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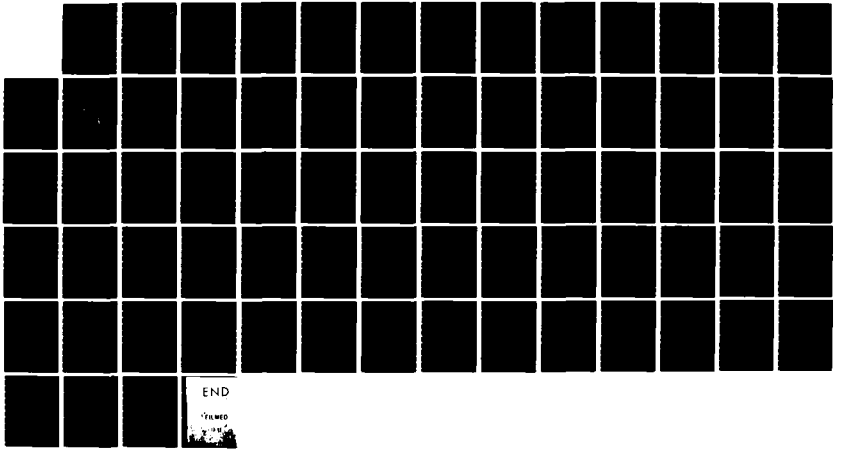

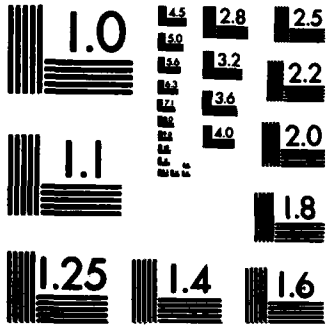

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STATISTICS
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A USER'S GUIDE TO BISAM: THE BIVARIATE DATA MODELING PROGRAM

by Terry J. Woodfield
Department of Statistics
Texas A&M University

Technical Report No. A-24
August 1983

Texas A&M Research Foundation
Project No. 4858

"Functional Statistical Data Analysis and Modeling"

Sponsored by the Army Research Office
Contract DAAG29-83-K-0051

Professor Emanuel Parzen, Principal Investigator

Approved for public release; distribution unlimited.

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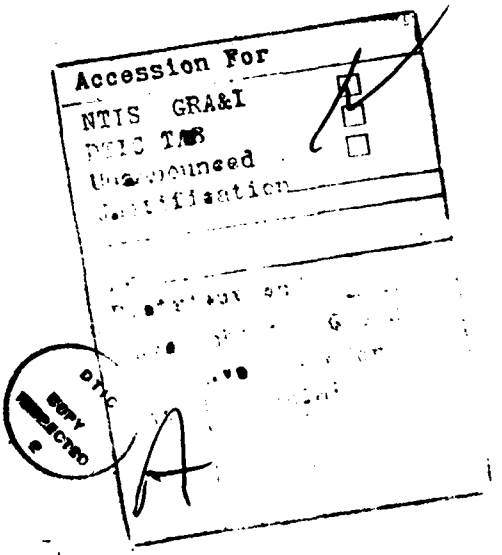


A USER'S GUIDE TO BISAM: The Bivariate Data Modeling Program

I. Introduction

The BISAM (BIvariate SAMple) program is a companion program to the ONESAM (Parzen and Anderson, 1980) and TWOSAM (Prihoda, 1981) programs developed for nonparametric data modeling. The main purpose of BISAM is to perform bivariate data analysis using Fourier expansions and quantile techniques. The motivation and theory behind the data modeling approach incorporated by BISAM is detailed in Woodfield (1982), with foundations provided by Parzen (1979), Tartar and Kronmal (1970, 1976), and Kimeldorf and Sampson (1975).

BISAM is a FORTRAN program composed of a main program and 37 subprograms. Several of the subprograms come from ONESAM and the TIMESBOARD Time Series Subroutine Library (Newton, 1979). The main feature of BISAM is the ability to provide estimates of the bivariate density-quantile function of a set of bivariate data. A univariate analysis is also provided similar to that of ONESAM but with considerably less output. The univariate analysis is not intended to replace a ONESAM analysis if such a detailed analysis is required. The bivariate analysis includes display of various nonparametric measures of association along with some entropy measures that provide diagnostics for model selection and testing for independence. Graphical display of the estimated bivariate dependence density and density-quantile is the responsibility of the user, but a two step procedure utilizing the GCONTOUR and G3D procedures of SAS/GRAPH will be suggested in a later section. Different installations will have different software to provide

three dimensional plots, hence the plotting option has been excluded from BISAM. One of the advantages of the modeling approach adopted by the BISAM program is the ability to obtain quickly and efficiently a set of function values for a dense grid of bivariate points promoting the examination of three dimensional representation of functions of interest.

This document will explain the algorithms employed in generating output and the steps necessary to perform an analysis of a set of bivariate data. The options available and the user input required to execute the BISAM program will also be described in detail. The user should be thoroughly acquainted with the input options before attempting to execute the BISAM program. Incorrectly specified option values may cause errors. Furthermore, BISAM is a very long and complex program that will be fairly expensive to use, and hence improper runs should be avoided.

2. Univariate Analyses

The analysis of each of the paired variables separately is essential to fully understand the nature of the bivariate data set. In particular, the estimation of univariate density-quantile functions should be performed in an optimal manner to insure that the estimated bivariate density-quantile function is appropriate. A univariate analysis will provide diagnostics to help one understand the nature of the univariate density-quantile function and thus guide one in the formulation of the bivariate density-quantile.

BISAM provides output for each variable that is a subset of what may be provided by ONESAM. The univariate analysis is done in two stages, however. In the first stage, descriptive statistics, an Informative Quantile plot, and a plot of $\tilde{D}(u)$ are provided in a goodness-of-fit exploration analysis to guide one in determining the underlying marginal distributions.

In the second stage, a univariate density-quantile function is estimated by the autoregressive method for the null case specified and is then used to form the bivariate density-quantile function as described in section 4. If $\tilde{D}(u)$ in stage one does not approximate a uniform distribution function for the null case specified, then one should specify another null value, or the bivariate density-quantile function estimated will be unreliable.

For a complete description of some of the above concepts, see Parzen (1979).

3. Bivariate Analysis

A bivariate analysis of a set of data includes computation of various nonparametric correlation coefficients, model selection diagnostics, and estimation of the bivariate dependence density and density quantile functions for a dense grid of points. Scatter plots are produced for the original data and the rank transformed data. Obtaining "publication quality" plots depends on the plotting hardware and software available on the system used.

Five correlation coefficients are produced along with various entropy measures of association. We will assume that the input data set is denoted by $(X_1, Y_1),\ldots,(X_n, Y_n)$. Pearson's product moment correlation coefficient is defined by

$$r = \sum_{i=1}^{n} (X_i - \bar{X})(Y_i - \bar{Y}) \Big/ \sqrt{\sum_{i=1}^{n} (X_i - \bar{X})^2 \sum_{i=1}^{n} (Y_i - \bar{Y})^2},$$

and is labeled "PEARSON" in the BISAM output. Spearman's rank correlation coefficient is given by

$$\rho_n = 1 - 6 \sum_{i=1}^{n} (Q_i - R_i)^2 / [n(n^2 - 1)],$$

where Q_i = rank (X_i) and R_i = rank (Y_i) and is labeled "SPEARMAN" in the BISAM output. Three correlation coefficients related to the concepts of concordance and discordance are also computed, two of which perform corrections for tied observations. Kendall's Tau is defined by

$$\tau_A = (N_C - N_D)/[n(n-1)/2] \quad ,$$

where N_C is the number of concordant pairs and N_D is the number of discordant pairs, and is labeled "KENDALL A" in the output. Kendall's TAU correcting for ties is given by

$$\tau_B = (N_C - N_D)/\sqrt{(N_C + N_D + T_X)(N_C + N_D + T_Y)},$$

where T_X is the number of tied observations in the X variable but not in the Y variable, and T_Y is the number of tied observations in the Y variable but not in the X variable. This measure is labeled "KENDALL B" in the output. Somer's d is defined by

$$d = (N_C - N_D) \; / \; (N_C + N_D + T_Y) \quad ,$$

and is seen to be similar to Kendall's Tau-B. This measure of association is labeled "SOMER'S D" in the output.

The ranking procedure employed assigns average ranks for tied observations. Other methods for assigning ranks to tied observations are often employed but are not attempted by BISAM. The presence of a large percentage of tied

observations will weaken the results obtained since underlying continuous distributions are assumed. One should avoid such situations if possible.

Two methods of bivariate density estimation are performed by BISAM, the nearest neighbor technique and the orthogonal expansion technique of Woodfield (1982). However, estimates obtained from the nearest neighbor technique are not displayed, but instead are used as input values for the ortnogonal expansion technique. Since the density estimation methods employed are fundamental to the bivariate analysis performed, the next section will discuss these techniques with considerable attention paid to the theory and implementation of such methods. Since the entropy measures of association and model selection diagnostics are so closely related to the density estimation technique employed, the discussion of these quantities will also be withheld until the next section.

4. Nonparametric Density Estimation

Nonparametric density estimation is performed three different ways by BISAM for different purposes. The k-nearest neighbor technique is employed first for k=6 to provide an estimate of the dependence density as input to an orthogonal expansion density estimation technique and to produce a raw estimate of the entropy associated with the joint probability density function (p.d.f.) and the marginal p.d.f.'s. The orthogonal expansion method of Woodfield (1982) is then employed to obtain smoothed estimates of the dependence density for various degrees of smoothing. Finally, autoregressive estimates of the marginal p.d.f.'s are obtained and used with the estimated dependence density to produce an estimate of the bivariate density-quantile function. We now elaborate on the details of these procedures.

Let $(X_1, Y_1),\ldots,(X_n, Y_n)$ be a bivariate random sample form the random vector (X,Y) with joint cumulative d.f. $F_{X,Y}$, marginals F_X, F_Y, joint p.d.f. $f_{X,Y}$, marginal p.d.f.'s f_X, f_Y, and quantile functions Q_X, Q_Y. Define the dependence distribution function $D(u_1, u_2)$ by

$$D(u_1, u_2) = F_{X,Y}(Q_X(u_1), Q_Y(u_2)), \quad 0 \leq u_1, u_2 \leq 1 \quad ,$$

and the dependence density function $d(u_1,u_2)$ by

$$d(u_1,u_2) = \frac{\partial^2}{\partial u_1 \partial u_2} D(u_1,u_2) = \frac{f_{X,Y}(Q_X(u_1)Q_Y(u_2))}{f_X Q_X(u_1) f_Y Q_Y(u_2)} \quad .$$

Define the information between two densities f and g by

$$I(f;g) = \int_{-\infty}^{\infty} \{\log \frac{f(x)}{g(x)}\} f(x) \quad dx$$

and the entropy of a density f by

$$H(f) = \int_{-\infty}^{\infty} -\{\log f(x)\} f(x) \, dx.$$

The information inequality states that for two densities f and g,

$$I(f;g) \geq 0.$$

Furthermore, $I(f;g) = 0$ iff $f=g$ a.e.

It is easy to see that

$$I(f_{X,Y};\ f_X f_Y) = -H(d) \quad ,$$

which justifies naming $d(u_1,u_2)$ the dependence density, since by virtue of the information inequality $d(u_1,u_2)$ is indirectly related to a measure of dependence between X and Y. This fact is exploited in obtaining diagnostics for model selection and tests of independence.

Let $\{\phi_k(u)\}_{k=-\infty}^{\infty}$ be a complete orthonormal system of functions in $L^2(0,1)$. Then the system $\{\phi_{jk}(u_1,u_2)\}_{j,k=-\infty}^{\infty}$ defined by

$$\phi_{jk}(u_1,u_2) = \phi_j(u_1)\phi_k(u_2) \quad , \quad 0 \le u_1,u_2 \le 1, \quad \text{all } j,k,$$

is a complete orthonormal system in the space of bivariate square integrable functions on the unit square. If $\log d(u_1,u_2)$ is square integrable, then

$$\log d(u_1,u_2) = \sum_{j,k=-\infty}^{\infty} \theta_{jk}\phi_j(u_1)\phi_k(u_2) - \Psi(\underset{\sim}{\theta})$$

in the sense of L^2 norm where $\{\theta_{jk}\}_{j,k=-\infty}^{\infty}$ are the Fourier coefficients defined by

$$\theta_{jk} = \int_0^1 \int_0^1 \phi_j(u_1)\phi_k(u_2) \log d(u_1,u_2)\, du_1 du_2, \quad j,k=-\infty, \ldots \infty \quad .$$

The term $\Psi(\underset{\sim}{\theta})$ is included to insure that $d(u_1,u_2)$ integrates to one. For the truncated m-th order model given by

$$\log d_m(u_1,u_2) = \sum_{j,k=-m}^{m} \theta_{jk}\phi_j(u_1)\phi_k(u_2) - \psi_m(\underline{\theta}) ,$$

it follows that $\log d_m(u_1,u_2) \to \log d(u_1,u_2)$ as $m \to \infty$, and hence one calls $d_m(u_1,u_2)$ the m-th order approximation of $d(u_1,u_2)$. One thus seeks an estimator of $d_m(u_1,u_2)$ based on a random sample of bivariate data.

Let

$$u_{1i} = R_i/(n+1), \qquad u_{2i} = Q_i/(n+1)$$

where R_i and Q_i are the ranks of X_i and Y_i as defined before. Thus $(u_{11}, u_{21}),\ldots,(u_{1n},u_{2n})$ approximates a random sample distributed uniformly on the unit square under an assumption of independence. Dependence of X and Y suggests alternate uniform distributions that may include a variety of bivariate density shapes from distributions having uniform (0,1) marginals. Next, form $\tilde{d}(u_1,u_2)$ evaluated at these uniform sample points based on the k-nearest neighbor techniques. BISAM uses k=6. Form $\log \tilde{d}(u_1,u_2)$ and use this as the dependent variable in a least squares regression routine with independent variables $\phi_j(u_1)\phi_k(u_2)$, j,k=-m,...,m. Essentially, both $\log \tilde{d}(u_1,u_2)$ and $\phi_j(u_1)\phi_k(u_2)$ represent bivariate functions imbedded into univariate representations for a multiple regression analysis. The design matrix X is an n x m^2 matrix consisting of the m^2 orthogonal combinations evaluated at the n uniform data points. The routine performed by BISAM forms the $(2m+1)^2$ x $(2m+1)^2$ correlation matrix* and then uses a SWEEP operator

*The (0,0) term is incorporated into the integration factor and is not included, i.e., the no intercept model is employed, hence, the correlation matrix is not $[(2m+1)^2+1]$ x $[(2m+1)^2+1]$.

on this matrix to obtain least squares estimates of the Fourier coefficients. The resulting estimate is given by

$$\log \hat{d}(u_1,u_2) = \sum_{j,k=-m}^{m} \hat{\theta}_{jk}\phi_j(u_1)\phi_k(u_2)$$

where $\{\hat{\theta}_{j,k}\}_{j,k=-m}^{m}$ is the collection of least squares estimates of the expansion parameters. The integration factor $\hat{\psi}_m(\hat{\theta})$ is then derived to insure that $d(u_1,u_2)$ numerically integrates to one. This is accomplished for $\hat{d}(u_1,u_2)$ equally spaced in the u_1 and u_2 directions within the unit square.

Three models are obtained for m=1,2,3 which translates into 8 variable, 24 variable, and 48 variable regression models, i.e., the terms with subscripts (i,k), i,k=-m,...,m for m=1,2,3 are included. These three models produce three density estimates evaluated at the 40 x 40 grid of (u_1,u_2) coordinates mentioned above. Using raw Riemann sums as numerical integrals, one then obtains estimates of the entropy H(d) mentioned earlier. A fourth estimate of the entropy of the dependence density is provided by the nearest neighbor estimate using the formula

$$H(\tilde{d}) = \int_0^1 \int_0^1 \log \tilde{d}(u_1,u_2)d\, D_n(u_1,u_2)$$

$$= \frac{1}{n} \sum_{j=1}^{n} \log \tilde{d}\left(\frac{R_j}{n+1}, \frac{Q_j}{n+1}\right) ,$$

where $D_n(u_1,u_2)$ is the empirical c.d.f. of (u_{1i}, u_{2i}), i=1,...,n.

As a rule-of-thumb for model selection, $H(\hat{d})$ is compared with $H(\hat{d}_8)$, $H(\hat{d}_{24})$, and $H(\hat{d}_{48})$. An information criterion modeled after Akaike's Information Criterion (AIC) familiar to time series analysts is used to select the "best" model. One forms

$$AIC\ (k) = H(\hat{d}_k) - H(\tilde{d}) - 2k/n \quad ;$$

and then selects model k for the k value at which AIC(k) achieves its positive minimum. An alternative approach chooses k for which $|AIC(k)|$ is minimum. Model selection criterion are still under investigation with promising results having been achieved for the criterion employed by BISAM.

Graphical displays of $\hat{d}_k$ suffer from the unruly behavior of $\hat{d}_k$ near the boundary of the unit square, and hence one may prefer to display values of the bivariate density-quantile function given by

$$f\hat{Q}(u_1,u_2) = \hat{d}_k(u_1,u_2)\ f\hat{Q}_X(u_1)\ f\hat{Q}_Y(u_2)$$

where $f\hat{Q}_X$ and $f\hat{Q}_Y$ are the autoregressive estimates of the univariate density-quantile functions. Figure 1 contains a three dimensional plot of the bivariate density-quantile function of order 8 for a set of simulated bivariate normal random variables with correlation coefficient $\rho = 0.9$. Figure 2 contains the theoretical bivariate density-quantile function for the simulated data. The plots were produced using SAS/GRAPH. Appendix B outlines a two step FORTRAN-SAS procedure that allows one to produce three dimensional or contour plots of bivariate functions of interest.

