637 .

TASK # 2: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 5
BASIS FUNCTION: X(x) = 0 + x
Coefficient of Determination, CD = .943212
Residual Variance, RV = 1.225407

6 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)= 43618.66 C(2)=-261180.2 C(3)= 620427.2
C(4)=-730689.8 C(5)= 426694.9 C(6)=-98849.59

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	20.83594	4.164063	.04
2	.9641	17	21.14844	-4.148438	.04
3	1.0185	21.5	20.46094	1.039063	.04
4	1.025	18	20.26563	-2.265625	.04
5	1.0772	21.5	20.90625	.59375	.04
6	1.1001	30.5	22.96094	7.539063	.04
7	1.1175	19	25.29688	-6.296875	.04
8	1.1566	40.5	32.69531	7.804688	.04
9	1.174	28.5	36.6875	-8.1875	.04
10	1.2132	41.5	46.14844	-4.648438	.04
11	1.2132	46	46.14844	-.1484375	.04
12	1.2382	55.5	51.97657	3.523438	.04
13	1.2654	64.5	57.59375	6.90625	.04
14	1.297	58	62.34375	-4.34375	.04
15	1.3263	65	64.90625	.09375	.04
16	1.3535	66.5	65.66406	.8359375	.04
17	1.4166	64.5	65.07813	-.578125	.04
18	1.4514	68.5	67.85156	.6484375	.04

The CHI^2 (to be used with Chi-square Distribution Table) is 14.70488 .

TASK # 2: ANALYSIS OF 'Mod. CHARPY DATA from RC-2'

Degree of Polynomial, P[X(x)], n = 6
BASIS FUNCTION: X(x) = 0 + x
Coefficient of Determination, CD = .943883
Residual Variance, RV = 1.321019

7 Coefficients (the last coefficient is the constant term in the polynomial):
C(1)= 166668 C(2)=-1160218 C(3)= 3347188
C(4)=-5124321 C(5)= 4392653 C(6)=-2000023
C(7)= 378072.7

i	x	y	P[X(x)]	Deviation	w
1	.9587	25	21.84375	3.15625	.04
2	.9641	17	21.15625	-4.15625	.04
3	1.0185	21.5	19.78125	1.71875	.04
4	1.025	18	19.9375	-1.9375	.04
5	1.0772	21.5	22.21875	-.71875	.04
6	1.1001	30.5	24.15625	6.34375	.04
7	1.1175	19	26.40625	-7.40625	.04
8	1.1566	40.5	32.65625	7.84375	.04
9	1.174	28.5	36.5	-8	.04
10	1.2132	41.5	45.96875	-4.46875	.04
11	1.2132	46	45.96875	.03125	.04
12	1.2382	55.5	52.59375	2.90625	.04
13	1.2654	64.5	57.71875	6.78125	.04
14	1.297	58	63.53125	-5.53125	.04
15	1.3263	65	66.59375	-1.59375	.04
16	1.3535	66.5	66.90625	-.40625	.04
17	1.4166	64.5	63.8125	.6875	.04
18	1.4514	68.5	68.65625	-.15625	.04

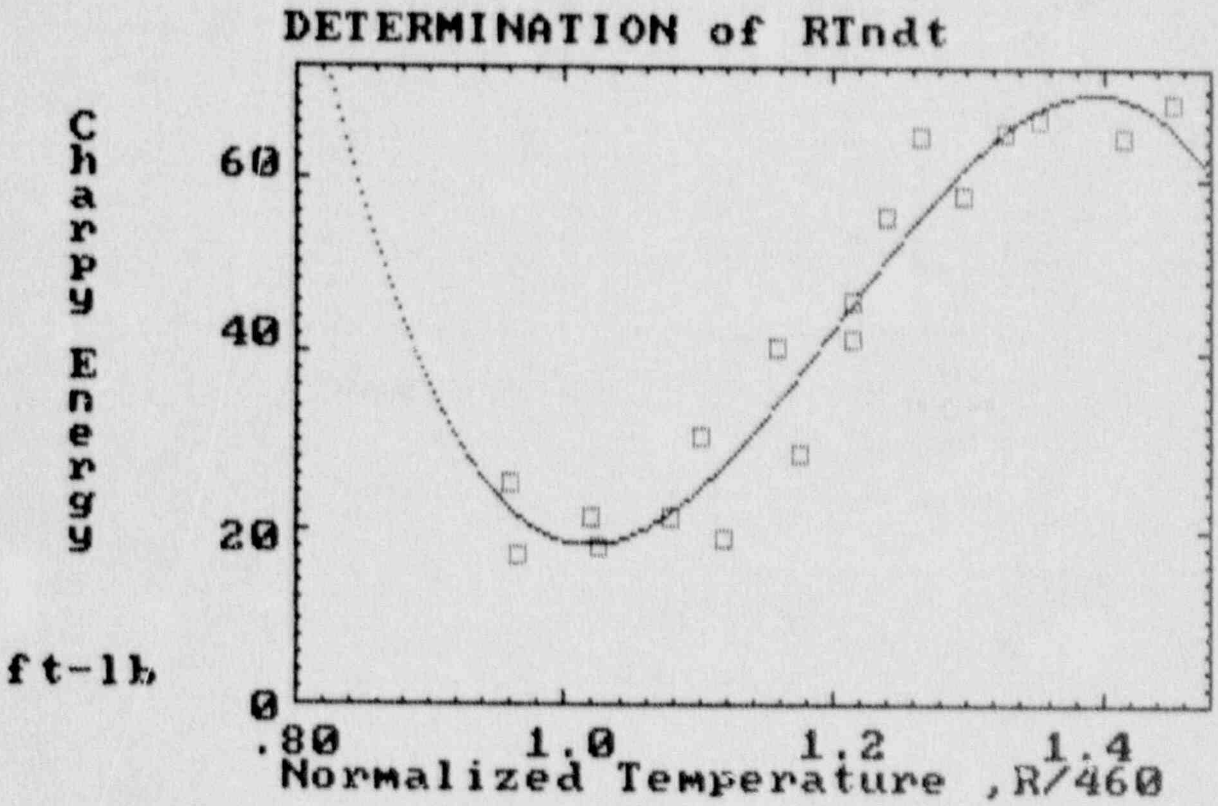
The CHI^2 (to be used with Chi-square Distribution Table) is 14.53121 .