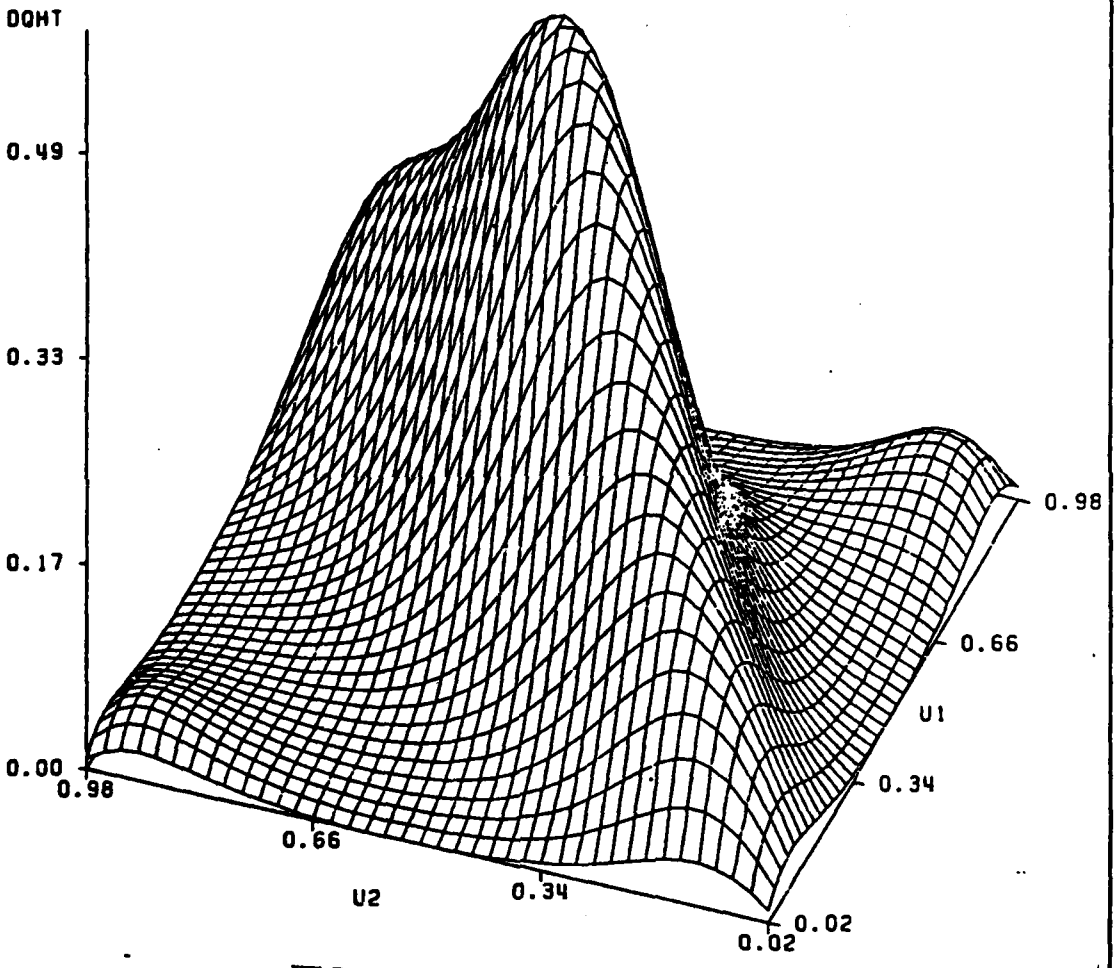


Figure 1. Three Dimensional Plot of Density-Quantile for Normal Data with Rho=0.9, Order=8

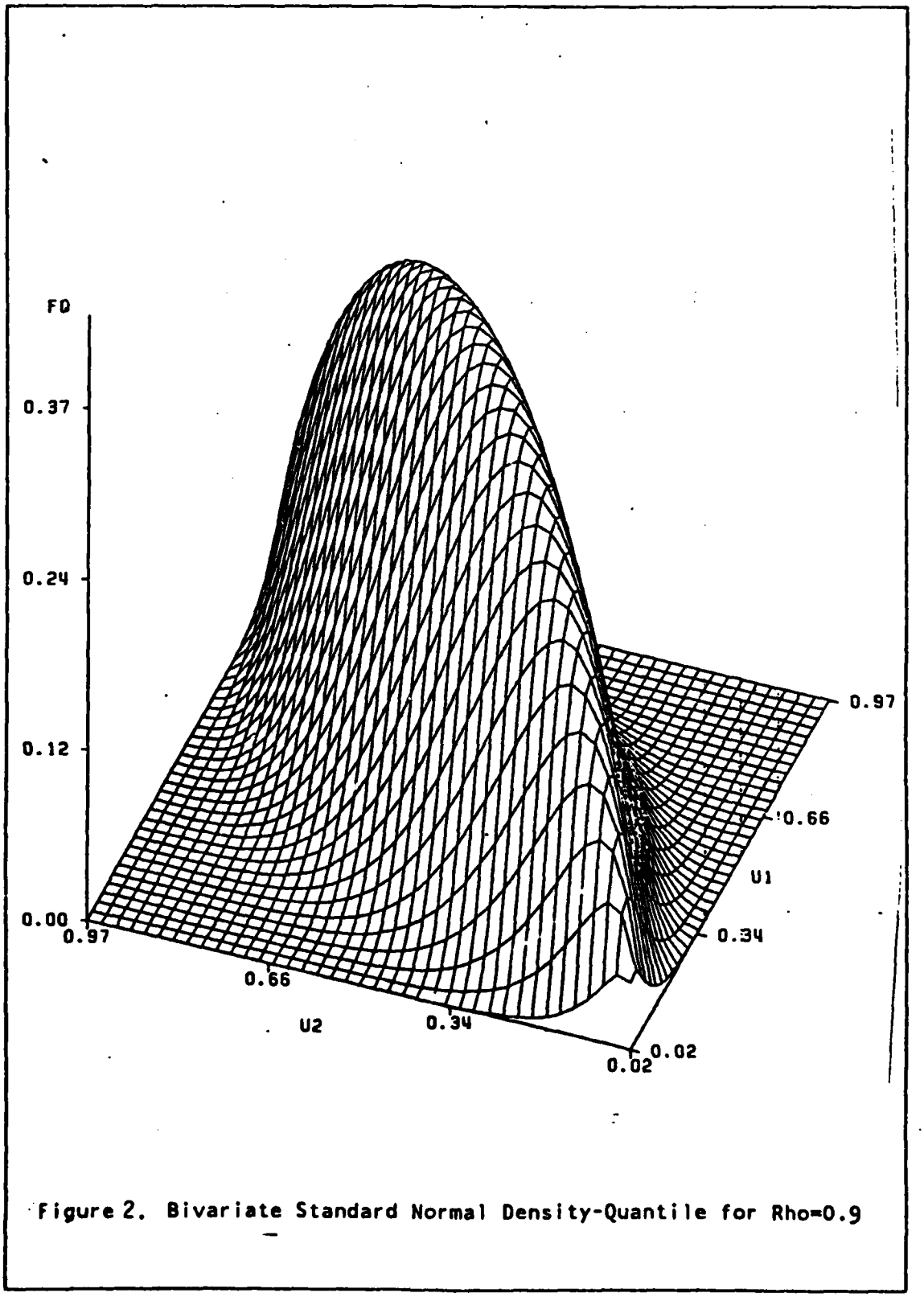


Figure 2. Bivariate Standard Normal Density-Quantile for Rho=0.9

5. Using BISAM to Analyze Time Series Data

Although primarily intended to analyze bivariate data in which the data values are uncorrelated, BISAM can also be used to analyze time series data. For a univariate data set one may use option IUNIV to do an analysis of a bivariate data set consisting of the univariate data set paired with lagged values of the data set.

Consider a Guassian time series X(t) with autocorrelation function $\rho(v)$ given by

$$\rho(v) = \text{Corr}[X(t), X(t+v)], \quad v=0, \pm 1, \ldots \quad .$$

Define the series Y(t) to be a lagged version of X(t), i.e., Y(t) = X(t+v). Then

$$\rho_{X,Y} = \text{Corr}[X,Y] = \text{Corr}[X(t), X(t+v)] = \rho(v).$$

For a bivariate normal random vector (X,Y) with correlation coefficient $\rho_{X,Y}$, it can be shown that

$$I(f_{X,Y} \; ; \; f_X f_Y) = -.05 \log (1-\rho^2_{X,Y}) \quad .$$

Consequently, the information between X and lagged values of X is

$$I(v) = -0.5 \log (1-\rho^2(v)) \quad .$$

In the non-normal case, this equation does not hold so that a nonparametric

estimator may be desired to indicate the relationship between X and lagged values of X.

When one specifies IUNIV = 1, values for KLAG1 and KLAG2 must also be specified. Then a bisam analysis is performed on (X(t), X(t+v)) for integer values v satisfying KLAG1 $\leq$ v $\leq$ KLAG2.

6. Input Options

The following options are input on the first data card in 11I5 format. They are input in the order listed, and if NTAPE = 5, the data set follows this card in the indicated format listed at the end of this section.

NTAPE - number referring to DD statement describing the input data set.

IDQX - null distribution for autoregressive smoothing for X input variable.

IDQY - same as IDQX except for Y input variable.

MORD - maximum autoregressive order to be used for univariate autoregressive density estimation ($\leq$ 6).

IPLT1 - 0 for no scatter plots.
1 for scatter plot of data.
2 for scatter plot of rank transformed data.
3 for both scatter plots.

IPLT2 - 0 for no univariate density plots.
1 for best order AR univariate density plots.

IDST - 0 for no univariate descriptive statistic.
1 for descriptive statistics for both X and Y.

KDEL - maximum number of extreme points to exclude from bivariate analysis. An extreme point is located based on the distance of the X or Y coordinate from its median. If KDEL=2 and both the extreme X and Y are paired together, then only that point will be omitted. If KDEL=3, two points with an extreme X value and one point with an extreme Y value will be omitted, i.e., the X-direction received precedence over the Y-direction for odd values of KDEL. This method of deleting outliers works well for nearly linear relationships between X and Y. Its use is questionable for other cases.

IOUTD - 0 if function values are not to be saved.

1 if function values for the three fitted models are to be written to tapes 1, 2, and 3 respectively.

If IOUTD=1, the JCL must contain three DD cards for FTØ1FØØ1, FTØ2FØØ1, and FTØ3FØØ1 defining permanent dish data files where the function values are to be written. Typically, 10 tracks of storage must be alloted for each file.

IREG - 0 if no quantile regression performed.

1 if nonparametric estimates of $rQ(u) = E[Y|X = Q(u)]$ and $r(x) = E[Y|X=x]$ are desired.

IUNIV - 0 if input data set is bivariate data.

1 if input data set is a univariate time series as described in section 5.

If IUNIV=1, a second data card is required containing the values KLAG1 and KLAG2 in 2I5 format as described in section 5.

If IDQX and/or IDQY specify the Pareto to Weibull distributions, a separate data card must be inserted containing estimates of the parametrs in those distributions. For the Weibull, the location estimate is given first, with the input format specified as 2F1Ø.Ø.

The input data set consists of two univariate data sets containing the same number of values. It is always assumed that the X data set is read in first. The values (X,Y) are then paired by the order they are read in. A univariate data set consists of a title card read in 20A4 format, a description card containing the number of data points and the format of the input data read in (I5, 4X, 5A4) format, and the data cards containing the data coded in the format indicated on card 3. If the number of data points indicated for X and Y do not match, theprogram will terminate.

Example of univariate data set:

YEARLY SNOWFALL IN BUFFALO, 1910-1972

63 (6F10.2)

71.2 69.5 47.8 58.4 29.9 42.5

etc.

The code for BISAM and sample output are contained in the Appendices.

7. Sample Output form BISAM

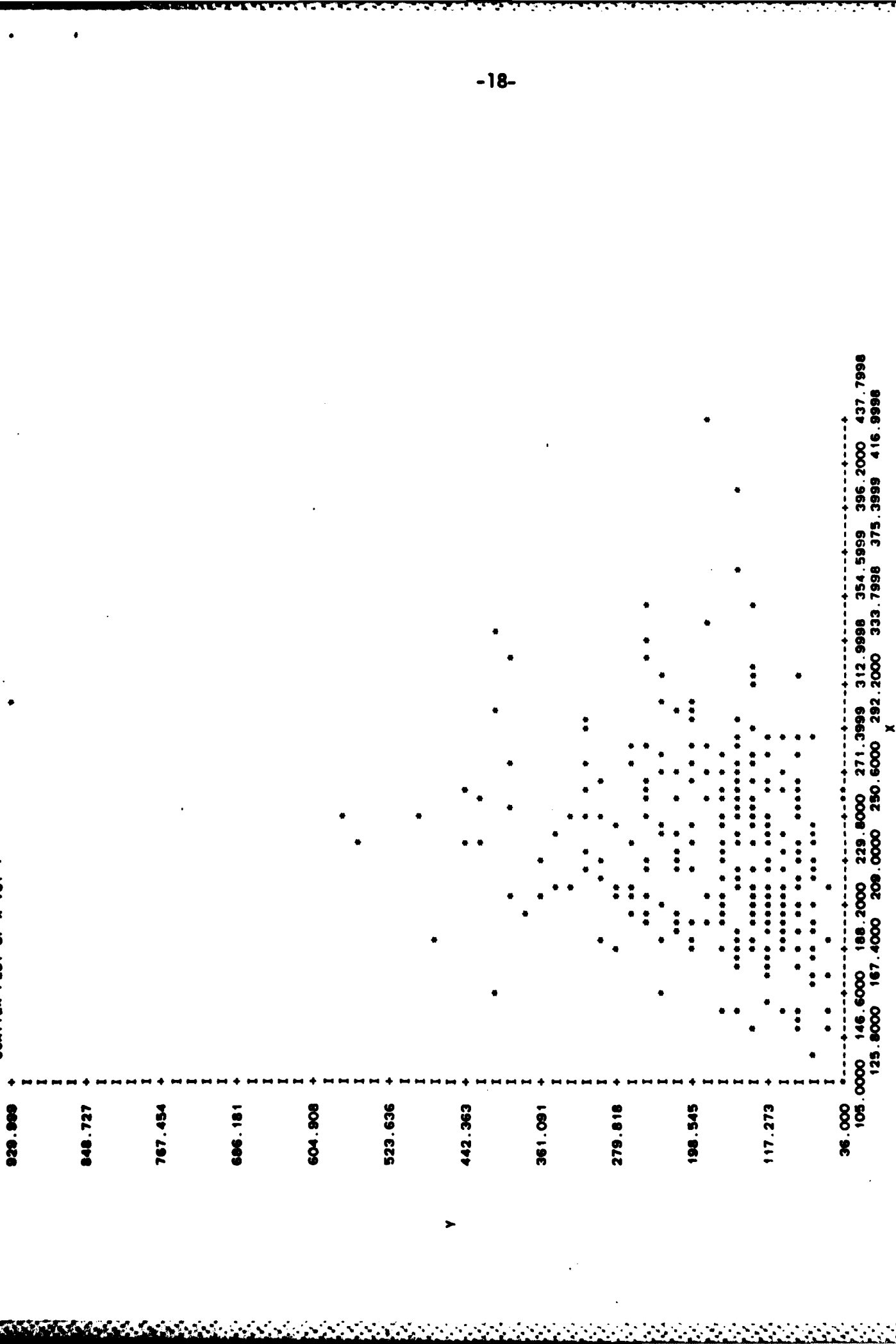
Following is a listing of the output from BISAM for a typical run with the input options clearly labeled. The JCL for executing BISAM at Texas A&M University is given in Appendix A.

```
**********************************************************************
*                                                                    *
*   BISAM - BIVARIATE DATA ANALYSIS USING FOURIER EXPANSIONS         *
*           AND QUANTILE TECHNIQUES                                  *
*                                                                    *
*   PROGRAMMER: TERRY J. WOODFIELD                                   *
*                                                                    *
**********************************************************************


 PLASMA CHOLESTEROL - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
 PLASMA TRIGLYCERIDES - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES

SAMPLE SIZE =  320

OPTIONS FOR THIS ANALYSIS:
        NTAPE = 13          IDQX =   1          IDQY =  1
        MORD =  2           IPLT1 =  3          IPLT2 =  1
        IDST =  1           KDEL =   1          IOUTD =   0
        IREG =   0          IUNIV =   0
```


SCATTER PLOT OF X VS. Y
929.999
848.727
767.454
686.181
604.908
523.636
442.363
361.091
279.818
198.545
117.273
36.000
Y
105.0000 125.8000 146.6000 167.4000 188.2000 209.0000 229.8000 250.6000 271.3999 292.2000 312.9998 333.7998 354.5999 375.3999 396.2000 416.9998 437.7998
X

FULLY NON-PARAMETRIC ANALYSIS

PLASMA CHOLESTEROL - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
ORIGINAL DATA - X

ORDER STATISTICS IN QUARTERS

SEQUENCE WITHIN QUARTILE	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
1	105.0000	185.0000	213.0000	242.0000
2	119.0000	185.0000	213.0000	243.0000
3	131.0000	186.0000	214.0000	243.0000
4	131.0000	187.0000	215.0000	243.0000
5	131.0000	187.0000	215.0000	244.0000
6	138.0000	188.0000	216.0000	244.0000
7	139.0000	188.0000	216.0000	245.0000
8	139.0000	189.0000	217.0000	245.0000
9	140.0000	189.0000	217.0000	245.0000
10	140.0000	189.0000	218.0000	245.0000
11	140.0000	190.0000	218.0000	245.0000
12	142.0000	191.0000	218.0000	246.0000
13	144.0000	191.0000	218.0000	247.0000
14	149.0000	191.0000	219.0000	247.0000
15	150.0000	191.0000	219.0000	248.0000
16	151.0000	191.0000	219.0000	248.0000
17	157.0000	191.0000	220.0000	249.0000
18	159.0000	192.0000	220.0000	249.0000
19	159.0000	193.0000	220.0000	249.0000
20	160.0000	193.0000	221.0000	250.0000
21	162.0000	193.0000	221.0000	250.0000
22	163.0000	193.0000	221.0000	250.0000
23	164.0000	194.0000	221.0000	251.0000
24	164.0000	194.0000	221.0000	251.0000
25	165.0000	194.0000	222.0000	251.0000
26	165.0000	194.0000	222.0000	252.0000
27	165.0000	194.0000	222.0000	253.0000
28	167.0000	194.0000	222.0000	254.0000
29	168.0000	194.0000	223.0000	254.0000
30	168.0000	195.0000	223.0000	255.0000
31	168.0000	195.0000	224.0000	257.0000
32	168.0000	196.0000	225.0000	258.0000
33	169.0000	196.0000	226.0000	258.0000
34	169.0000	196.0000	227.0000	258.0000
35	170.0000	197.0000	227.0000	258.0000
36	171.0000	197.0000	227.0000	259.0000
37	171.0000	197.0000	228.0000	260.0000
38	171.0000	197.0000	228.0000	260.0000
39	171.0000	197.0000	228.0000	260.0000
40	171.0000	197.0000	229.0000	261.0000
41	171.0000	198.0000	229.0000	262.0000
42	171.0000	198.0000	230.0000	262.0000
43	172.0000	198.0000	230.0000	263.0000

44	172.0000	198.0000	230.0000	264.0000
45	172.0000	198.0000	230.0000	264.0000
46	172.0000	199.0000	230.0000	265.0000
47	173.0000	200.0000	230.0000	266.0000
48	173.0000	200.0000	230.0000	267.0000
49	174.0000	200.0000	231.0000	267.0000
50	175.0000	201.0000	231.0000	268.0000
51	175.0000	201.0000	231.0000	269.0000
52	175.0000	203.0000	232.0000	270.0000
53	175.0000	204.0000	232.0000	271.0000
54	176.0000	204.0000	232.0000	271.0000
55	176.0000	206.0000	232.0000	273.0000
56	177.0000	206.0000	232.0000	274.0000
57	178.0000	206.0000	233.0000	276.0000
58	178.0000	206.0000	233.0000	278.0000
59	178.0000	207.0000	233.0000	279.0000
60	178.0000	207.0000	233.0000	280.0000
61	178.0000	208.0000	233.0000	283.0000
62	179.0000	208.0000	234.0000	283.0000
63	179.0000	208.0000	235.0000	284.0000
64	180.0000	208.0000	236.0000	285.0000
65	180.0000	208.0000	236.0000	287.0000
66	180.0000	208.0000	237.0000	294.0000
67	181.0000	208.0000	237.0000	297.0000
68	181.0000	209.0000	238.0000	298.0000
69	184.0000	209.0000	239.0000	299.0000
70	184.0000	209.0000	239.0000	304.0000
71	184.0000	210.0000	239.0000	306.0000
72	184.0000	210.0000	239.0000	308.0000
73	184.0000	210.0000	239.0000	313.0000
74	185.0000	211.0000	240.0000	319.0000
75	185.0000	211.0000	240.0000	323.0000
76	185.0000	211.0000	240.0000	331.0000
77	185.0000	211.0000	242.0000	332.0000
78	185.0000	211.0000	242.0000	348.0000
79	185.0000	212.0000	242.0000	386.0000
80	185.0000	212.0000	242.0000	417.0000
SUM	13318.0000	15923.0000	18226.0000	21713.0000
SUM OF SQUARES	2240472.00	3174275.00	4157714.00	5973541.00

DESCRIPTIVE STATISTICS

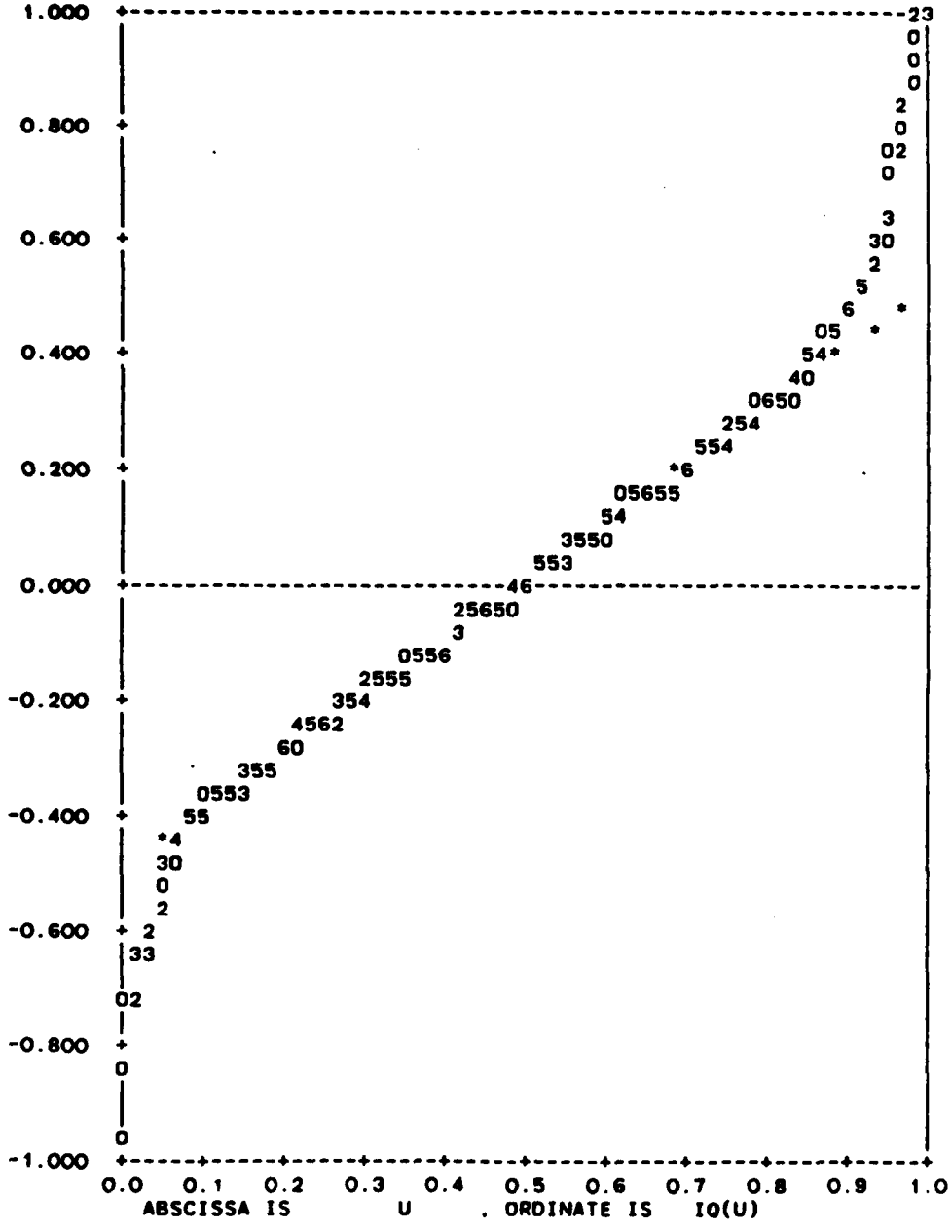
****

SUMSTAT SUMSTAT	SAMPLE SIZE	LOWER QUARTILE	MEDIAN	UPPER QUARTILE	INT_QUARTL RANGE	TRIMEAN	GASTWIRTHS ESTIMATE
SUMSTAT	320	185.0	212.5	242.0	57.00	213.0	212.8

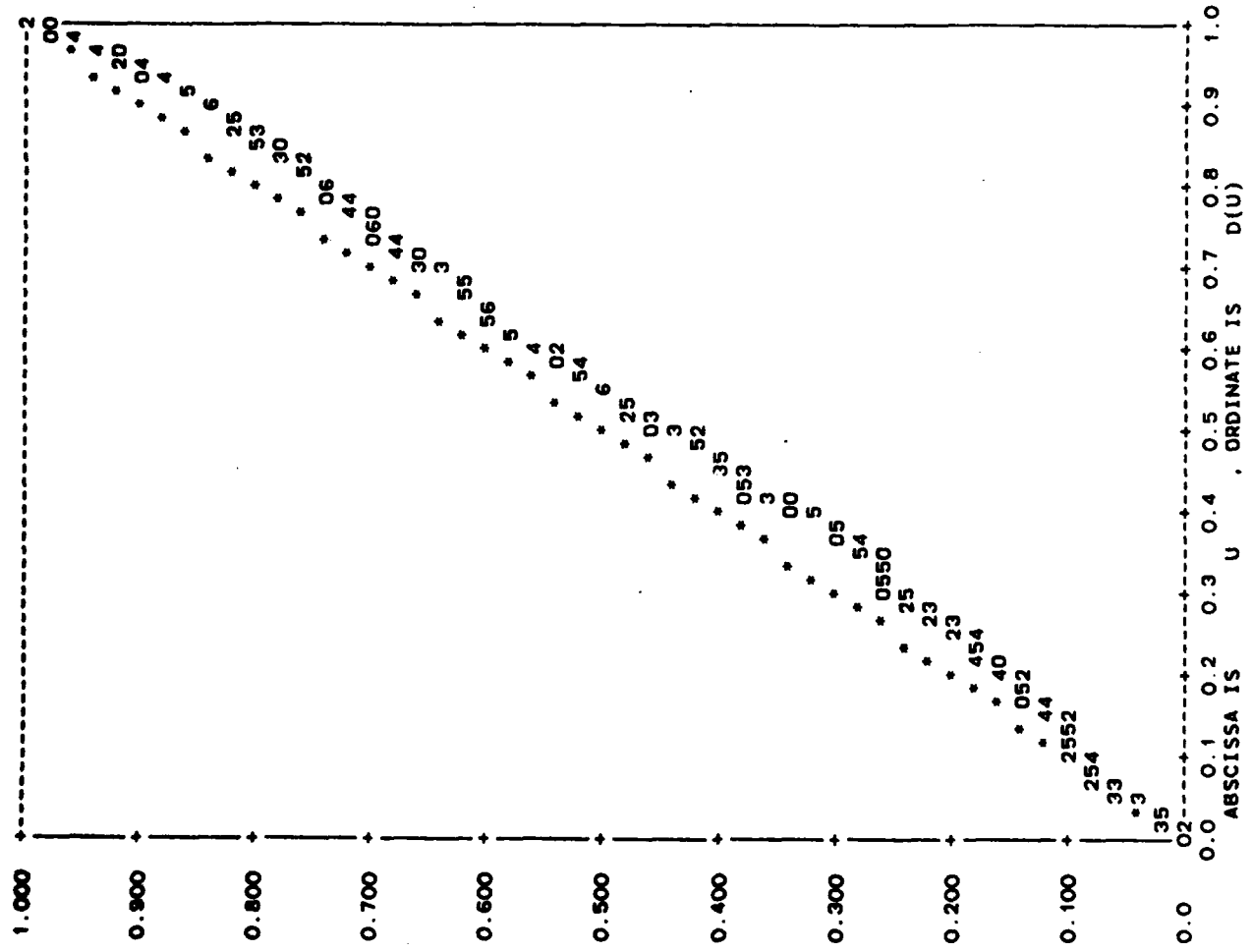
SUMSTAT	SUMSQ/N	MEAN	VARIANCE	STD DEV	MEAN IQ	STD DEV IQ	LOG STD IQ
SUMSTAT	.4858E+05	216.2	1850.	43.01	.3235E-01	.3773	-.9747

TRUNCATION POINT	WINSORIZED MEAN	TRIMMED MEAN
0.050	213.9	214.7
0.100	213.5	214.0
0.250	212.1	213.4

PLASMA CHOLESTEROL - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
INFORMATIVE QUANTILE - ORIGINAL DATA - X



U	0.01000	0.05000	0.10000	0.25000	0.75000	0.90000	0.95000	0.99000
IQ(U)	-0.71491	-0.53684	-0.38947	-0.24123	0.25877	0.47807	0.65263	1.15909


RAW DISTRIBUTION D(U) NORMAL CASE
D+ = 0.0360 AT U = 0.0516 . D- = -1.5590 AT U = 0.3859
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
ABSCISSA IS U , ORDINATE IS D(U)

FULLY NON-PARAMETRIC ANALYSIS

PLASMA TRIGLYCERIDES - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
ORIGINAL DATA - Y

ORDER STATISTICS IN QUARTERS

SEQUENCE WITHIN QUARTILE	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
1	36.0000	115.0000	150.0000	220.0000
2	38.0000	116.0000	151.0000	220.0000
3	50.0000	116.0000	151.0000	221.0000
4	54.0000	117.0000	151.0000	222.0000
5	56.0000	117.0000	152.0000	222.0000
6	59.0000	118.0000	152.0000	223.0000
7	61.0000	119.0000	152.0000	227.0000
8	68.0000	120.0000	152.0000	229.0000
9	72.0000	120.0000	153.0000	231.0000
10	73.0000	120.0000	153.0000	232.0000
11	75.0000	120.0000	153.0000	233.0000
12	76.0000	121.0000	153.0000	233.0000
13	77.0000	122.0000	154.0000	237.0000
14	78.0000	123.0000	154.0000	240.0000
15	80.0000	124.0000	154.0000	240.0000
16	80.0000	124.0000	154.0000	242.0000
17	80.0000	124.0000	155.0000	245.0000
18	80.0000	125.0000	156.0000	246.0000
19	82.0000	125.0000	156.0000	248.0000
20	82.0000	125.0000	156.0000	250.0000
21	84.0000	125.0000	156.0000	255.0000
22	84.0000	125.0000	158.0000	256.0000
23	84.0000	126.0000	158.0000	256.0000
24	84.0000	126.0000	158.0000	256.0000
25	84.0000	126.0000	160.0000	257.0000
26	85.0000	126.0000	161.0000	258.0000
27	87.0000	127.0000	161.0000	259.0000
28	87.0000	127.0000	161.0000	259.0000
29	88.0000	128.0000	162.0000	260.0000
30	88.0000	130.0000	162.0000	261.0000
31	89.0000	130.0000	163.0000	262.0000
32	89.0000	130.0000	164.0000	265.0000
33	90.0000	130.0000	164.0000	267.0000
34	90.0000	130.0000	165.0000	268.0000
35	90.0000	131.0000	166.0000	269.0000
36	91.0000	131.0000	166.0000	271.0000
37	91.0000	133.0000	168.0000	272.0000
38	91.0000	133.0000	168.0000	273.0000
39	91.0000	134.0000	169.0000	278.0000
40	91.0000	135.0000	170.0000	284.0000
41	92.0000	135.0000	170.0000	290.0000
42	92.0000	135.0000	170.0000	291.0000

43	92.0000	135.0000	170.0000	296.0000
44	93.0000	136.0000	171.0000	297.0000
45	95.0000	137.0000	172.0000	300.0000
46	96.0000	137.0000	172.0000	304.0000
47	96.0000	137.0000	173.0000	304.0000
48	97.0000	137.0000	174.0000	306.0000
49	98.0000	137.0000	176.0000	312.0000
50	99.0000	140.0000	177.0000	316.0000
51	100.0000	140.0000	179.0000	317.0000
52	100.0000	141.0000	179.0000	322.0000
53	101.0000	141.0000	180.0000	323.0000
54	101.0000	142.0000	181.0000	325.0000
55	101.0000	142.0000	182.0000	327.0000
56	101.0000	142.0000	183.0000	328.0000
57	101.0000	142.0000	184.0000	328.0000
58	101.0000	143.0000	188.0000	333.0000
59	102.0000	144.0000	189.0000	340.0000
60	102.0000	144.0000	192.0000	347.0000
61	103.0000	144.0000	195.0000	348.0000
62	103.0000	145.0000	196.0000	363.0000
63	104.0000	145.0000	196.0000	376.0000
64	105.0000	145.0000	198.0000	390.0000
65	106.0000	146.0000	199.0000	400.0000
66	107.0000	146.0000	199.0000	400.0000
67	108.0000	146.0000	199.0000	402.0000
68	108.0000	146.0000	200.0000	408.0000
69	108.0000	146.0000	201.0000	418.0000
70	109.0000	148.0000	201.0000	424.0000
71	110.0000	148.0000	202.0000	426.0000
72	110.0000	148.0000	202.0000	432.0000
73	111.0000	148.0000	207.0000	441.0000
74	112.0000	148.0000	207.0000	446.0000
75	112.0000	149.0000	208.0000	454.0000
76	112.0000	149.0000	209.0000	489.0000
77	112.0000	149.0000	210.0000	492.0000
78	115.0000	149.0000	217.0000	567.0000
79	115.0000	149.0000	217.0000	583.0000
80	115.0000	150.0000	218.0000	930.0000
SUM	7260.0000	10725.0000	13965.0000	25442.0000
SUM OF SQUARES	682086.000	1446605.00	2469517.00	9003904.00

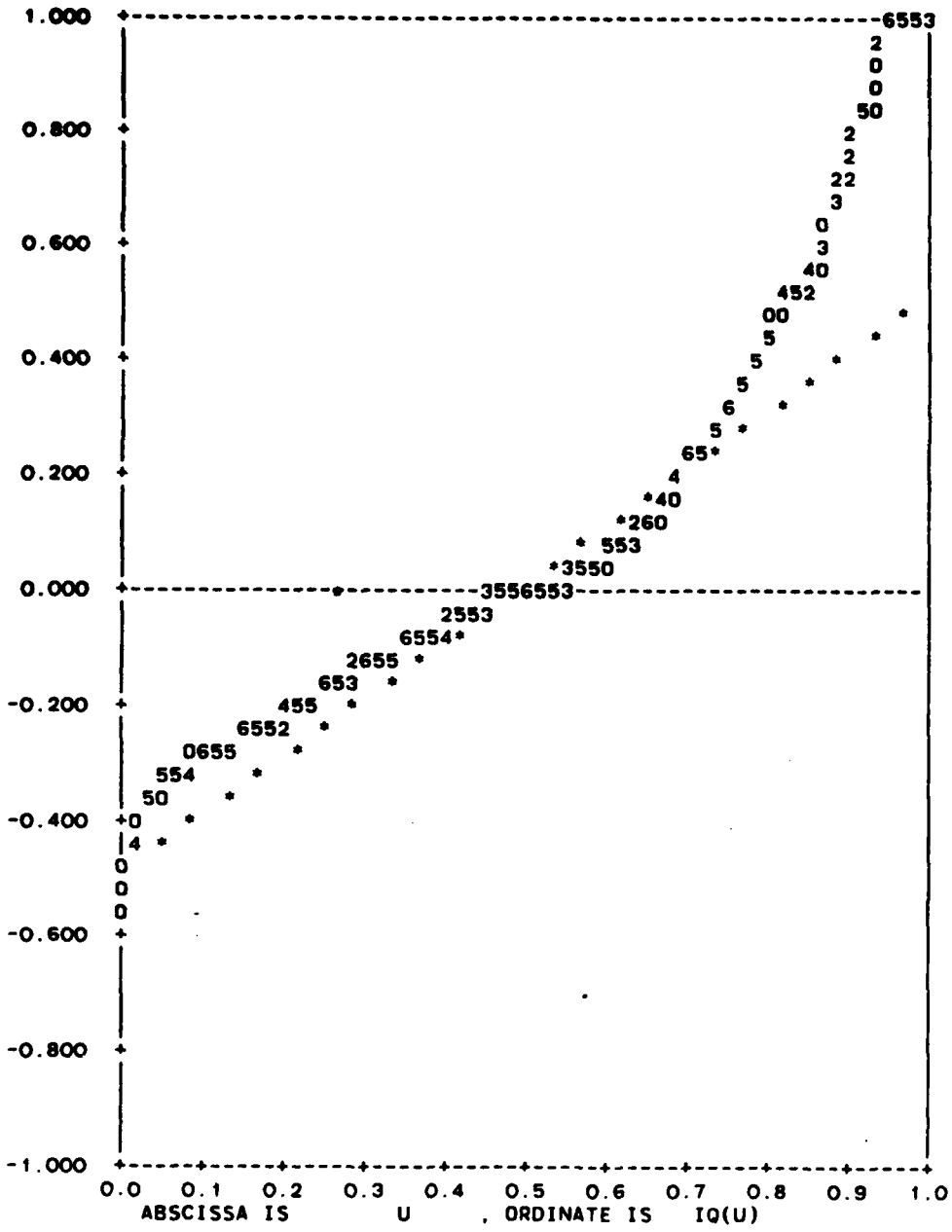
DESCRIPTIVE STATISTICS
****

SUMSTAT SUMSTAT	SAMPLE SIZE	LOWER QUARTILE	MEDIAN	UPPER QUARTILE	INT_QUARTL RANGE	TRIMEAN	GASTWIRTHS ESTIMATE
SUMSTAT	320	115.0	150.0	219.5	104.5	158.6	152.4