SUMMARY OF TASK # 2

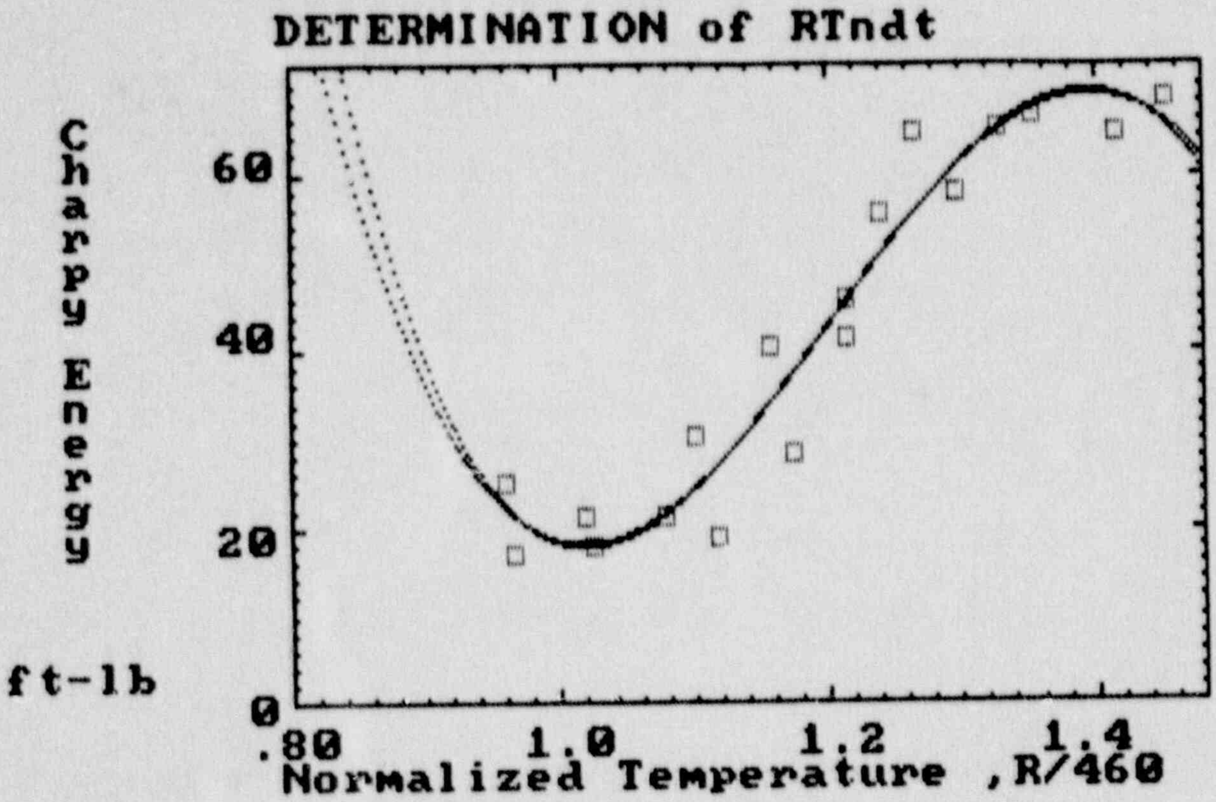
This task investigated Polynomials of degree 3 through 6 fit to the Data Set,
Mod. CHARPY DATA from RC-2, using the
BASIS FUNCTION: X(x) = 0 + x

The polynomial of degree 3 produces the largest fractional decrease in RV (note, its RV = 1.202892), hence, is taken as the BEST POLYNOMIAL/BEST FIT for this Data Set (i.e., from among the polynomials with the specifically chosen Basis Function and within the degree range investigated). PLOTnFIT suggests that it is a polynomial of high enough degree that it should come close to the 'true function', i.e., the 'true model', yet low enough that it 'averages out' random errors.