SUMSTAT	SUMSQ/N	MEAN	VARIANCE	STD DEV	MEAN IQ	STD DEV IQ	LOG STD IQ
SUMSTAT	.4251E+05	179.3	.1037E+05	101.8	.1404	.4873	-.7189

TRUNCATION POINT	WINSORIZED MEAN	TRIMMED MEAN
0.050	174.1	168.9
0.100	169.3	163.7
0.250	159.4	154.3

PLASMA TRIGLYCERIDES - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
INFORMATIVE QUANTILE - ORIGINAL DATA - Y



U	0.01000	0.05000	0.10000	0.25000	0.75000	0.90000	0.95000	0.99000
IQ(U)	-0.47445	-0.33493	-0.29139	-0.16746	0.33254	0.77225	1.19378	1.91978

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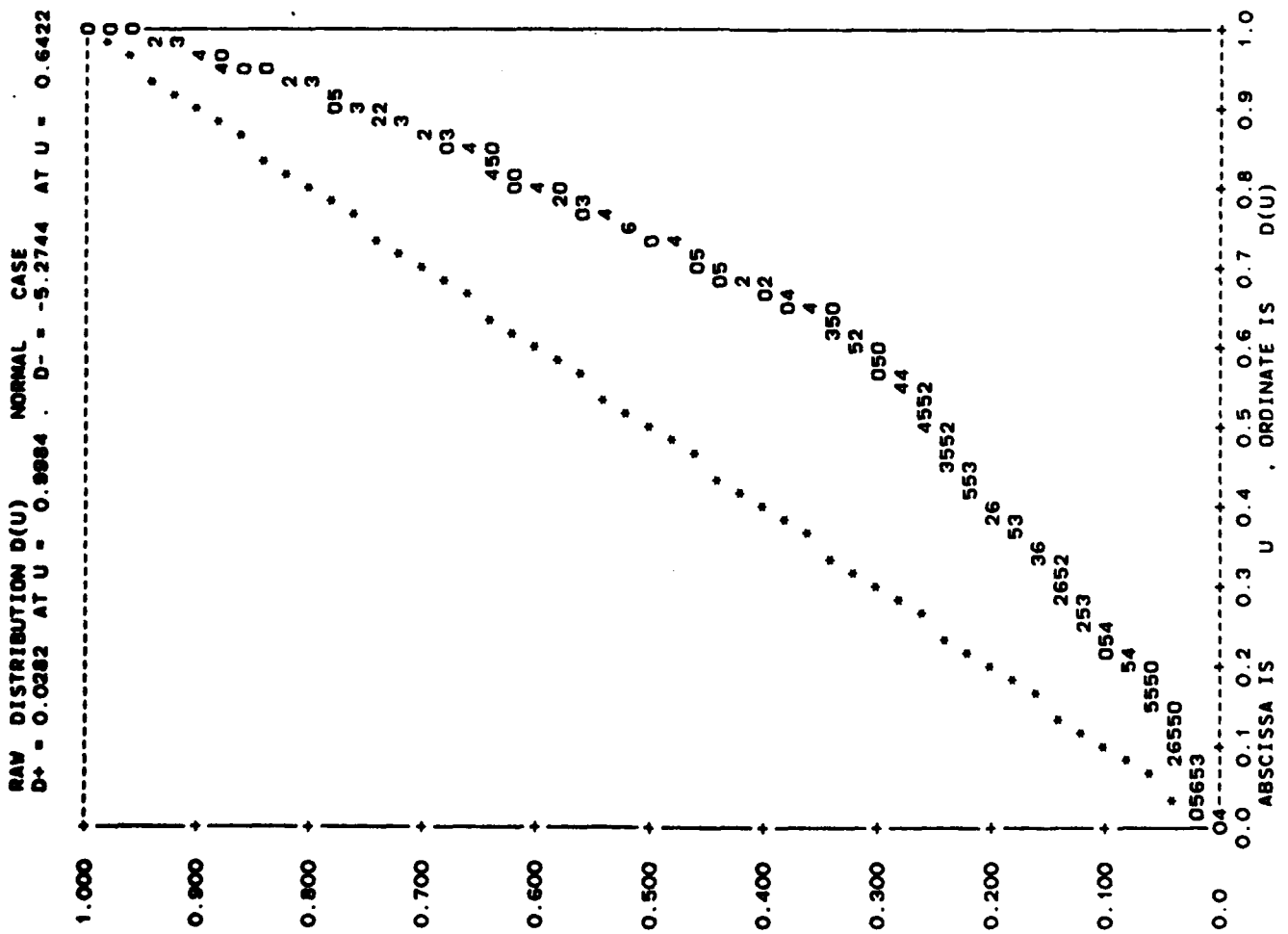
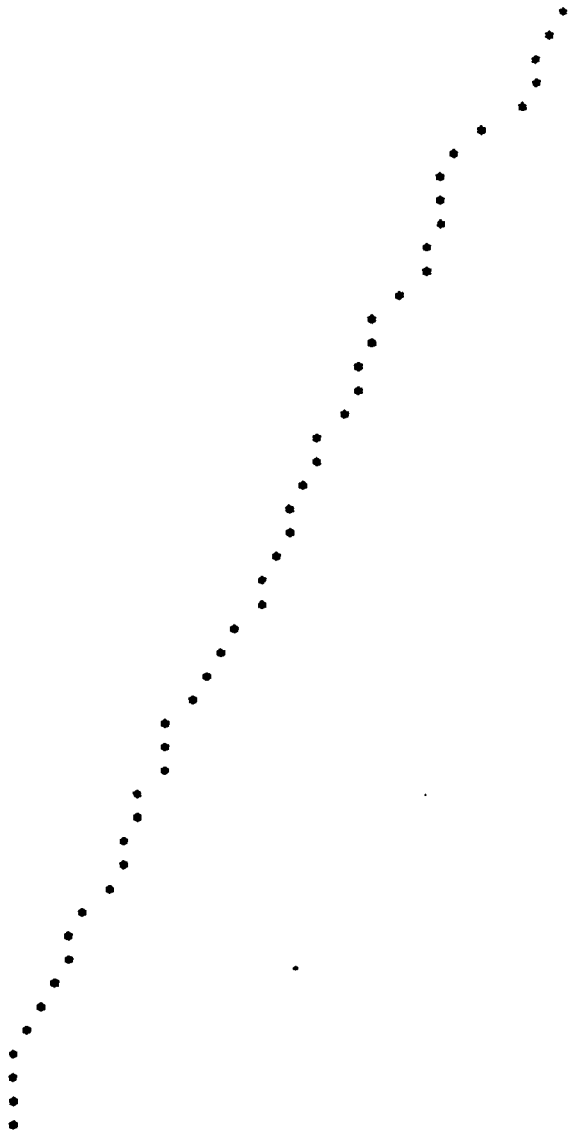

RAW DISTRIBUTION D(U) NORMAL CASE
D+ = 0.0382 AT U = 0.9884 . D- = -5.2744 AT U = 0.6422
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
ABSCISSA IS U , ORDINATE IS D(U)

THE FOLLOWING POINTS WERE DELETED FROM THE DATA SET:
320

1 POINTS WERE DELETED LEAVING 319 POINTS IN THE DATA SET.

I	RVAR
1	0.9905
2	0.9799
3	0.9646
4	0.9562
5	0.9457
6	0.9033
7	0.8624
8	0.8471
9	0.8434
10	0.8424
11	0.8382
12	0.8316
13	0.8071
14	0.7790
15	0.7660
16	0.7636
17	0.7621
18	0.7385
19	0.7115
20	0.7092
21	0.7002
22	0.6845
23	0.6702
24	0.6571
25	0.6489
26	0.6402
27	0.6133
28	0.6061
29	0.5895
30	0.5632
31	0.5417
32	0.5353
33	0.5292
34	0.5037
35	0.5025
36	0.4944
37	0.4907
38	0.4792
39	0.4503
40	0.4308
41	0.4229
42	0.4191
43	0.3909
44	0.3737
45	0.3699
46	0.3679
47	0.3655
48	0.3649



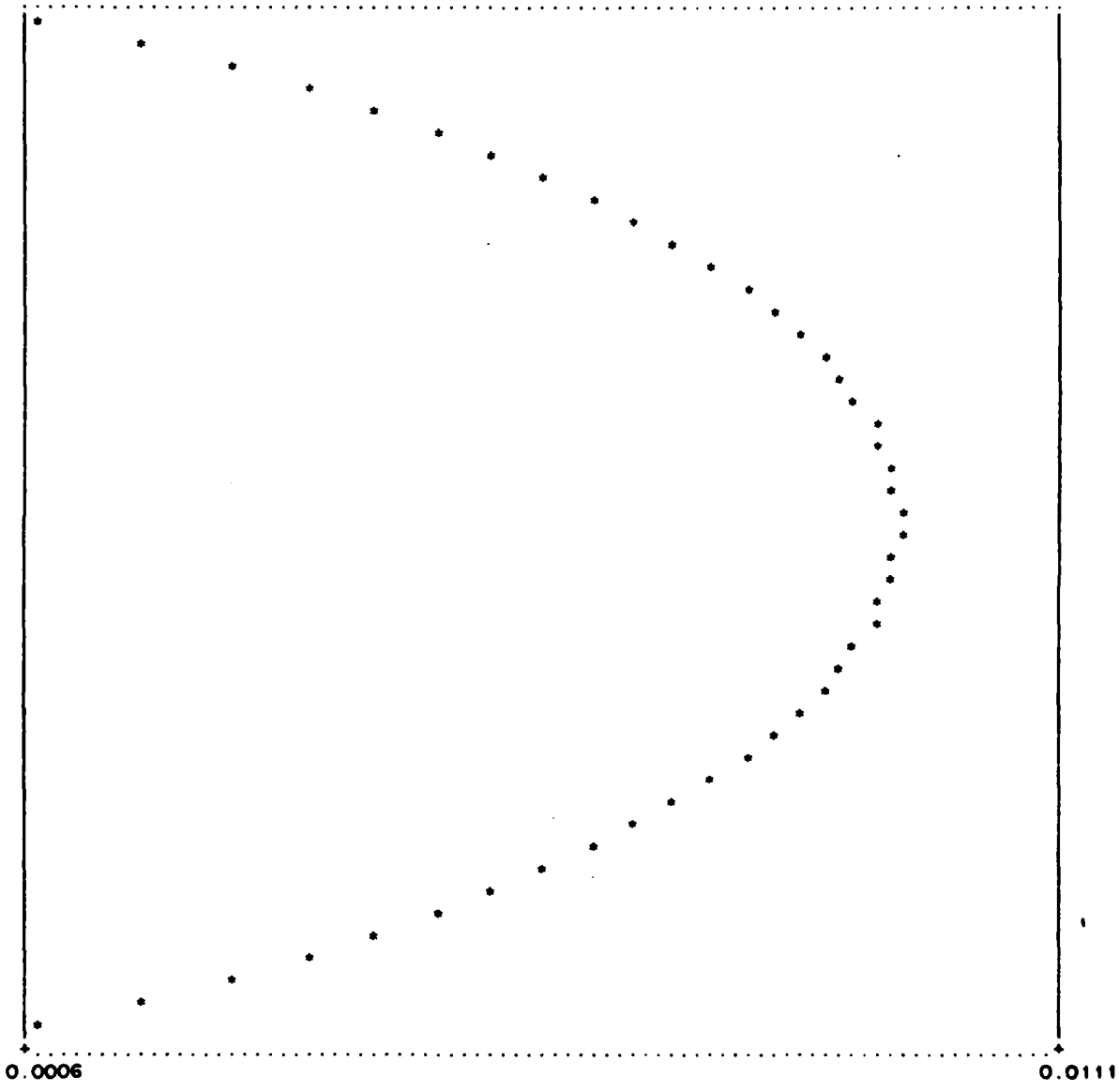
UNIVARIATE DENSITY ESTIMATION RESULTS FOR VARIABLE X

I	RVAR
1	0.9972
2	0.9876

SIGO = 42.6821

UNIVARIATE DENSITY-QUANTILE FOR RANDOM VARIABLE X

U	FQ
0.0099	0.0006
0.0317	0.0017
0.0535	0.0025
0.0752	0.0033
0.0970	0.0040
0.1188	0.0047
0.1406	0.0052
0.1624	0.0058
0.1842	0.0062
0.2059	0.0067
0.2277	0.0071
0.2495	0.0074
0.2713	0.0078
0.2931	0.0081
0.3149	0.0083
0.3366	0.0086
0.3584	0.0088
0.3802	0.0089
0.4020	0.0091
0.4238	0.0092
0.4455	0.0093
0.4673	0.0093
0.4891	0.0093
0.5109	0.0093
0.5327	0.0093
0.5545	0.0093
0.5762	0.0092
0.5980	0.0091
0.6198	0.0089
0.6416	0.0088
0.6634	0.0086
0.6851	0.0083
0.7069	0.0081
0.7287	0.0078
0.7505	0.0074
0.7723	0.0071
0.7941	0.0067
0.8158	0.0062
0.8376	0.0058
0.8594	0.0052
0.8812	0.0047
0.9030	0.0040
0.9248	0.0033
0.9465	0.0025
0.9683	0.0017
0.9901	0.0006



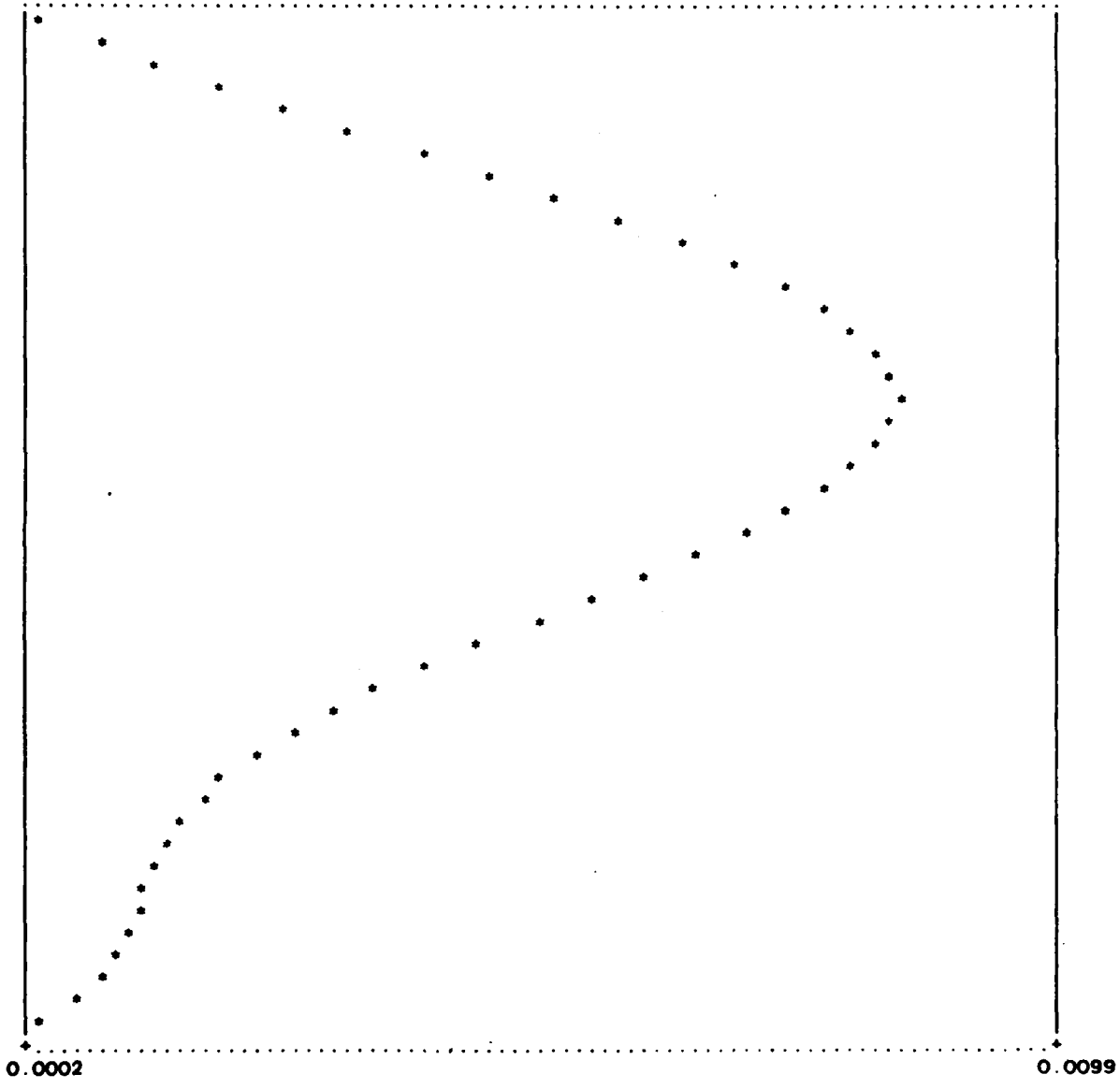
UNIVARIATE DENSITY ESTIMATION RESULTS FOR VARIABLE Y

I	RVAR	
1	0.8826	*
2	0.8789	*

SIGO = 91.7530

UNIVARIATE DENSITY-QUANTILE FOR RANDOM VARIABLE Y

U	FQ
0.0099	0.0003
0.0317	0.0008
0.0535	0.0014
0.0752	0.0019
0.0970	0.0026
0.1188	0.0032
0.1406	0.0038
0.1624	0.0045
0.1842	0.0051
0.2059	0.0057
0.2277	0.0062
0.2495	0.0068
0.2713	0.0072
0.2931	0.0076
0.3149	0.0079
0.3366	0.0081
0.3584	0.0083
0.3802	0.0083
0.4020	0.0083
0.4238	0.0081
0.4455	0.0079
0.4673	0.0076
0.4891	0.0073
0.5109	0.0069
0.5327	0.0064
0.5545	0.0059
0.5762	0.0054
0.5980	0.0049
0.6198	0.0044
0.6416	0.0039
0.6634	0.0034
0.6851	0.0030
0.7069	0.0026
0.7287	0.0023
0.7505	0.0020
0.7723	0.0018
0.7941	0.0016
0.8158	0.0014
0.8376	0.0013
0.8594	0.0012
0.8812	0.0012
0.9030	0.0011
0.9248	0.0010
0.9465	0.0008
0.9683	0.0006
0.9901	0.0002



UNIVARIATE BEST ORDERS: NVX = 0, NVY = 1

RESULTS FOR ORDER 8 MODEL:

U1	U2	DQHT	DHAT
0.18749994	0.18749994	0.00004772	1.46289539
0.18749994	0.38749993	0.00005591	1.06929111
0.18749994	0.58749992	0.00002575	0.79277152
0.18749994	0.78749990	0.00000923	0.90147328
0.18749994	0.98749989	0.00000250	1.31640625
0.38749993	0.18749994	0.00006505	1.40138245
0.38749993	0.38749993	0.00009387	1.26168442
0.38749993	0.58749992	0.00004522	0.97862923
0.38749993	0.78749990	0.00001353	0.92904085
0.38749993	0.98749989	0.00000313	1.15987206
0.58749992	0.18749994	0.00004023	0.85252440
0.58749992	0.38749993	0.00008944	1.18259430
0.58749992	0.58749992	0.00006110	1.30061340
0.58749992	0.78749990	0.00001472	0.99437904
0.58749992	0.98749989	0.00000210	0.76591164
0.78749990	0.18749994	0.00002302	0.65457690
0.78749990	0.38749993	0.00005429	0.96295321
0.78749990	0.58749992	0.00004399	1.25609970
0.78749990	0.78749990	0.00001111	1.00626469
0.78749990	0.98749989	0.00000138	0.67261958
0.98749989	0.18749994	0.00000358	0.91388923
0.98749989	0.38749993	0.00000569	0.90484190
0.98749989	0.58749992	0.00000361	0.92501044
0.98749989	0.78749990	0.00000117	0.94707549
0.98749989	0.98749989	0.00000021	0.94002223

****

INTEGRATING FACTOR FOR ORDER 8 IS 0.9728

MAXIMUM VALUE FOR DEPENDENCE DENSITY QUANTILE:

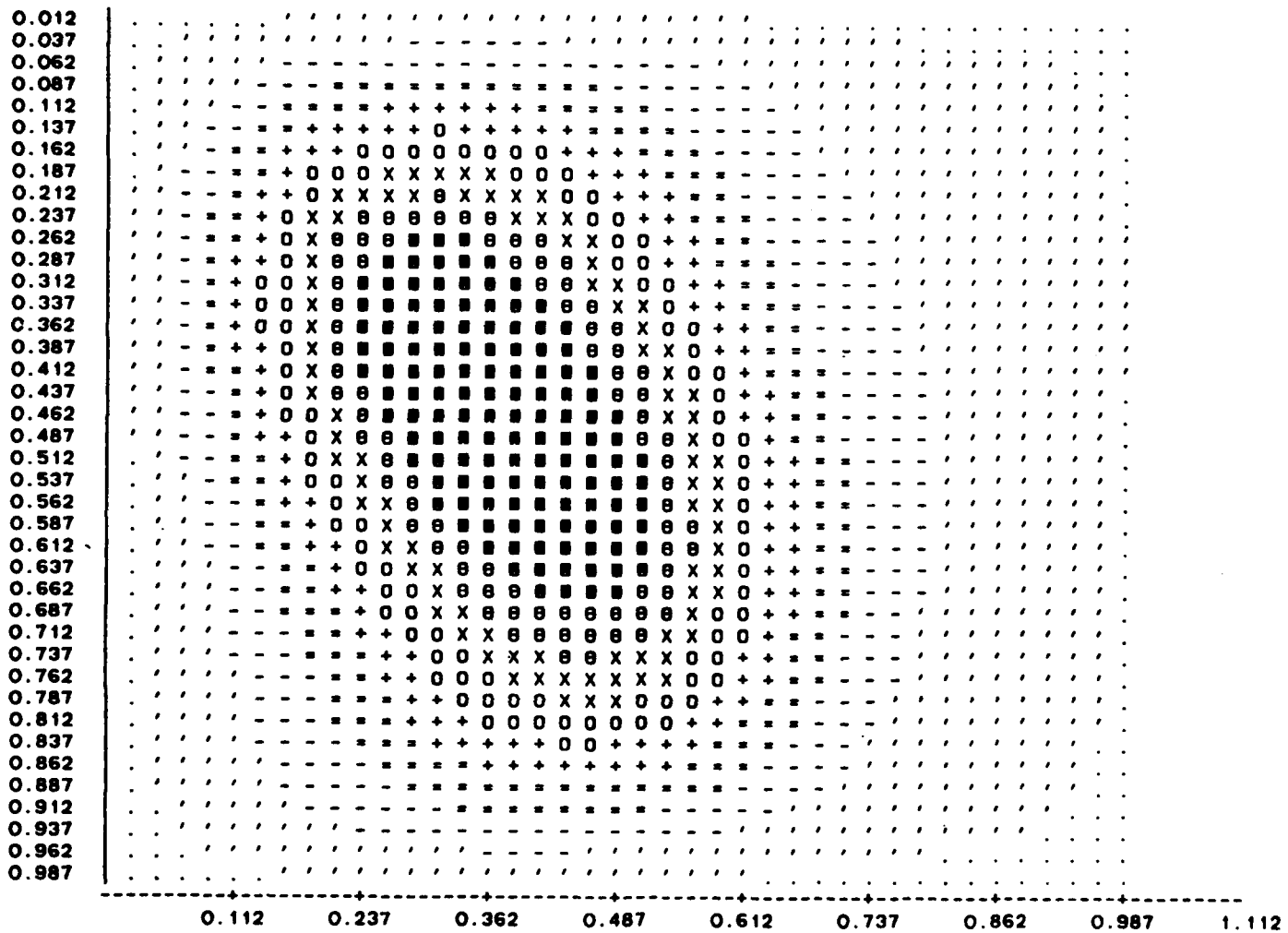
D(0.43750,0.36250) = 0.0001011

U1*N = 139.56 U2*N = 115.64

COEFFICIENTS FOR BIVARIATE DEPENDENCE DENSITY

NU1	NU2	REAL(COF)	IMAG(COF)
0	-1	-0.0290	0.0168
-1	0	-0.0341	0.0560
-1	-1	-0.0360	0.0561
0	1	-0.0290	-0.0168
1	0	-0.0341	-0.0560
-1	1	0.0820	0.0736
1	-1	0.0820	-0.0736
1	1	-0.0360	-0.0561

PLASMA CHOLESTEROL - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
PLASMA TRIGLYCERIDES - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
CONTOUR PLOT FOR BIVARIATE DENSITY QUANTILE - ORDER = 8



ORDINATE IS U1, ABSCISSA IS U2
U1 CORRESPONDS TO X (FIRST VARIABLE), U2 TO Y

RESULTS FOR ORDER 24 MODEL:

U1	U2	DQHT	DHAT
0.18749994	0.18749994	0.00006591	2.02025032
0.18749994	0.38749993	0.00005909	1.13007641
0.18749994	0.58749992	0.00002053	0.63217348
0.18749994	0.78749990	0.00000841	0.82144260
0.18749994	0.98749989	0.00000127	0.67156988
0.38749993	0.18749994	0.00005310	1.14403343
0.38749993	0.38749993	0.00008828	1.18650246
0.38749993	0.58749992	0.00004822	1.04348946
0.38749993	0.78749990	0.00002334	1.60251522
0.38749993	0.98749989	0.00000298	1.10544777
0.58749992	0.18749994	0.00004044	0.85700732
0.58749992	0.38749993	0.00012231	1.61717510
0.58749992	0.58749992	0.00005357	1.14039707
0.58749992	0.78749990	0.00001090	0.73636955
0.58749992	0.98749989	0.00000271	0.98877615
0.78749990	0.18749994	0.00002065	0.58699453
0.78749990	0.38749993	0.00006526	1.15753841
0.78749990	0.58749992	0.00004041	1.15400219
0.78749990	0.78749990	0.00001366	1.23773098
0.78749990	0.98749989	0.00000131	0.64088982
0.98749989	0.18749994	0.00000330	0.84250641
0.98749989	0.38749993	0.00000408	0.64825362
0.98749989	0.58749992	0.00000514	1.31678867
0.98749989	0.78749990	0.00000102	0.82501429
0.98749989	0.98749989	0.00000027	1.17862511

****

INTEGRATING FACTOR FOR ORDER 24 IS 1.0001

MAXIMUM VALUE FOR DEPENDENCE DENSITY QUANTILE:

D(0.61250,0.41250) = 0.0001278

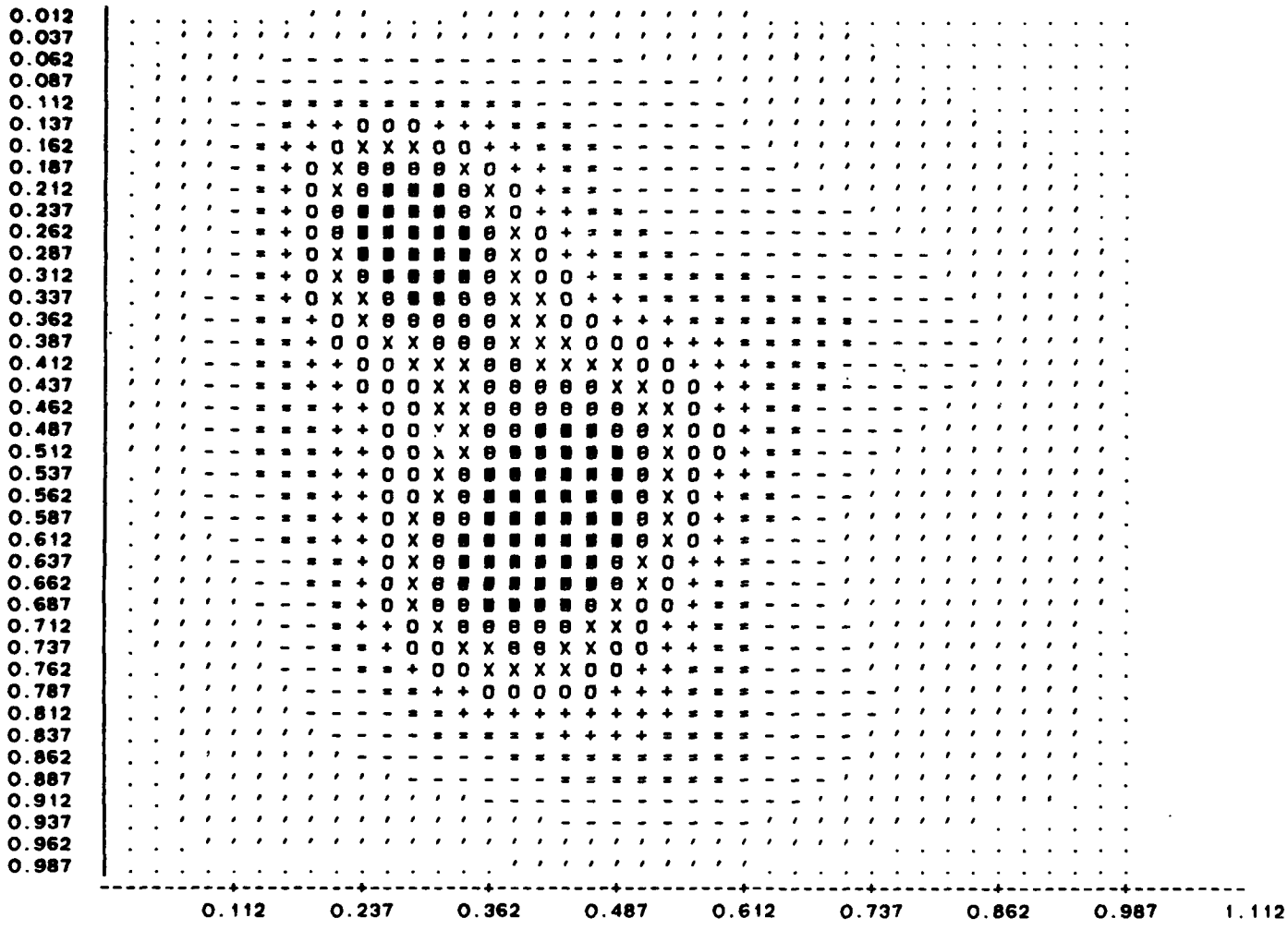
U1*N = 195.39 U2*N = 131.59

COEFFICIENTS FOR BIVARIATE DEPENDENCE DENSITY

NU1	NU2	REAL(COF)	IMAG(COF)
0	-1	-0.0433	0.0113
-1	0	-0.0550	0.0321
-1	-1	-0.0372	0.0418
0	1	-0.0433	-0.0113
1	0	-0.0550	-0.0321
-1	1	0.0737	0.0619
1	-1	0.0737	-0.0619
1	1	-0.0372	-0.0418
0	-2	-0.0169	-0.0112
-2	0	0.0175	-0.0269
-1	-2	-0.0197	-0.0072
-2	-1	-0.0509	-0.0294
1	-2	0.0178	0.0904

-2	1	0.0935	0.0131
-2	-2	0.0525	0.0351
0	2	-0.0169	0.0112
2	0	0.0175	0.0269
-1	2	0.0178	-0.0904
2	-1	0.0935	-0.0131
1	2	-0.0197	0.0072
2	1	-0.0509	0.0294
-2	2	0.0646	-0.0214
2	-2	0.0646	0.0214
2	2	0.0525	-0.0351

PLASMA CHOLESTEROL - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
PLASMA TRIGLYCERIDES - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
CONTOUR PLOT FOR BIVARIATE DENSITY QUANTILE - ORDER = 24



ORDINATE IS U1, ABSCISSA IS U2
U1 CORRESPONDS TO X (FIRST VARIABLE), U2 TO Y

RESULTS FOR ORDER 48 MODEL:

U1	U2	DQHT	DHAT
0.18749994	0.18749994	0.00006638	2.03462219
0.18749994	0.38749993	0.00005525	1.05659676
0.18749994	0.58749992	0.00003006	0.92565721
0.18749994	0.78749990	0.00000834	0.81518406
0.18749994	0.98749989	0.00000080	0.42414057
0.38749993	0.18749994	0.00010054	2.16585255
0.38749993	0.38749993	0.00006806	0.91477740
0.38749993	0.58749992	0.00005214	1.12818909
0.38749993	0.78749990	0.00001949	1.33813477
0.38749993	0.98749989	0.00000247	0.91500378
0.58749992	0.18749994	0.00002933	0.62150997
0.58749992	0.38749993	0.00010528	1.39199924
0.58749992	0.58749992	0.00005599	1.19188213
0.58749992	0.78749990	0.00001759	1.18802643
0.58749992	0.98749989	0.00000212	0.77384871
0.78749990	0.18749994	0.00003154	0.89657325
0.78749990	0.38749993	0.00006950	1.23278046
0.78749990	0.58749992	0.00004922	1.40551186
0.78749990	0.78749990	0.00001147	1.03926563
0.78749990	0.98749989	0.00000134	0.65280330
0.98749989	0.18749994	0.00000217	0.55329788
0.98749989	0.38749993	0.00000563	0.89526796
0.98749989	0.58749992	0.00000369	0.94539171
0.98749989	0.78749990	0.00000111	0.90271294
0.98749989	0.98749989	0.00000029	1.25734138

****

INTEGRATING FACTOR FOR ORDER 48 IS · 1.0443

MAXIMUM VALUE FOR DEPENDENCE DENSITY QUANTILE:

D(0.43750,0.48750) = 0.0001421

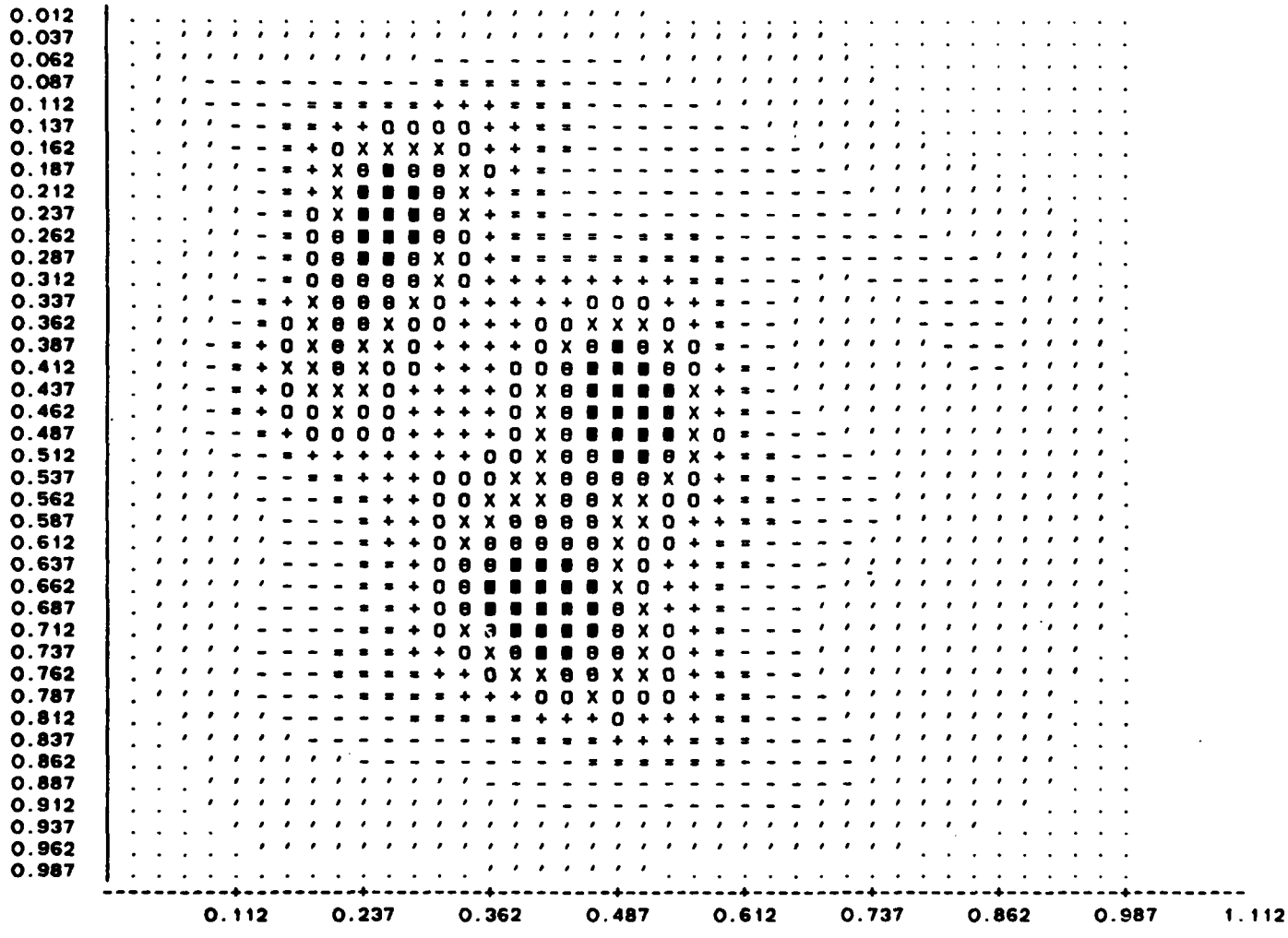
U1*N = 139.56 U2*N = 155.51

COEFFICIENTS FOR BIVARIATE DEPENDENCE DENSITY

NU1	NU2	REAL(COF)	IMAG(COF)
0	-1	-0.0785	0.0079
-1	0	-0.0592	0.0134
-1	-1	-0.0556	0.0353
0	1	-0.0785	-0.0079
1	0	-0.0592	-0.0134
-1	1	0.0687	0.0356
1	-1	0.0687	-0.0356
1	1	-0.0556	-0.0353
0	-2	-0.0196	-0.0085
-2	0	0.0075	-0.0215
-1	-2	-0.0236	-0.0120
-2	-1	-0.0386	-0.0357
1	-2	0.0194	0.1037

-2	1	0.0895	0.0027
-2	-2	0.0487	0.0302
0	2	-0.0196	0.0085
2	0	0.0075	0.0215
-1	2	0.0194	-0.1037
2	-1	0.0895	-0.0027
1	2	-0.0236	0.0120
2	1	-0.0386	0.0357
-2	2	0.0708	-0.0040
2	-2	0.0708	0.0040
2	2	0.0487	-0.0302
0	-3	-0.0462	-0.0077
-3	0	-0.0064	0.0327
-1	-3	0.0733	0.0192
-3	-1	-0.0524	0.0136
1	-3	0.0271	0.0480
-3	1	0.0891	0.0206
-2	-3	-0.0161	0.0730
-3	-2	-0.0033	0.0341
2	-3	0.0262	-0.0330
-3	2	0.0512	0.0774
-3	-3	-0.0111	0.0080
0	3	-0.0462	0.0077
3	0	-0.0064	-0.0327
-1	3	0.0271	-0.0480
3	-1	0.0891	-0.0206
1	3	0.0733	-0.0192
3	1	-0.0524	-0.0136
-2	3	0.0262	0.0330
3	-2	0.0512	-0.0774
2	3	-0.0161	-0.0730
3	2	-0.0033	-0.0341
-3	3	0.0259	-0.0136
3	-3	0.0259	0.0136
3	3	-0.0111	-0.0080

PLASMA CHOLESTEROL - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
PLASMA TRIGLYCERIDES - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
CONTOUR PLOT FOR BIVARIATE DENSITY QUANTILE - ORDER = 48



ORDINATE IS U1, ABSCISSA IS U2
U1 CORRESPONDS TO X (FIRST VARIABLE), U2 TO Y

BEST MODEL BY AIC IS ORDER 8 MODEL.

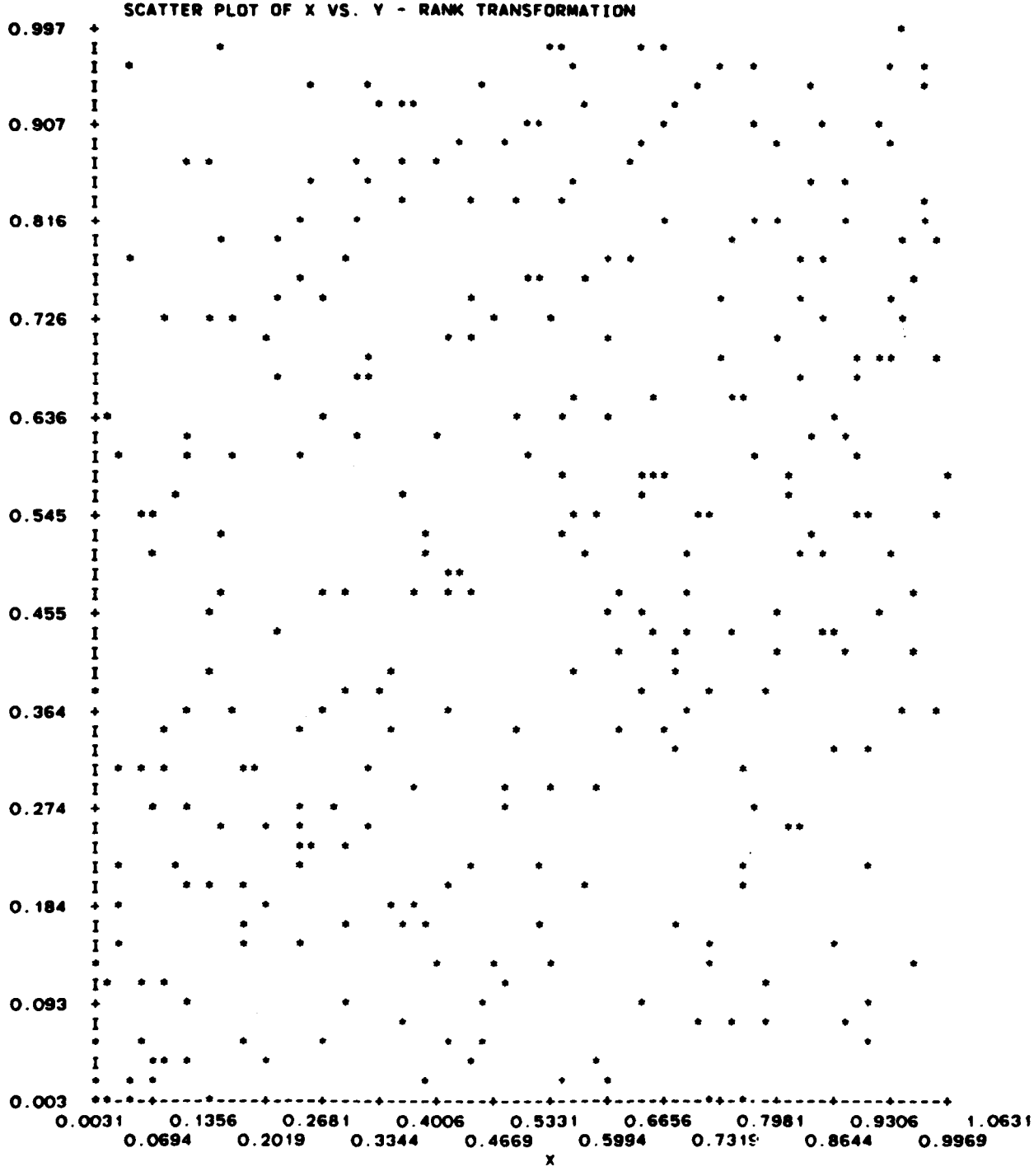
TIES IN X = 388, TIES IN Y = 234

PLASMA CHOLESTEROL - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES
PLASMA TRIGLYCERIDES - DISEASE IN AT LEAST 1 OF 3 CORONARY ARTERIES

SAMPLE SIZE = 319

CORRELATION COEFICIENT	VALUE	INFORMATION (NORMAL CASE)
PEARSON	0.233332	0.027991
SPEARMAN	0.273826	0.038970
KENDALL A	0.186018	0.017608
KENDALL B	0.187173	0.017831
SOMER'S D	0.187459	0.017887

MODEL	INFORMATION	AIC
D-TILDA	0.03909	0.0
D-HAT 8	0.07118	-0.08224
D-HAT 24	0.09854	-0.20992
D-HAT 48	0.13924	-0.40108


SCATTER PLOT OF X VS. Y - RANK TRANSFORMATION
0.997
0.907
0.816
0.726
0.636
0.545
0.455
0.364
0.274
0.184
0.093
0.003
Y
0.0031
0.0694
0.1356
0.2019
0.2681
0.3344
0.4006
0.4669
0.5331
0.5994
0.6656
0.7319
0.7981
0.8644
0.9306
0.9969
1.0631
X

APPENDIX A - JCL for Executing BISAM

```
// Job Card
//* JES3 Control Cards
//PROCLIB DD DSN=USR.R579.TW.PROCLIB,DISP=SHR
// EXEC BISAM
//SYSIN DD *
      Parameter Input Card(s)
      Data if NTAPE=5
```

If NTAPE≠5, the value of NTAPE is coded as a number nn between 8 and 99 except for 11. (The value 11 is currently used for a scratch file.) A DD card is then inserted defining the input data set. For example,

```
//FT13F001 DD DSN=USR.R579.TW.DATA,DISP-SHR
```

described the dish file containing the input data with NTAPE=13. If IOUTD-1, three such cards will be required as described in section 6.

APPENDIX B - OBTAINING THREE DIMENSIONAL PLOTS

```
1.      //  JOB CARD
2.      //* JES3 CONTROL CARDS
3.      //PROCLIB DD DSN=USR.R579.TW.PROCLIB,DISP=SHR
4.      // EXEC BISAM
5.      //SYSIN DD *
6.
7.
8.
9.
10.     *** OPTION CARD FOLLOWED BY DATA IF NTAPE=5 ***
11.     //FT01F001 DD DSN=WYL.XX.YYY.STOR1,DISP=OLD
12.     //FT02F001 DD DSN=WYL.XX.YYY.STOR2,DISP=OLD
13.     //FT03F001 DD DSN=WYL.XX.YYY.STOR3,DISP=OLD
14.     //FT13F001 DD DSN=WYL.XX.YYY.DAT1,DISP=OLD
15.     /*
16.     //STEP2 EXEC SAS,COND=(0,LT)
17.     //FILE1 DD DSN=WYL.XX.YYY.STOR1,DISP=OLD
18.     //FILE2 DD DSN=WYL.XX.YYY.STOR2,DISP=OLD
19.     //FILE3 DD DSN=WYL.XX.YYY.STOR3,DISP=OLD
20.     //SYSIN DD *
21.     DATA ONE; INFILE FILE1; INPUT U1 U2 DQHT DHAT;
22.     TITLE .F=COMPLEX .H=1 FIRST ORDER BIVARIATE DENSITY;
23.     PROC G3D DATA=ONE GOUT=A; PLOT U1*U2=DQHT;.
24.     PROC G3D DATA=ONE GOUT=B; PLOT U1*U2=DHAT;
25.     DATA TWO; INFILE FILE2; INPUT U1 U2 DQHT DHAT;
26.     TITLE .F=COMPLEX .H=1 SECOND ORDER BIVARIATE DENSITY;
27.     PROC G3D DATA=TWO GOUT=C; PLOT U1*U2=DQHT;
28.     PROC G3D DATA=TWO GOUT=D; PLOT U1*U2=DHAT;
29.     DATA THREE; INFILE FILE3; INPUT U1 U2 DQHT DHAT;
30.     TITLE .F=COMPLEX .H=1 THIRD ORDER BIVARIATE DENSITY;
31.     PROC G3D DATA=THREE GOUT=E; PLOT U1*U2=DQHT;
32.     PROC G3D DATA=THREE GOUT=F; PLOT U1*U2=DHAT;
33.     DATA COMBINE; SET  A B C D E F;
34.     PROC GREPLAY DATA=COMBINE;
35.     /*
```

NOTES: 1. USE CURRENT SAS/GRAPH JCL IN LINE 16.

3. XX.YYY IS USER'S ACCOUNT.

5. THE SAS PROCEDURE GCONTOUR MAY BE SUBSTITUTED FOR G3D TO PRODUCE CONTOUR PLOTS INSTEAD OF 3D PLOTS.
6. AS INDICATED, PLOTS OF DHAT MAY NOT BE INFORMATIVE, SO DHAT PLOTS INDICATED ABOVE ARE USUALLY OMITTED.
7. IN LINES 11-13, THE WYLBUR FILES ARE DUMMY FILES SAVED IN CARD IMAGE THAT WILL BE WRITTEN TO. IN LINE 14, NTAPE=13 HAS BEEN SPECIFIED AND DAT1 CONTAINS THE BIVARIATE DATA SET TO BE ANALYZED.