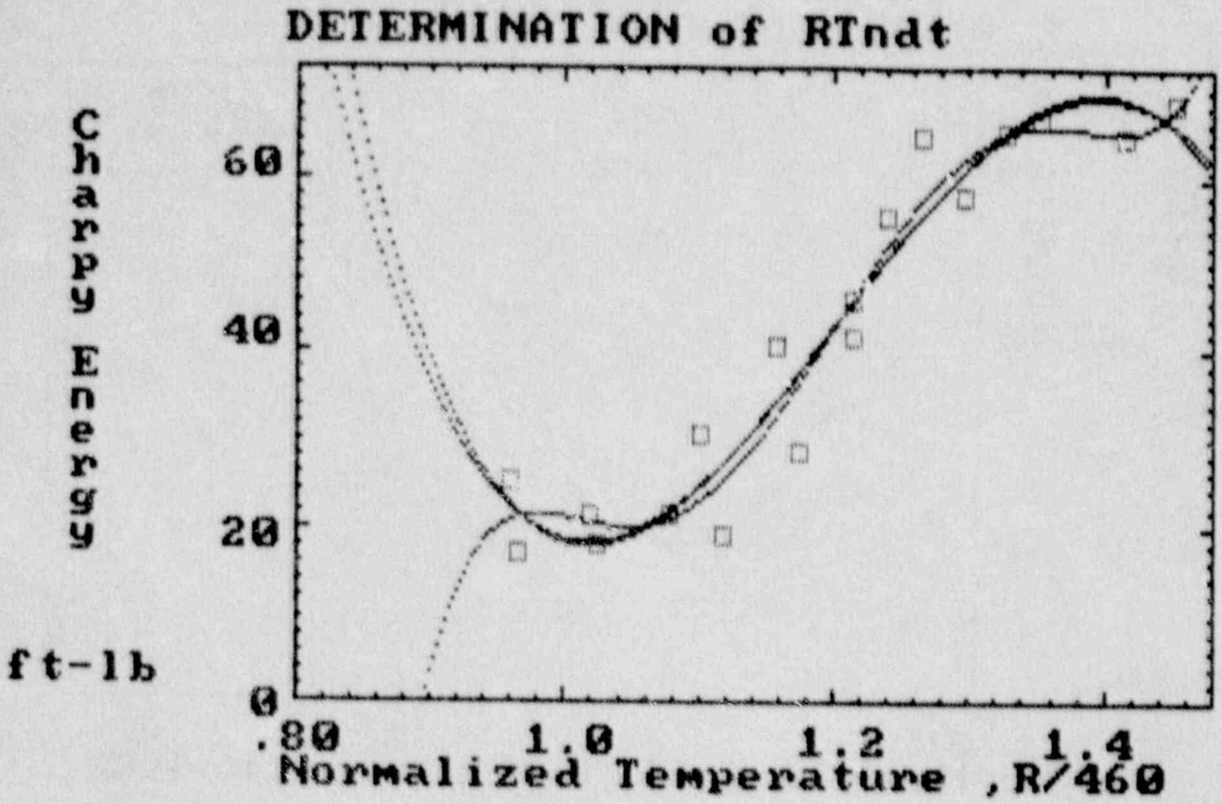
THE HIGHEST DEGREE POLYNOMIAL SHOWN IN THIS PLOT IS 3,
BASIS FUNCTION: X(x) = 0 + x



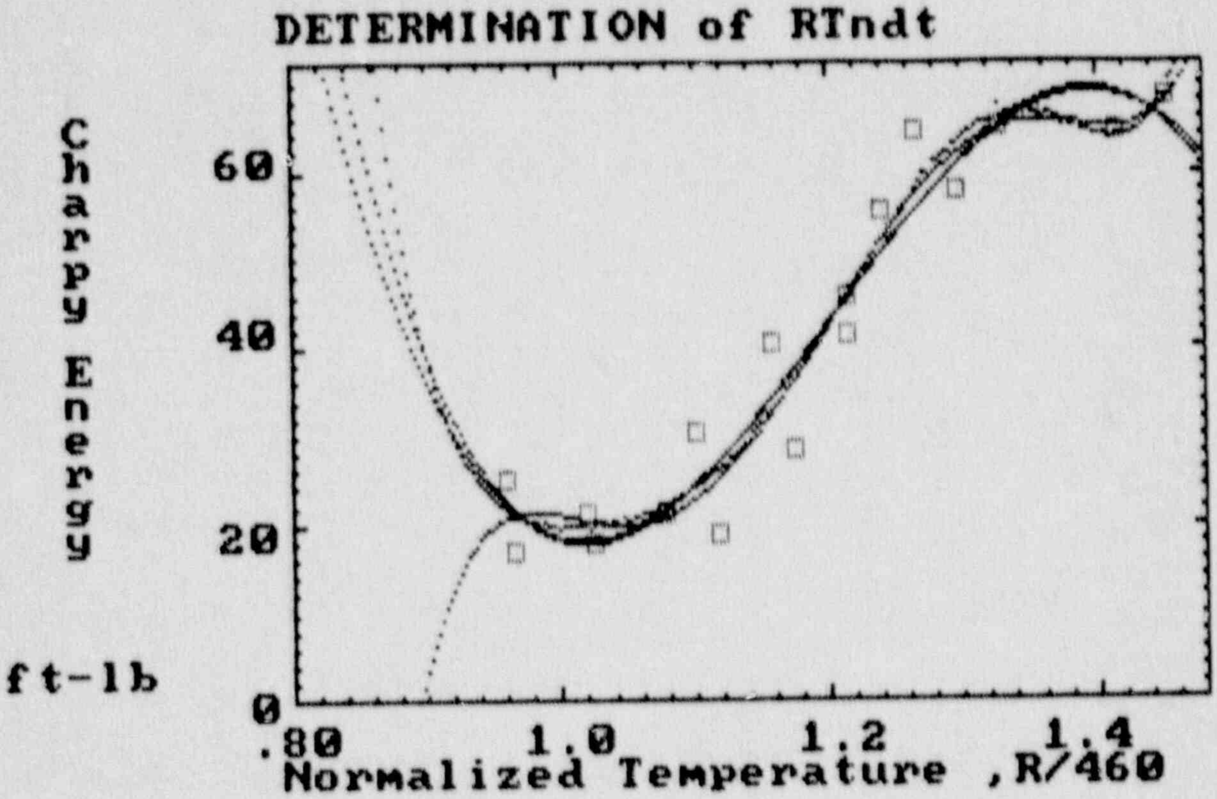
THE HIGHEST DEGREE POLYNOMIAL SHOWN IN THIS PLOT IS 4,
BASIS FUNCTION: X(x) = 0 + x



THE HIGHEST DEGREE POLYNOMIAL SHOWN IN THIS PLOT IS 5,
BASIS FUNCTION: X(x) = 0 + x



THE HIGHEST DEGREE POLYNOMIAL SHOWN IN THIS PLOT IS 6.
BASIS FUNCTION: X(x) = 0 + x



Do you agree with PLOTnFIT's choice for the polynomial degree that yields the most satisfactory correlation of the data (y/n)? n