APPENDIX C - PROGRAM LISTING

MEMBER	NUMBER OF RECORDS
BISAM	2706

```
C     PROGRAM BISAM                                                     BISAM
C                                                                       BISAM
C*****************************************************************    BISAM
C                                                                       BISAM
C   DRIVER PROGRAM FOR BIVARIATE DATA ANALYSIS                          BISAM
C                                                                       BISAM
C   INPUT: NTAPE - TAPE WHERE DATA SET RESIDES                          BISAM
C          (X,Y) - BIVARIATE DATA (INDIVIDUALLY, X FIRST)               BISAM
C          MORD - MAXIMUM AUTOREGRESSIVE ORDER TO BE USED FOR           BISAM
C                 UNIVARIATE AR DENSITY ESTIMATION (<=6)                BISAM
C          IDOX,IDOY - NULL DISTRIBUTIONS FOR AUTOREGRESSIVE SMOOTHING  BISAM
C          IPLT1 - 0--> NO SCATTER PLOTS                                BISAM
C                  1--> SCATTER PLOT OF DATA                            BISAM
C                  2--> SCATTER PLOT OF RANK TRANSFORMED DATA           BISAM
C                  3--> BOTH SCATTER PLOTS                              BISAM
C          IPLT2 - 0--> NO AUTOREGRESSIVE DENSITY PLOTS                 BISAM
C                  1--> BEST ORDER AR DENSITY PLOTS                     BISAM
C          IDST - 0--> NO UNIVARIATE DESCRIPTIVE STATISTICS             BISAM
C                 1--> UNIVARIATE DESCRIPTIVE STATISTICS FOR X AND Y    BISAM
C          KDEL - MAXIMUM NUMBER OF EXTREME POINTS TO EXCLUDE FROM      BISAM
C                 BIVARIATE ANALYSIS                                    BISAM
C          IOUTD - 1 IF THE 3 MODELS ESTIMATED ARE TO HAVE VALUES       BISAM
C                  WRITTEN TO TAPES 1,2, AND 3; 0 O.W.                  BISAM
C                  FT01F001, ETC. DD JCL CARDS MUST BE INCLUDED IF      BISAM
C                  IOUTD=1.                                             BISAM
C          IREG - 1 IF QUANTILE REGRESSION PERFORMED, 0 O.W.            BISAM
C          IUNIV - 1 IF UNIVARIATE DATA SET TO BE READ IN AND A         BISAM
C                  BIVARIATE DATA SET CREATED AS ORIGINAL DATA          BISAM
C                  AND LAGGED DATA, 0 O.W.                              BISAM
C          KLAG1,KLAG2 - RANGE OF LAGS INPUT IF IUNIV=1                 BISAM
C                                                                       BISAM
C   SUBPROGRAMS CALLED: AREST,AUTDEN,AUTORG,CLPLT1,CMPINF,CPLOT,       BISAM
C                       CPYENT,CSGREG,CSWEEP,DATAIN,DESTAT,FCDBEA,      BISAM
C                       FORIER,FOPNC,FTERP,ICDBEA,KENDAL,KSD,MAX,       BISAM
C                       MORRIS,MIN,MINMAX,ORD2,PARZ,PEARSN,PLOTXY,      BISAM
C                       PPLOT,QFIND,QPLOT,QREG,QTOFQ,QUENT,QUICK,       BISAM
C                       RANK,SPRMN,TRIM,WSPACE                          BISAM
C                                                                       BISAM
C   NOTE: SCRATCH TAPE NUMBER IS SET AT 11 IN FCDBEA. A DD CARD         BISAM
C         FOR FT11F001 MUST BE INCLUDED IN THE JCL SET UP.              BISAM
C                                                                       BISAM
C   JULY 1983                                                           BISAM
C   PROGRAMMER: TERRY J. WOODFIELD                                      BISAM
C                                                                       BISAM
C*****************************************************************    BISAM
C                                                                       BISAM
      COMMON /DATAR/ X(500),Y(500),RANKX(500),RANKY(500)                BISAM
      COMMON /PARM/ BETAP,BETAW                                         BISAM
      DIMENSION L(8),LABY(20),LABX(20),T(500,2),MD(4),AIC(4)            BISAM
      DIMENSION CHAR(5),XNAME(20),YNAME(20),CAPT(20),CRNK(6)            BISAM
      DIMENSION W(1000),LABS(2),LABBX(20),LABBY(20)                     BISAM
      EQUIVALENCE (T(1,1),X(1))                                         BISAM
      EQUIVALENCE (T(1,2),Y(1))                                         BISAM
      DATA NOUT,NIN/6,5/                                                BISAM
      DATA LAG/4H N +,4H LAG/                                           BISAM
      DATA CHAR/1H+,1H*,1HX,1H=,1H./                                    BISAM
      DATA XNAME/10*1H ,1HX,9*1H /                                      BISAM
      DATA YNAME/10*1H ,1HY,9*1H /                                      BISAM
      DATA LABBX/4HBRIE,4HINAL,4H DAT,4HA - ,4HX   ,16*4H    /          BISAM
      DATA LABBY/4HBRIE,4HINAL,4H DAT,4HA - ,4HY   ,16*4H    /          BISAM
      DATA CAPT/4HSCAT,4HTER ,4HPLOT,4H OF ,4HX VS,4H. Y ,14*4H    /    BISAM
      DATA CRNK/4H- RA,4HNK T,4HRANS,4HFORM,4HATIO,4HN   /              BISAM
C                                                                       BISAM
      LAGT=0                                                            BISAM
      WRITE(NOUT,1)                                                     BISAM
    1 FORMAT(1H1)                                                       BISAM
      READ(NIN,10) NTAPE,IDOX,IDOY,MORD,IPLT1,IPLT2,IDST,KDEL,IOUTD,    BISAM
     +IREG,IUNIV                                                        BISAM
   10 FORMAT(12I5)                                                      BISAM
      IF(IUNIV.EQ.1) READ(NIN,10) KLAG1,KLAG2                           BISAM
      IF(IDOX.EQ.9) READ(NIN,12) BETAPX                                 BISAM
      IF(IDOX.EQ.10) READ(NIN,12) BETAPX,BETAWX                         BISAM
      IF(IDOY.EQ.9) READ(NIN,12) BETAPY                                 BISAM
      IF(IDOY.EQ.10) READ(NIN,12) BETAPY,BETAWY                         BISAM
   12 FORMAT(2F10.0)                                                    BISAM
      WRITE(NOUT,20)                                                    BISAM
   20 FORMAT(///,10X,20(4H****),/,10X,'*',78X,'*',/,10X,'*   BISAM ',   BISAM
     +'- BIVARIATE DATA ANALYSIS USING FOURIER EXPANSIONS',19X,'*',     BISAM
     +/,10X,'*              AND QUANTILE TECHNIQUES',44X,'*',/,10X,'*',  BISAM
     +78X,'*',/,10X,'*    PROGRAMMER: TERRY J. WOODFIELD',T90,'*',      BISAM
     +/,10X,'*',78X,'*',/,10X,20(4H****))                               BISAM
      IF(IUNIV.EQ.0) GO TO 28                                           BISAM
      CALL DATAIN(NTAPE,W,NW,L,LABX)                                    BISAM
      DO 200 KLAG=KLAG1,KLAG2                                           BISAM
      N=NW-KLAG                                                         BISAM
      DO 22 I=1,N                                                       BISAM
      X(I)=W(I)                                                         BISAM
      Y(I)=W(I+KLAG)                                                    BISAM
   22 CONTINUE                                                          BISAM
      DO 24 I=1,20                                                      BISAM
   24 LABY(I)=LABX(I)                                                   BISAM
      CALL ICODEA(KLAG,8H(14)    ,LABY(17))                             BISAM
      LABY(15)=LABS(1)                                                  BISAM
      LABY(16)=LABS(2)                                                  BISAM
      GO TO 40                                                          BISAM
   28 CONTINUE                                                          BISAM
      CALL DATAIN(NTAPE,X,NX,L,LABX)                                    BISAM
      CALL DATAIN(NTAPE,Y,NY,L,LABY)                                    BISAM
      N=NX                                                              BISAM
      IF(NX.EQ.NY) GO TO 40                                             BISAM
      WRITE(NOUT,30) LABX,LABY                                          BISAM
   30 FORMAT(1H ,10X,20A4/,10X,20A4,//,10X,'SAMPLE SIZES NOT EQUAL.',   BISAM
     +' BIVARIATE ANALYSIS INAPROPRIATE. EXECUTION TERMINATED.')        BISAM
      STOP                                                              BISAM
   40 IF(LAGT.EQ.1) GO TO 51                                            BISAM
      WRITE(NOUT,50) LABX,LABY,N,NTAPE,IDOX,IDOY,MORD,IPLT1,IPLT2,      BISAM
     +IDST,KDEL,IOUTD,IREG,IUNIV                                        BISAM
   50 FORMAT(///,10X,20A4,/,10X,20A4,//,10X,'SAMPLE SIZE = ',I6,        BISAM
     +//,10X,'OPTIONS FOR THIS ANALYSIS:',/,T20,'NTAPE = ',I2,         BISAM
     +T40,'IDOX = ',I3,T60,'IDOY = ',I2,/,T20,'MORD = ',I2,            BISAM
     +T40,'IPLT1 = ',I2,T60,'IPLT2 = ',I2,/,T20,'IDST = ',I2,          BISAM
     +T40,'KDEL = ',I3,T60,'IOUTD = ',I3,/,T20,'IREG = ',I3,T40,       BISAM
     +'IUNIV = ',I2)                                                    BISAM
      IF((IPLT1.EQ.1).OR.(IPLT1.EQ.3))                                  BISAM
     +CALL PPLOT(X,Y,500,N,1,CHAR,CAPT,XNAME,YNAME,0)                   BISAM
   51 WRITE(NOUT,1)                                                     BISAM
C                                                                       BISAM
C   ORDER BIVARIATE DATA BY X VALUES                                    BISAM
C                                                                       BISAM
      CALL ORD2(T,N,500)                                                BISAM
      IF((IDST.EQ.0).OR.(LAGT.EQ.1)) GO TO 52                           BISAM
      BETAP=BETAPX                                                      BISAM
      BETAW=BETAWX                                                      BISAM
```

```
      CALL QUENT(N,X,LABX,LABDX,IDOX,N+4,X25,XMED,X75,XBAR,SDX)
      BETAP=BETAPY
      BETAW=BETAWY
      CALL QUENT(N,Y,LABY,LABDY,IDOY,N+4,Y25,YMED,Y75,YBAR,SDY)
C
C   TRIM DATA SET OF AT MOST KDEL EXTREME POINTS
C
   82 CALL TRIM(X,Y,XMED,YMED,KDEL,N,NEWN)
      N=NEWN
C
C   OBTAIN RANKS OF X AND Y VALUES
C
      CALL RANK(X,N,RANKX)
      CALL RANK(Y,N,RANKY)
C
C   COMPUTE CORRELATION COEFFICIENTS
C
      CALL SPEMN(N,RHO,SUMD)
      CALL KENDAL(N,TAUA,TAUB,SOMER,NC,ND,NINB,NDEP,NPAIRS)
      CALL PEARSN(N,R)
C
C   OBTAIN ESTIMATES OF BIVARIATE DEPENDENCE DENSITY AND DENSITY
C   QUANTILE FUNCTION
C
      CALL CMPINF(N,MORD,IDOX,IDOY,IPLT2,IOUTD,IRES,LABX,LABY,MD,AIC)
      WRITE(NOUT,1)
      IF((NINB.EQ.0).AND.(NDEP.EQ.0)) GO TO 69
      WRITE(NOUT,65) NINB,NDEP
   65 FORMAT(///,10X,'TIES IN X =',I4,', TIES IN Y =',I4,//)
   69 WRITE(NOUT,60) LABX,LABY,N
   60 FORMAT(///,10X,20A4,/,10X,20A4,//,10X,'SAMPLE SIZE =',I5)
C
C   OBTAIN INFORMATION MEASURES FOR NORMAL CASE
C
      R1=-0.5*ALOG(1.-R*R)
      RHO1=-0.5*ALOG(1.-RHO*RHO)
      TAUA1=-0.5*ALOG(1.-TAUA*TAUA)
      TAUB1=-0.5*ALOG(1.-TAUB*TAUB)
      SOMER1=-0.5*ALOG(1.-SOMER*SOMER)
C
C   WRITE VALUES OF CORRELATION COEFFICIENTS
C
      WRITE(NOUT,64) R,R1,RHO,RHO1,TAUA,TAUA1,TAUB,TAUB1,SOMER,SOMER1
   64 FORMAT(///,T10,'CORRELATION COEFICIENT',T45,'VALUE',T55,
     +'INFORMATION (NORMAL CASE)',/,T10,23(1H-),T40,10(1H-),T55,
     +25(1H-),/,T20,'PEARSON',T40,F10.6,T60,F15.6,/,T20,'SPEARMAN',
     +T40,F10.6,T60,F15.6,/,T20,'KENDALL A',T40,F10.6,T60,F15.6,/,
     +T20,'KENDALL B',T40,F10.6,T60,F15.6,/,T20,'SOMER''S D',T40,
     +F10.6,T60,F15.6)
      DO 66 I=1,4
   66 MD(I)=-MD(I)
      WRITE(NOUT,68) MD(4),AIC(4),MD(1),AIC(1),MD(2),AIC(2),MD(3),
     +AIC(3)
   68 FORMAT(///,T10,'MODEL',T35,'INFORMATION',T67,'AIC',/,T10,8(1H-),
     +T35,11(1H-),T60,10(1H-),/,T10,'D-TILDA',T35,F11.5,T60,F10.5,/,
     +T10,'D-HAT 8',T35,F11.5,T60,F10.5,/,T10,'D-HAT 24',T35,F11.5,
     +T60,F10.5,/,T10,'D-HAT 48',T35,F11.5,T60,F10.5)
      DO 80 I=1,N
      X(I)=RANKX(I)/FLOAT(N+1)
      Y(I)=RANKY(I)/FLOAT(N+1)
   80 CONTINUE
      DO 90 I=1,6
      CAPT(I+6)=CRNK(I)
   90 CONTINUE
      IF((IPLT1.EQ.2).OR.(IPLT1.EQ.3))
     +CALL PPLOT(X,Y,500,N,1,CHAR,CAPT,XNAME,YNAME,0)
C
      LAST=1
      IPLT2=0
  200 CONTINUE
      STOP
      END
      FUNCTION AREST(X,L,OPTKNM,OPTCOE)
C**********************************************************************
C   FUNCTION TO COMPUTE AUTOREGRESSIVE ESTIMATOR EVALUATED AT X
C   METHOD: ARTWO = OPTKNM / ABS(1 + Y)**2
C             WHERE Y = OPTCOE(J)*EXP(1*J*2*PI*X) SUMMED OVER J = 1, L
C   INPUT:
C         X: SCALAR AT WHICH AUTOREGRESSIVE ESTIMATE IS EVALUATED.
C         L: ORDER. MUST BE LESS THAN 11. SEE METHOD.
C         OPTKNM: SEE METHOD.
C         OPTCOE: AUTOREGRESSIVE COEFFICIENTS OF ORDER L. SEE METHOD.
C                 OPTCOE IS A COMPLEX 10-VECTOR.
C   OUTPUT: FUNCTION RETURNS VALUE OF AUTOREGRESSIVE ESTIMATOR EVALUATED
C           AT X.
C   SUBROUTINES CALLED: NONE.
C**********************************************************************
      COMPLEX OPTCOE(L)
      COMPLEX S
      PI=4.*ATAN(1.0)
      S=CMPLX(1.,0.)
      DO 1 J=1,L
      FJ=J
      S=S+OPTCOE(J)*CEXP(CMPLX(0.,X*2.*PI*FJ))
    1 CONTINUE
      AREST=OPTKNM/REAL(S*CONJG(S))
      RETURN
      END
      SUBROUTINE AUTDEN(W,N,IDOH,IPLT2,MORD,ALPH,RVARW,SIGO,NVW,
     +ISORT,WLAB)
C**********************************************************************
C
C   THIS SUBPROGRAM COMPUTES A SMOOTHED DENSITY QUANTILE
C   FUNCTION BASED ON THE AUTOREGRESSIVE METHOD OF PARZEN(1979).
C
C   INPUT: W - RAW DATA
C          N - SAMPLE SIZE
C          IDOH - INDICATOR FOR NULL DIST. OF W
C          ISORT - 0 IF W AND RANKW SORTED, 1 OTHERWISE.
C          MORD - MAXIMUM ALLOWABLE ORDER (<=8)
C          IPLT2 - 0--> NO PLOTS
C                  1--> PLOT OF AR DENSITY-QUANTILE FUNCTION
C          WLAB - VARIABLE NAME FOR W IN A4 FORMAT
C
C   OUTPUT: NVW - ORDER OF AUTOREGRESSIVE DENSITY ESTIMATOR
C           ALPH - COEFFICIENTS FOR AUTOREGRESSIVE REPRESENTATION
C           RVARW - RESIDUAL VARIANCE FOR BEST ORDER
C           SIGO - INTEGRATING FACTOR (SIGMA-TILDA FOR NULL MODEL)
C
C   SUBPROGRAMS CALLED: SRD,GTSFO,WSPACE,FORIER,AUTORS,PARZ,
C                       AREST,FOFNC,MONRIS,OPINO,PLOTSY,FTERP,MINMAX,
C                       MIN,MAX
C
C**********************************************************************
      COMMON /PARM/ BETAP,BETAW
      DIMENSION W(N),RVAR(8),U(500),QN(500),QL(500),FQ(500),
     +WHS(500),CWHS(500),ILOC(8),CAT(8),WK1(500)
      DIMENSION CAPT(20)
      COMPLEX A(8),PHI(8),ALPH(8),ALPHA(10),RESVAR
      DATA CAPT/4HUNIV,4HARIA,4HTE D,4HENSI,4HTY-Q,4HUANT,4HILE ,
     +4HFOR ,4HRAND,4HOM V,4HARIA,4HBLE ,8*4H    /
      DATA SPCFAC/0.1/
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      CAPT(13)=WLAB                                                    BISAM
      WRITE(6,1) WLAB                                                  BISAM
    1 FORMAT(//,10X,'UNIVARIATE DENSITY ESTIMATION RESULTS FOR ',      BISAM
     +'VARIABLE ',A4,//)                                               BISAM
      DO 5 I=1,N                                                       BISAM
      ON(I)=W(I)                                                       BISAM
    5 CONTINUE                                                         BISAM
      N2=N+2                                                           BISAM
      M=MORD+1                                                         BISAM
      IF(M.GT.5) M=5                                                   BISAM
      MM1=M-1                                                          BISAM
      N=1./FLOAT(N)                                                    BISAM
      IF(ISORT.EQ.0) GO TO 10                                          BISAM
      CALL QUICK(N,ON)                                                 BISAM
   10 CONTINUE                                                         BISAM
C                                                                      BISAM
C   COMPUTE N EQUALLY SPACED U VALUES BETWEEN 0 AND 1                  BISAM
C                                                                      BISAM
      U(1)=.5*N                                                        BISAM
      DO 30 J=1,N                                                      BISAM
      U(J+1)=U(J)+N                                                    BISAM
   30 CONTINUE                                                         BISAM
C                                                                      BISAM
C   COMPUTE LITTLE Q AND FQ=1/(LITTLE Q)                               BISAM
C                                                                      BISAM
      NP1=N+1                                                          BISAM
      CALL QTOFQ(ON,U,NP1,QL,SPCFAC)                                   BISAM
C                                                                      BISAM
C   COMPUTE WEIGHTED SPACINGS (LITTLE D(U)) BASED ON IDON DIST.        BISAM
C                                                                      BISAM
      DO 40 I=1,N                                                      BISAM
   40 WK1(I)=FOFNC(U(I+1),IDON)                                        BISAM
      CALL WSPACE(WKS,CWKS,NP1,QL,WK1,U,SIGQ)                          BISAM
C                                                                      BISAM
C   COMPUTE FOURIER TRANSFORM OF WEIGHTED SPACINGS                     BISAM
C                                                                      BISAM
      CALL FORIER(WKS,U(2),N,A,M)                                      BISAM
C                                                                      BISAM
C   COMPUTE AUTOREGRESSIVE COEFFICIENTS FOR ORDERS 1 TO M              BISAM
C                                                                      BISAM
      II=1                                                             BISAM
      DO 100 K=1,MM1                                                   BISAM
      KP1=K+1                                                          BISAM
      CALL AUTORG(A,KP1,M,ALPN,PHI,RESVAR)                             BISAM
      RVAR(K)=REAL(RESVAR)                                             BISAM
      ILOC(K)=II                                                       BISAM
      DO 90 J=1,K                                                      BISAM
      ALPHA(II)=ALPN(J)                                                BISAM
      II=II+1                                                          BISAM
   90 CONTINUE                                                         BISAM
  100 CONTINUE                                                         BISAM
      CALL PARZ(RVAR,M-1,N,CAT,NVW)                                    BISAM
      IF(NVW.EQ.0) GO TO 115                                           BISAM
      LOC=ILOC(NVW)                                                    BISAM
      DO 110 I=1,NVW                                                   BISAM
      ALPN(I)=ALPHA(LOC)                                               BISAM
      LOC=LOC+1                                                        BISAM
  110 CONTINUE                                                         BISAM
  115 CALL CLPLT1(RVAR,M-1,1,4HRVAR,61,1)                              BISAM
C                                                                      BISAM
C   COMPUTE UNIVARIATE DENSITY-QUANTILE AT 100 POINTS AND PLOT         BISAM
C                                                                      BISAM
      WRITE(6,120) SIGQ                                                BISAM
  120 FORMAT(/,10X,'SIGQ = ',F10.6)                                    BISAM
      RVARW=RVAR(NVW)                                                  BISAM
      DO 150 I=1,100                                                   BISAM
      U(I)=FLOAT(I)/101.0                                              BISAM
      FI=1.0                                                           BISAM
      IF(NVW.GT.0) FI=AREST(U(I),NVW,RVARW,ALPN)                       BISAM
      IF(FI.EQ.0.) FI=N                                                BISAM
      FQ(I)=FOFNC(U(I),IDON)/(FI*SIGQ)                                 BISAM
  150 CONTINUE                                                         BISAM
      IF(IPLT2.EQ.1)                                                   BISAM
     +CALL PLOTXY(U,FQ,100,CAPT,4H   U,4H  FQ,1)                       BISAM
      RETURN                                                           BISAM
      END                                                              BISAM
      SUBROUTINE AUTORG(A,LSP1,M,ALPHA,PHI,FKN)                        BISAM
C*****************************************************************   BISAM
C     COMPUTES THE COEFFICIENTS ALPHA(.) AND FKN OF THE                BISAM
C     AUTOREGRESSIVE ESTIMATOR ACCORDING TO A RECURSIVE                BISAM
C     ALGORITHM                                                        BISAM
C     INPUT :                                                          BISAM
C          A : VECTOR OF COMPLEX FOURIER TRANSFORM,                    BISAM
C              OF DIMENSION AT LEAST M                                 BISAM
C          M : (M-1) IS THE MAXIMUM ORDER OF SCHEME                    BISAM
C              TO BE COMPUTED                                          BISAM