What degree polynomial do you think best represents this Data Set?

n = 5 , RV = 1.225407

PLOTnFIT.4th

JOB: CHARPY RC-2 DCONT-06/29/89

time - 11:52:15

KEY PROGRAM PARAMETERS AND OUTPUT DATA

TNDP= 36

XMIN= .9587		XMAX= 1.4514		DKX= .02	
YMIN= 17		YMAX= 68.5		DKY= 2	
LJX= 10		LIX= 4		CX= 80	
LJY= 10		LIY= 4		CY= 40	
XS= 75		XE= 315		XO=-207	
YS= 12		YE= 162		YO= 162	
NXS= 40		NXE= 74		NXT= 34	
NYS= 0		NYE= 36		NYT= 36	
IYLL= 0	IYUL= 0	NYC= 0	YLL= 0	YUL= 0	
IXLL= 0	IXUL= 0	NXC= 0	XLL= 0	XUL= 0	
I= 0	UX= .8	SX= 9	UY= 0	SY= 21	
I= 1	UX= 1	SX= 18	UY= 20	SY= 16	
I= 2	UX= 1.2	SX= 27	UY= 40	SY= 10	
I= 3	UX= 1.4	SX= 35	UY= 60	SY= 5	
I= 4	UX= 1.6	SX= 0	UY= 80	SY= 0	

TASK # 1
Every 10th Point On The Best Polynomial Curve
Best Fit To 'Mod. CHARPY DATA from RC-2':

XPI	x	P[X(x)]	YPI	dP[X(x)]/dx	Int P[X(x)]dx	IT
75	.799	20.21819	120	8.600216E-02	0	3
85	.8273333	20.22183	120	.1819072	0	3
95	.8556667	20.22941	120	.3751415	0	3
105	.8840001	20.24483	120	.755479	0	3
115	.9123334	20.27551	120	1.487667	0	3
125	.9406667	20.33518	120	2.867474	0	3
135	.9690001	20.4489	120	5.413761	.2314342	3
145	.9973334	20.66117	119	10.0128	.8135206	3
155	1.025667	21.04923	119	18.12807	1.403879	3
165	1.054	21.74303	117	32.06022	2.009175	3
175	1.082333	22.95212	115	55.14407	2.640818	3
185	1.110667	24.99342	110	91.50798	3.317623	3
195	1.139	28.29585	104	144.4708	4.069013	3
205	1.167333	33.3217	93	211.9675	4.937401	3
215	1.195667	40.30155	79	276.0898	5.975937	3
225	1.224	48.72762	61	306.5502	7.235229	3
235	1.252333	56.92102	44	257.1568	8.735229	3
245	1.280667	62.63449	32	140.4854	10.43684	3
255	1.309	65.03956	27	39.23042	12.25238	3
265	1.337334	65.51625	26	3.857172	14.10424	3
275	1.365667	65.54738	26	7.564261E-02	15.96119	3
285	1.394	65.54778	26	1.25394E-04	17.81838	3
295	1.422333	65.54778	26	4.856977E-09	19.67556	3
305	1.450667	65.54778	26	6.508952E-16	21.53274	3
315	1.479	65.54778	26	1.807926E-26	21.71846	3

The Total Integral Of P[X(x)]dx is From .9576667 To 1.4535
and the Constant of Intergration is 0 .

TASK # 2
Every 6th Point On The Best Polynomial Curve
Best Fit To 'Mod. CHARPY DATA from RC-2':

Coefficients of the Derivative:

C(1)= 218093.3	C(2)=-1044721	C(3)= 1861282
C(4)=-1461380	C(5)= 426694.9	C(6)= 0

Coefficients of the Integral:

C(1)= 7269.777	C(2)=-52236.05	C(3)= 155106.8
C(4)=-243563.3	C(5)= 213347.4	C(6)=-88849.59

XPI	x	P[X(x)]	YPI	dP[X(x)]/dx	Int P[X(x)]dx	IT
75	.799	-166.2031	508	3287.969	0	0
81	.8160001	-116.1875	404	2612.219	0	0
87	.833	-76.82813	322	2037.688	0	0
93	.85	-46.35938	258	1554.906	0	0
99	.8670001	-23.45313	210	1154.531	0	0
105	.8840001	-6.726563	176	828.0313	0	0
111	.901	5.0625	152	566.9375	0	0
117	.9180001	12.89844	136	363.5938	0	0
123	.9350001	17.69531	126	210.4688	0	0
129	.952	20.28125	120	100.5938	0	0
135	.9690001	21.32813	118	27.53125	.25	0
141	.9860001	21.40625	118	-14.90625	.5976563	0
147	1.003	20.97656	119	-32.40625	.9648438	0
153	1.02	20.40625	120	-30.125	1.314453	0
159	1.037	20.03125	121	-12.78125	1.65625	0
165	1.054	20.02344	121	15.21875	1.992188	0
171	1.071	20.58594	120	49.78125	2.353516	0
177	1.088	21.76563	117	87.71875	2.720703	0
183	1.105	23.5625	113	125.875	3.083985	0
189	1.122	26.02344	108	161.6563	3.511719	0
195	1.139	29.0625	102	192.7188	3.978516	0
201	1.156	32.55469	95	217.8438	4.511719	0
207	1.173	36.36719	87	235.125	5.091797	0
213	1.19	40.49219	78	244.0313	5.75	0
219	1.207	44.59375	70	244.25	6.484375	0
225	1.224	48.76563	61	235.6563	7.28711	0
231	1.241	52.60157	53	218.5	8.125	0
237	1.258	56.21875	45	194.1563	9.050781	0
243	1.275	59.25782	39	163.8125	10.02148	0
249	1.292	61.6875	34	128.75	11.0625	0
255	1.309	63.60157	30	91.90625	12.13281	0
261	1.326	64.78906	28	55.46875	13.19727	0
267	1.343	65.54688	26	22.71875	14.34766	0
273	1.36	65.625	26	-3.125	15.42578	0
279	1.377	65.48438	26	-17.53125	16.58984	0
285	1.394	65.16406	27	-16.75	17.66016	0
291	1.411	65.03125	27	4.5625	18.80859	0
297	1.428	65.47656	26	51.4375	19.90625	0
303	1.445	66.9375	23	129.375	21.01172	0
309	1.462	70.10156	16	244.9688	21.5918	0
315	1.479	75.5	5	404.6875	21.5918	0

The Total Integral Of P[X(x)]dx is From .9576667 To 1.4535
and the Constant of Intergration is -18925.81 .

JOB: CHARPY RC-2 DCONT-06/29/89

time - 11:57:26

JOB DESCRIPTION

This is a continuation of the analysis begun with job 'INITIAL ANALYSIS--06/26/89' and extended through job 'CHARPY RC-2 CCONT- 06/27/89.' This job will compare results using Basis Functions # 6 and # 1 on the modified data from file 'FOL06891.SIS.'

EACH CURVE IS A 'BEST FIT' WITH AN nth DEGREE POLYNOMIAL

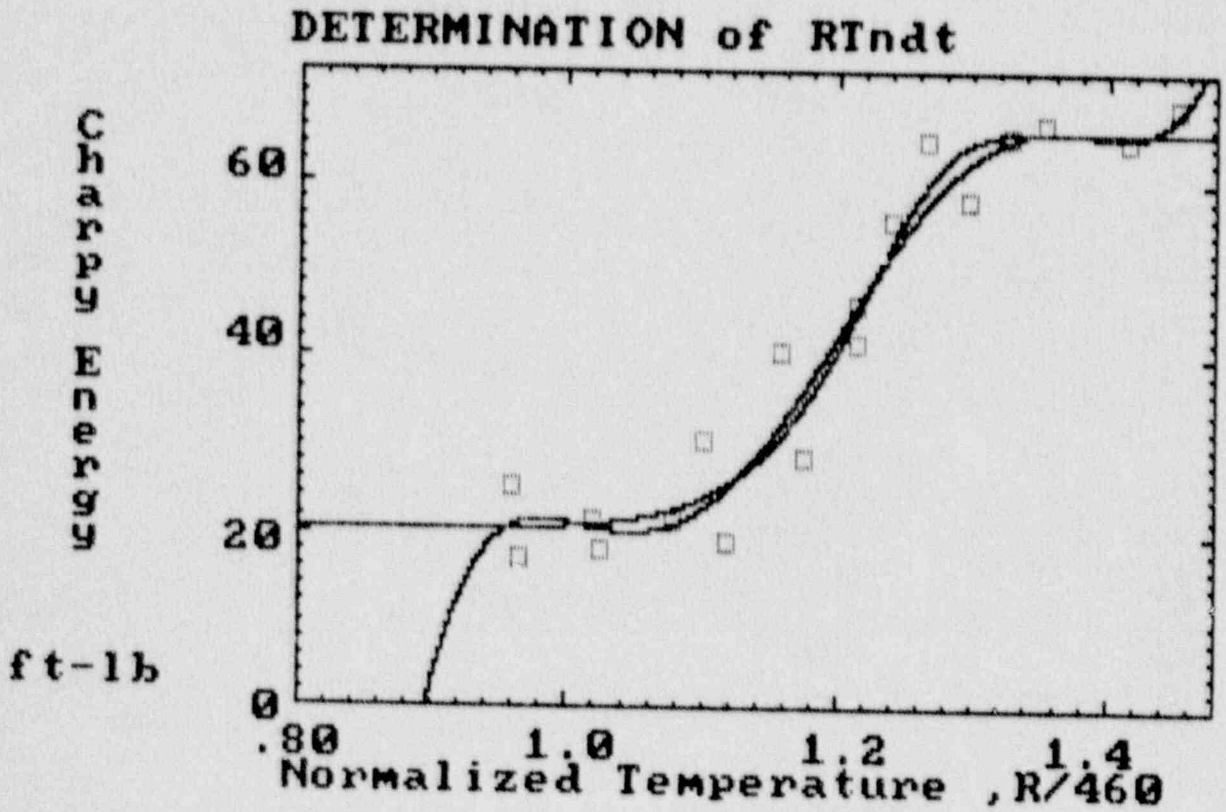
P[X(x)] = C(1)X(x)^n + C(2)X(x)^(n-1) + ... + C(n)X(x) + C(n+1)

PLOTTING INSTRUCTIONS

Generate (color) MEDIUM resolution, LINEAR graphs with PLOTnFIT DETERMINED COORDINATE RANGES AND MARKING INTERVALS

***** DATA *****

TASK#	IDENTIFICATION	n	SYMBOL	NDP	SOURCE
1	Mod. CHARPY DATA from RC-2	1	LARGE SQUARE	18	FILE fol06891.sis
2	Mod. CHARPY DATA from RC-2	5	LARGE I	18	FILE fol06891.sis



Part 3.b) Comments on OUTPUT

1. The results of this part of the analysis show that, using Basis Function # 6 with the coefficients from Part 3.a), curves fit with high degree polynomials are not an improvement over that obtained with degree n = 1. For n = 2 and n = 3, the high order terms in the polynomial tend to be suppressed, while for n = 4 the higher order coefficients start to get large as RV increases further (see pages A-88 and A-89). As shown by the graphs on pages A-90 through A-92, the effect of going from n = 1 to 3 is barely perceptible, but in going to n = 4, the curve begins to "strain" toward the data points.

2. Using Basis Function # 6, CHI^2 decreases slightly (from 13.9665 to 13.2000) with increasing polynomial degree n (= 1 to 4) while RV increases (from 0.873 to 1.015). The reason for this is that as n increases, the number of degrees of freedom NU decreases from 16 to 13 (not taking into account the two coefficients in the Basis Function that are obtained by "trial-and-error" fit to the data) and the calculated CHI^2 is independent of NU while RV is inversely proportional to NU; consequently, RV is a better parameter for interactively comparing polynomials. With regard to CHI^2, the effect of NU is taken into account in the interpretation of the value of CHI^2 relative to the Chi-square distribution table in Appendix B.

3. Although RV is lowest for the polynomial of degree n = 3 when using Basis Function # 1 (see pages A-94 and A-95), the polynomial of degree n = 5 was taken as being more representative of the data because it shows a shape that is "more like" typical Charpy energy versus temperature data (see pages A-96 through A-99). All the coefficients increase steadily with increasing n, becoming very large above n = 5 (while RV continues to increase), suggesting that higher degree polynomials may not only fail to improve the fit, but may result in problems with loss of significance due to the limitations of single-precision arithmetic.

4. With regard to the tables on pages A-100 and A-101, note that every 10th point is shown for Task # 1 (which is the PLONnFIT default for $n \leq 3$) and every 6th point is shown for Task # 2 (which is the PLOTnFIT default for $3 < n \leq 7$); if n had been greater than 7 for either task, the corresponding table would have shown every 3rd point. The only options available for you to choose are to request that all the points be displayed in the table [as was done in Part 2.a); see pages A-19 through A-26] or to request that none of the points be displayed (as was done in Part 1; see pages A-11 and A-12).

5. Page A-102 shows the comparison of the "best polynomial/best fit" using (a) Basis Function # 6 (Task # 1) and (b) Basis Function # 1 (Task # 2). For case (a) there are actually 4 data-determined coefficients (hence, 14 degrees of freedom) and CHI^2 is 13.97; for case (b) there are 6 data-determined coefficients (hence, 12 degrees of freedom) and CHI^2 is 14.70. Although both models may be considered to fit the data adequately (i.e., in both cases the deviations are probably due to chance; see the table in Appendix B), which is what you would expect on the basis of the curves

shown, Basis Function # 6 yields (a) a simpler model, (b) a slightly better fit to the data, (c) lower shelf and upper shelf energies from the best fit to all data points, and (d) meaningful extrapolation to regions outside the data range.

6. The lower and upper shelf energies estimated from the "best polynomial/best fit" using Basis Function # 1 [see Part 2.a) Comments on OUTPUT, page A-27] are 20.7 ft-lb and 65.3 ft-lb, respectively. The coefficients returned by PLOTnFIT, for the polynomial of degree n = 1, with Basis Function # 6 (CSI = 0, CO1 = 0, DC1 = 0, CE1 = 1, CF1 = -0.0105, and CG1 = 22.5), are C(2) = 65.55 ft-lb (which is equivalent to the upper shelf energy) and C(1) = -45.33 ft-lb (which represents the difference between the lower and upper shelf energies); that is, C(2) + C(1) = 65.55 - 45.33 = 20.22 ft-lb, which is the lower shelf energy.

APPENDIX B

CHI-SQUARE DISTRIBUTION TABLE

NU \ Q	0.99	0.98	0.95	0.90	0.80	0.70	0.50	0.30	0.20	0.10	0.05	0.02	0.01	0.001
1	0.000157	0.000628	0.00393	0.0158	0.0642	0.148	0.455	1.074	1.642	2.706	3.841	5.412	6.635	10.827
2	0.0201	0.0404	0.103	0.211	0.446	0.713	1.386	2.408	3.219	4.605	5.991	7.824	9.210	13.815
3	0.115	0.185	0.352	0.584	1.005	1.424	2.366	3.665	4.642	6.251	7.815	9.837	11.341	16.266
4	0.297	0.429	0.711	1.064	1.649	2.195	3.357	4.878	5.989	7.779	9.488	11.668	13.277	18.467
5	0.554	0.752	1.145	1.610	2.343	3.000	4.351	6.064	7.289	9.236	11.070	13.388	15.086	20.515
6	0.872	1.134	1.635	2.204	3.070	3.828	5.348	7.231	8.558	10.645	12.592	15.033	16.812	22.457
7	1.239	1.564	2.167	2.833	3.822	4.671	6.346	8.383	9.803	12.017	14.067	16.622	18.475	24.322
8	1.646	2.032	2.733	3.490	4.594	5.527	7.344	9.524	11.030	13.362	15.507	18.168	20.090	26.125
9	2.088	2.532	3.325	4.168	5.380	6.393	8.343	10.656	12.242	14.684	16.919	19.679	21.666	27.877
10	2.558	3.059	3.940	4.865	6.179	7.267	9.342	11.781	13.442	15.987	18.307	21.161	23.209	29.588
11	3.053	3.609	4.575	5.578	6.989	8.148	10.341	12.899	14.631	17.275	19.675	22.618	24.725	31.264
12	3.571	4.178	5.226	6.304	7.807	9.034	11.340	14.011	15.812	18.549	21.026	24.054	26.217	32.909
13	4.107	4.765	5.892	7.042	8.634	9.926	12.340	15.119	16.985	19.812	22.362	25.472	27.688	34.528
14	4.660	5.368	6.571	7.790	9.467	10.821	13.339	16.222	18.151	21.064	23.685	26.873	29.141	36.123
15	5.229	5.985	7.261	8.547	10.307	11.721	14.339	17.322	19.311	22.307	24.996	28.259	30.578	37.697
16	5.812	6.614	7.962	9.312	11.152	12.624	15.338	18.418	20.465	23.542	26.296	29.633	32.000	39.252
17	6.408	7.255	8.672	10.085	12.002	13.531	16.338	19.511	21.615	24.769	27.587	30.995	33.409	40.790
18	7.015	7.906	9.390	10.865	12.857	14.440	17.338	20.601	22.760	25.989	28.869	32.346	34.805	42.312
19	7.633	8.567	10.117	11.651	13.716	15.352	18.338	21.689	23.900	27.204	30.144	33.687	36.191	43.820
20	8.260	9.237	10.851	12.443	14.578	16.266	19.337	22.775	25.038	28.412	31.410	35.020	37.566	45.315
21	8.897	9.915	11.591	13.240	15.445	17.182	20.337	23.858	26.171	29.615	32.671	36.343	38.932	46.797
22	9.542	10.600	12.338	14.041	16.314	18.101	21.337	24.939	27.301	30.813	33.924	37.659	40.289	48.268
23	10.196	11.293	13.091	14.848	17.187	19.021	22.337	26.018	28.429	32.007	35.172	38.968	41.638	49.728
24	10.856	11.992	13.848	15.659	18.062	19.943	23.337	27.096	29.553	33.196	36.415	40.270	42.980	51.179
25	11.524	12.697	14.611	16.473	18.940	20.867	24.337	28.172	30.675	34.382	37.652	41.566	44.314	52.620
26	12.198	13.409	15.379	17.292	19.820	21.792	25.336	29.246	31.795	35.563	38.885	42.856	45.642	54.052
27	12.879	14.125	16.151	18.114	20.703	22.719	26.336	30.319	32.912	36.741	40.113	44.140	46.963	55.476
28	13.565	14.847	16.928	18.939	21.588	23.647	27.336	31.391	34.027	37.916	41.337	45.419	48.278	56.893
29	14.256	15.574	17.708	19.768	22.475	24.577	28.336	32.461	35.139	39.087	42.557	46.693	49.588	58.302
30	14.953	16.306	18.493	20.599	23.364	25.508	29.336	33.530	36.250	40.256	43.773	47.962	50.892	59.703
32	16.362	17.783	20.072	22.271	25.148	27.373	31.336	35.665	38.466	42.585	46.194	50.487	53.486	62.487
34	17.789	19.275	21.664	23.952	26.938	29.242	33.336	37.795	40.676	44.903	48.602	52.995	56.061	65.247
36	19.233	20.783	23.269	25.643	28.735	31.115	35.336	39.922	42.879	47.212	50.999	55.489	58.619	67.985
38	20.691	22.304	24.884	27.343	30.537	32.992	37.335	42.045	45.076	49.513	53.384	57.969	61.162	70.703
40	22.164	23.838	26.509	29.051	32.345	34.872	39.335	44.165	47.269	51.805	55.759	60.436	63.691	73.402

NU \ Q	0.99	0.98	0.95	0.90	0.80	0.70	0.50	0.30	0.20	0.10	0.05	0.02	0.01	0.001
42	23.650	25.383	28.144	30.765	34.157	36.755	41.335	46.282	49.456	54.090	58.124	62.892	66.206	76.084
44	25.148	26.939	29.787	32.487	35.974	38.641	43.335	48.396	51.639	56.369	60.481	65.337	68.710	78.750
46	26.657	28.504	31.439	34.215	37.795	40.529	45.335	50.507	53.818	58.641	62.830	67.771	71.201	81.400
48	28.117	30.080	33.098	35.949	39.621	42.420	47.335	52.616	55.993	60.907	65.171	70.197	73.683	84.037
50	29.707	31.664	34.764	37.689	41.449	44.313	49.335	54.723	58.164	63.167	67.505	72.613	76.154	86.661
52	31.246	33.256	36.437	39.433	43.281	46.209	51.335	56.827	60.332	65.422	69.832	75.021	78.616	89.272
54	32.793	34.856	38.116	41.183	45.117	48.106	53.335	58.930	62.496	67.673	72.153	77.422	81.069	91.872
56	34.350	36.464	39.801	42.937	46.955	50.005	55.335	61.031	64.658	69.919	74.468	79.815	83.513	94.461
58	35.913	38.078	41.492	44.696	48.797	51.906	57.335	63.129	66.816	72.160	76.778	82.201	85.950	97.039
60	37.485	39.699	43.188	46.459	50.641	53.809	59.335	65.227	68.972	74.397	79.082	84.580	88.379	99.607
62	39.063	41.327	44.889	48.226	52.487	55.714	61.335	67.322	71.125	76.630	81.381	86.953	90.802	102.166
64	40.649	42.960	46.595	49.996	54.336	57.620	63.335	69.416	73.276	78.860	83.675	89.320	93.217	104.716
66	42.240	44.599	48.305	51.770	56.188	59.527	65.335	71.508	75.424	81.085	85.965	91.681	95.626	107.258
68	43.838	46.244	50.020	53.548	58.042	61.436	67.335	73.600	77.571	83.308	88.250	94.037	98.028	109.791
70	45.442	47.893	51.739	55.329	59.898	63.346	69.334	75.689	79.715	85.527	90.531	96.388	100.425	112.317

For larger degrees of freedom, NU, the expression $\sqrt{2CHI^2} - \sqrt{2NU - 1}$ may be used as a normal deviate with unit variance.

This table is reproduced from Table IV, "Distribution of χ^2," of Fisher & Yates, Statistical Tables for Biological, Agricultural and Medical Research, published by Longman Group UK Ltd., London (previously published by Oliver and Boyd, Ltd., Edinburgh) and by permission of the authors and publishers.

APPENDIX C

PROGRAM OUTLINE

```
36    REM                         PLOTnFIT
37    REM                  (PLOTNFIT.4TH -  7/31/89)
38    REM          A Program Written in IBM BASIC (A2.10) for
39    REM        Plotting and Analyzing  (i.e., Curve Fitting) Data
116 REM          <<<          INPUT - Plotting Instructions          >>>
526 REM          <<<          INPUT - Data to  be Plotted            >>>
771 REM          <<<   Determine the Data Range for the Coordinates
772 REM                     and Marking Intervals for the Axes       >>>
826 REM          <<<             ... For the LINEAR axes             >>>
1011 REM         <<<          ... For the  LOGARITHMIC axes          >>>
1501 REM         <<<        OUTPUT - Prepare "GRAPH PAPER"           >>>
2056 REM         <<<        OUTPUT - Plot Data  and Curves           >>>
2206 REM      *******************************************************
2207 REM *******       Subroutine to Choose BASIS FUNCTIONS          *******
2336 REM *******    Subroutine to INPUT Data from the KEYBOARD       *******
2396 REM *******    Subroutine to INPUT Data from a STORED FILE      *******
2716 REM *******    Subroutine to OUTPUT Data to a STORED FILE       *******
2821 REM *******   Subroutines for Drawing DATA POINTS & CURVES      *******
2822 REM                    ***         I          ***
2841 REM                    ***       CROSS        ***
2861 REM                    ***         X          ***
2881 REM                    ***         H          ***
2901 REM                    ***      DIAMOND       ***
2921 REM                    ***    TRIANGLE-UP     ***
2941 REM                    ***   TRIANGLE-DOWN    ***
2961 REM                    ***      SQUARE        ***
2971 REM                    ***       CURVE        ***
2981 REM *******     Subroutine to Scale the Coordinate Axes         *******
3166 REM *******          Subroutine for Job Description             *******
3231 REM *******         Subroutine to Print Job Summary             *******
3451 REM *******    Subroutine to Print Key Program Variables        *******
3591 REM *******       Subroutine for Program Introduction           *******
3666 REM *******         Subroutine for Centering Strings            *******
3676 REM *******         Subroutine for Setting Print Type           *******
3681 REM *******  Subroutine for Accepting Responses to Queries      *******
3691 REM *******           Subroutine for a Screen Pause             *******
3696 REM *******      Subroutine for Polynomial Curve Fitting        *******
3697 REM                            and Plotting
4126 REM        <<<    Plot All Polynomials for the Lth Data Set      >>>
4221 REM        <<<          Save Best Fit Coefficients               >>>
4351 REM *******    Subroutine for Plotting Each Data Set and        *******
4352 REM           Corresponding Best Polynomial/Best Fit Curve
4661 REM *******    Subroutine to Define Chosen BASIS FUNCTIONs      *******
5051 REM *******    Subroutine for Integration of Polynomials        *******
5141 REM *******    Subroutine for INPUT Variable Range Check        *******
5161 REM *******   Subroutine to Print Polynomial Coefficients       *******
5196 REM ******* Subroutine with Cautionary Note on Use of PLOTnFIT *******
5316 REM *******  Subroutine for Trapping "File Opening" Errors      *******
```

NRC FORM 335 (2-89) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER (Assigned by NRC. Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG-1378

2. TITLE AND SUBTITLE

PLOTnFIT: A BASIC Program for Data Plotting and Curve Fitting

3. DATE REPORT PUBLISHED

MONTH	YEAR
October	1989

4. FIN OR GRANT NUMBER

5. AUTHOR(S)

John O. Schiffgens

6. TYPE OF REPORT

Computer Program

7. PERIOD COVERED (Inclusive Dates)

8. PERFORMING ORGANIZATION – NAME AND ADDRESS (If NRC, provide Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)

Division of Engineering and Systems Technology
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

9. SPONSORING ORGANIZATION – NAME AND ADDRESS (If NRC, type "Same as above"; if contractor, provide NRC Division, Office or Region, U.S. Nuclear Regulatory Commission, and mailing address.)

Same as above

10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

PLOTnFIT is a BASIC program to be used with an IBM or IBM-compatible personal computer (PC) for plotting and fitting curves to measured or observed data for both extrapolation and interpolation. It uses the Least Squares method to calculate the coefficients of nth degree polynomials (e.g., up to 10th degree) of Basis Functions so that each polynomial fits the data in a Least Squares sense, then plots the data and the polynomial that a user decides best represents them.

PLOTnFIT is very versatile. It can be used to generate linear, semilog, and log-log graphs and can automatically scale the coordinate axes to suit the data. It can plot more than one data set on a graph (e.g., up to 8 data sets) and more data points than a user is likely to put on one graph (e.g., up to 225 points). A PC diskette containing (1) READIST.PNF (a summary of this NUREG), (2) INI06891.SIS and FOL06891.SIS (two data files), and (3) PLOTNFIT.4TH (the latest version of the program) may be obtained from the National Energy Software Center, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)

BASIC
curve fitting
computer graphics
curve plotting
data analysis
data deviations
data errors
data evaluation
IBM computers
least squares fit
mathematical models
polynomials
statistics

13. AVAILABILITY STATEMENT

Unlimited

14. SECURITY CLASSIFICATION

(This Page) Unclassified

(This Report) Unclassified

15. NUMBER OF PAGES

16. PRICE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

SPECIAL FOURTH-CLASS RATE
POSTAGE & FEES PAID
USNRC
PERMIT No. G-67

120555139531 1 1AN1CV1RC1RF1
US NRC-OADM
DIV FOIA & PUBLICATIONS SVCS
TPS PDR-NUREG
P-223
WASHINGTON DC 20555