C          LSP1 : ORDER OF SCHEME BEING COMPUTED PLUS 1. LSP1.GE.2     BISAM
C     OUTPUT :                                                         BISAM
C          ALPHA : VECTOR OF COEFFICIENTS DEFINING THE                 BISAM
C              APPROXIMATING FUNCTION, HAS TO BE DIMEN-                BISAM
C              SIONED AT LEAST M AND DECLARED COMPLEX                  BISAM
C          FKN : SCALES THE AUTOREGRESSIVE ESTIMATOR TO                BISAM
C              INTEGRATE TO A(1), DECLARED REAL                        BISAM
C     ALPHA, PHI AND FKN ARE USED RECURSIVELY,IE. THEIR                BISAM
C     VALUES AT OUTPUT FOR ORDER J ARE USED AS INPUT                   BISAM
C     FOR ORDER (J+1)                                                  BISAM
C*****************************************************************   BISAM
      COMPLEX A(LSP1),ALPHA(LSP1),PHI(LSP1),G,FJN                      BISAM
      COMPLEX FKN                                                      BISAM
      LS=LSP1-1                                                        BISAM
      TWOPI=8.*ATAN(1.0)                                               BISAM
      FJN=CMPLX(0.,0.)                                                 BISAM
      PHI(LS) = CMPLX(1.,0.)                                           BISAM
      IF(LS .EQ. 1) FKN = CONJG(A(1))                                  BISAM
      DO 4 I = 1,LS                                                    BISAM
    4 FJN=FJN+CONJG(A(I+1))*PHI(I))                                    BISAM
      G=-FJN/FKN                                                       BISAM
      ALPHA(LS) = G                                                    BISAM
      IF(LS .EQ. 1) GO TO 5                                            BISAM
      K = LS -1                                                        BISAM
      DO 2 I = 1,K                                                     BISAM
    2 ALPHA(I) = ALPHA(I) + G*PHI(I)                                   BISAM
    5 CONTINUE                                                         BISAM
      DO 3 I=1,LS                                                      BISAM
    3 PHI(I) = CONJG(ALPHA(LS+1-I))                                    BISAM
      FKN=FKN-FJN*CONJG(FJN)/CONJG(FKN)                                BISAM
      RETURN                                                           BISAM
      END                                                              BISAM
      SUBROUTINE CLPLT1(X,N,INIT,NAME,MM,IOPT)                         CLPLT1 BISAM
C*****************************************************************   CLPLT1 BISAM
C                                                                      CLPLT1 BISAM
C   SUBROUTINE TO PRINT AND PRINTER PLOT THE N-VECTOR X.               CLPLT1 BISAM
C                                                                      CLPLT1 BISAM
C   INPUT :                                                            CLPLT1 BISAM
C            N,X                                                       CLPLT1 BISAM
C            INIT : PRINTED INDEX OF FIRST PRINTED X                   CLPLT1 BISAM
C            NAME : 4 CHARACTER LITERAL CONSTANT GIVING                CLPLT1 BISAM
C                   LABEL FOR X                                        CLPLT1 BISAM
C            MM : NUMBER OF COLUMNS IN PLOT (LE.101)                   CLPLT1 BISAM
C            IOPT : 1,2 (POINT OR BAR PLOT)                            CLPLT1 BISAM
C                                                                      CLPLT1 BISAM
C   SUBROUTINES CALLED : MAX,MIN                                       CLPLT1 BISAM
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      C                                                                 CLPLT1   BISAM
      C*****************************************************************CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
            DIMENSION X(N),AL(101)                                      CLPLT1   BISAM
            DATA NIN,NOUT/5,6/                                          CLPLT1   BISAM
            DATA BLANK,DOT,Z/1H ,1H.,1H*/                                        BISAM
      C                                                                 CLPLT1   BISAM
            IOPTX=0                                                     CLPLT1   BISAM
            IF(N.GT.1) GO TO 10                                         CLPLT1   BISAM
            WRITE(NOUT,11) NAME,X(1)                                    CLPLT1   BISAM
        11  FORMAT(10X,A4,'(1) = ',F15.8)                                        BISAM
            GO TO 99                                                    CLPLT1   BISAM
        10  CONTINUE                                                    CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
      C   INITIALIZE AL :                                               CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
            MM=(NM-1)/2                                                 CLPLT1   BISAM
            DO 20 J=1,MM                                                CLPLT1   BISAM
        20  AL(J)=DOT                                                   CLPLT1   BISAM
            WRITE(NOUT,25) NAME,(AL(J),J=1,MM)                          CLPLT1   BISAM
        25  FORMAT(/,14X,1H1,6X,A4/10X,15(1H-),2X,101A1)                CLPLT1   BISAM
            DO 30 J=1,MM                                                CLPLT1   BISAM
        30  AL(J)=BLANK                                                 CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
      C   FIND MAX AND MIN :                                            CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
            CALL MAX(X,N,XMAX,IND)                                      CLPLT1   BISAM
            CALL MIN(X,N,XMIN,IND)                                      CLPLT1   BISAM
            RX=XMAX-XMIN                                                CLPLT1   BISAM
            IF(RX.LT.1.E-20) IOPTX=1                                    CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
      C   PLOT :                                                        CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
            JJ=INIT                                                     CLPLT1   BISAM
            DO 40 J=1,N                                                 CLPLT1   BISAM
            IF(IOPTX.EQ.1) GO TO 36                                     CLPLT1   BISAM
            C1=(X(J)-XMIN)/RX                                           CLPLT1   BISAM
            C1=2.*(C1-.5)                                               CLPLT1   BISAM
            GO TO 37                                                    CLPLT1   BISAM
        36  C1=0.                                                       CLPLT1   BISAM
        37  K=ON*(C1+1.)+1.5                                            CLPLT1   BISAM
            AL(K)=Z                                                     CLPLT1   BISAM
            IF(IOPT.EQ.1) GO TO 38                                      CLPLT1   BISAM
            DO 39 I=1,K                                                 CLPLT1   BISAM
        39  AL(I)=Z                                                     CLPLT1   BISAM
        38  CONTINUE                                                    CLPLT1   BISAM
            WRITE(NOUT,38) JJ,X(J),(AL(I),I=1,MM)                       CLPLT1   BISAM
        38  FORMAT(10X,I5,F10.4,2X,101A1)                               CLPLT1   BISAM
            JJ=JJ+1                                                     CLPLT1   BISAM
            AL(K)=BLANK                                                 CLPLT1   BISAM
            IF(IOPT.EQ.1) GO TO 40                                      CLPLT1   BISAM
            DO 41 I=1,K                                                 CLPLT1   BISAM
        41  AL(I)=BLANK                                                 CLPLT1   BISAM
        40  CONTINUE                                                    CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
      C                                                                 CLPLT1   BISAM
        99  CONTINUE                                                    CLPLT1   BISAM
            RETURN                                                      CLPLT1   BISAM
            END                                                         CLPLT1   BISAM
            SUBROUTINE CMPINF(N,MORD,IDOX,IDOY,IPLT2,IBUTD,IREG,LABX,LABY,       BISAM
           *ND,AIC)                                                     BISAM
      C*****************************************************************BISAM
      C                                                                 BISAM
      C   SUBROUTINE TO COMPUTE COVARIANCE MATRIX OF COMPLEX            BISAM
      C   EXPONENTIAL "SUFFICIENT STATISTICS" TO BE USED IN             BISAM
      C   SEQUENTIAL REGRESSION ROUTINE TO OBTAIN "REGRESSION"          BISAM
      C   MODELS FOR ORDERS 1 THROUGH M=M. SUBROUTINE CPTENT IS USED    BISAM
      C   TO OBTAIN COEFFICIENTS FOR THREE MAXIMUM ENTROPY              BISAM
      C   ESTIMATES OF THE BIVARIATE DEPENDENCE DENSITY. THEN THE       BISAM
      C   BIVARIATE DENSITY QUANTILE IS FORMED BY TAKING THE PRODUCT    BISAM
      C   OF THE ESTIMATED DEPENDENCE DENSITY AND THE UNIVARIATE        BISAM
      C   AUTOREGRESSIVE ESTIMATORS.                                    BISAM
      C                                                                 BISAM
      C   INPUT: RANKX,RANKY - VECTORS CONTAINING RANKS OF X AND CORANKS BISAM
      C                        OF Y                                     BISAM
      C          X,Y - BIVARIATE DATA                                   BISAM
      C          N - SAMPLE SIZE                                        BISAM
      C          MORD - MAXIMUM AUTOREGRESSIVE ORDER TO BE USED FOR     BISAM
      C                 UNIVARIATE AR DENSITY ESTIMATION (<=6)          BISAM
      C          IDOX,IDOY - NULL DISTRIBUTIONS FOR AUTOREGRESSIVE SMOOTHING BISAM
      C          IPLT2 - 0--> NO AUTOREGRESSIVE DENSITY PLOTS           BISAM
      C                  1--> BEST ORDER AR DENSITY PLOTS               BISAM
      C          IBST - 0--> NO UNIVARIATE DESCRIPTIVE STATISTICS       BISAM
      C                 1--> UNIVARIATE DESCRIPTIVE STATISTICS FOR X AND Y BISAM
      C          IBUTD - 1 IF THE 3 MODELS ESTIMATED ARE TO HAVE VALUES BISAM
      C                  WRITTEN TO TAPES 1,2, AND 3; 0 O.W.           BISAM
      C                  FT01F001, ETC. DD JCL CARDS MUST BE INCLUDED IF BISAM
      C                  IBUTD=1.                                      BISAM
      C          IREG - 1 IF QUANTILE REGRESSION PERFORMED, 0 O.W.     BISAM
      C          LABX,LABY - LABELS FOR X AND Y                        BISAM
      C                                                                BISAM
      C   OUTPUT: PHI - COVARIANCE MATRIX                              BISAM
      C           FOX,FOY - UNIVARIATE DENSITY QUANTILE FUNCTIONS      BISAM
      C           BQMAT - BIVARIATE DENSITY QUANTILE FUNCTION          BISAM
      C           ND - VECTOR OF ENTROPY ESTIMATORS: 1 - ORDER 8 MODEL BISAM
      C                                              2 - ORDER 24 MODEL BISAM
      C                                              3 - ORDER 48 MODEL BISAM
      C                                              4 - RAW (FROM D-TILDA) BISAM
      C           AIC - VALUES OF ENTROPY CRITERION FUNCTION BASED ON  BISAM
      C                 AKAIKE'S INFORMATION CRITERION                 BISAM
      C                                                                BISAM
      C   NOTE: FOX,FOY ARE NOT PASSED BACK TO THE CALLING PROGRAM.    BISAM
      C         ALSO, CRITERION FUNCTIONS ARE PLOTTED BUT NOT PASSED   BISAM
      C         BACK TO THE CALLING PROGRAM.                           BISAM
      C                                                                BISAM
      C   SUBPROGRAMS CALLED: CSOREG,CPTENT,PLOTXY,FTERP,AUTDEN,MIN    BISAM
      C                                                                BISAM
      C*****************************************************************BISAM
      C                                                                BISAM
            COMMON /DATAR/ X(500),Y(500),RANKX(500),RANKY(500)          BISAM
            COMMON /PARM/ BETAP,BETAW                                   BISAM
            DIMENSION IND(97),RADS0(500),IORD(49),                      BISAM
           *ND(4),AIC(4),DTIL(500),AMAT(48,48)                          BISAM
            DIMENSION MENT(3),PSI(3),LABX(20),LABY(20)                  BISAM
            COMPLEX ARGM(12,12),PHI(50,50),CEXP,CONJG,CMPLX,ZARG       BISAM
            COMPLEX ALPHX(6),ALPHY(6),COF(97)                           BISAM
            DATA IORD/25,24,18,17,26,33,10,31,33,23,11,16,10,30,12,9,   BISAM
           *27,39,20,38,34,40,13,37,41,32,6,15,3,29,5,8,2,36,6,1,28,    BISAM
           *46,21,45,35,47,14,44,42,48,7,43,49/                         BISAM
            DATA MENT/8,24,48/                                          BISAM
            REAL LEGMAT                                                 BISAM
            IF(N.GT.20) GO TO 20                                        BISAM
            WRITE(6,10) N                                               BISAM
        10  FORMAT(10X,'SAMPLE SIZE ',I2,' IS TOO SMALL. CMPINF SKIPPED.') BISAM
            RETURN                                                      BISAM
      C                                                                 BISAM
      C   SET VALUES OF CONSTANTS                                       BISAM
      C                                                                 BISAM
        20  N2=N-2                                                      BISAM
            DO 21 I=1,4                                                 BISAM
        21  ND(I)=999.0                                                 BISAM
      C                                                                 BISAM
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C     FOR THIS VERSION USING COMPLEX SEQUENTIAL REGRESSION THE                  DISAM
C     MAXIMUM APPROXIMATING ORDER IS SET AT 7.                                  DISAM
C                                                                               DISAM
      M=7                                                                       DISAM
      L=MOD(M,2)                                                                DISAM
      ML=(M-L)/2                                                                DISAM
      IF(L.EQ.0) M=M+1                                                          DISAM
      M2=2*M-1                                                                  DISAM
      MM=M*M                                                                    DISAM
      M1=MM+1                                                                   DISAM
      MM1=MM-1                                                                  DISAM
      DENOM=1.0/FLOAT(N+1)                                                      DISAM
      TWOPI=8.0*ATAN(1.0)                                                       DISAM
      PI=TWOPI/2.0                                                              DISAM
C                                                                               DISAM
C     COMPUTE NEAREST NEIGHBOR DENSITY ESTIMATE AND RAW ESTIMATE                DISAM
C     OF ENTROPY                                                                DISAM
C                                                                               DISAM
      HDO=0.0                                                                   DISAM
      DO 30 I=3,M2                                                              DISAM
      DO 25 J=1,N                                                               DISAM
      RADSQ(J)=(RANKX(I)-RANKX(J))**2+(RANKY(I)-RANKY(J))**2                    DISAM
   25 CONTINUE                                                                  DISAM
      DO 26 K=1,6                                                               DISAM
      CALL MIN(RADSQ,N,RMIN,INDR)                                               DISAM
      RADSQ(INDR)=FLOAT(2*N*N)                                                  DISAM
   26 CONTINUE                                                                  DISAM
      VXJ=RMIN*DENOM*DENOM*PI                                                   DISAM
      IF(VXJ.EQ.0.0) VXJ=0.5*DENOM*DENOM*PI                                     DISAM
C                                                                               DISAM
C     DTIL IS ALOG(DTIL)                                                        DISAM
C                                                                               DISAM
      DTIL(I)=ALOG(5.0/(FLOAT(N+1)*VXJ))                                        DISAM
      HDO=HDO-DTIL(I)                                                           DISAM
   30 CONTINUE                                                                  DISAM
      HD(6)=HDO/FLOAT(N-6)                                                      DISAM
C                                                                               DISAM
C     COMPUTE MATRIX OF EXPONENTIAL CROSS-PRODUCTS TO BE USED FOR               DISAM
C     COVARIANCE COMPUTATIONS                                                   DISAM
C                                                                               DISAM
      DO 60 I=1,M2                                                              DISAM
      I1=1-M                                                                    DISAM
      DO 50 J=1,M2                                                              DISAM
      J1=J-M                                                                    DISAM
      ARGM(I,J)=CMPLX(0.0,0.0)                                                  DISAM
      DO 40 K=3,N2                                                              DISAM
      ARG=TWOPI*(FLOAT(I1)*RANKX(K)+FLOAT(J1)*RANKY(K))*DENOM                   DISAM
      ZARG=CMPLX(0.,ARG)                                                        DISAM
      ARGM(I,J)=ARGM(I,J)+CEXP(ZARG)                                            DISAM
   40 CONTINUE                                                                  DISAM
      ARGM(I,J)=ARGM(I,J)/FLOAT(N-6)                                            DISAM
   50 CONTINUE                                                                  DISAM
C                                                                               DISAM
C     COMPUTE COVARIANCE MATRIX                                                 DISAM
C                                                                               DISAM
      DO 60 IN=1,MM                                                             DISAM
      I=IN-1                                                                    DISAM
      I2=MOD(I,M)                                                               DISAM
      I1=(I-I2)/M+M-ML                                                          DISAM
      I2=I2+M-ML                                                                DISAM
      DO 55 JN=1,IN                                                             DISAM
      J=JN-1                                                                    DISAM
      J2=MOD(J,M)                                                               DISAM
      J1=(J-J2)/M                                                               DISAM
      II=I1-J1+ML                                                               DISAM
      JJ=I2-J2+ML                                                               DISAM
      J1=J1+M-ML                                                                DISAM
      J2=J2+M-ML                                                                DISAM
      PHI(IN,JN)=ARGM(II,JJ)-ARGM(I1,I2)*CONJG(ARGM(J1,J2))                     DISAM
      PHI(JN,IN)=CONJG(PHI(IN,JN))                                              DISAM
   55 CONTINUE                                                                  DISAM
   60 CONTINUE                                                                  DISAM
C                                                                               DISAM
C     COMPUTE LAST ROW OF COVARIANCE MATRIX                                     DISAM
C                                                                               DISAM
      DBAR=0.0                                                                  DISAM
      DO 70 I=3,N2                                                              DISAM
      DBAR=DBAR+DTIL(I)                                                         DISAM
   70 CONTINUE                                                                  DISAM
      DBAR=DBAR/FLOAT(N-6)                                                      DISAM
      DO 90 IN=1,MM                                                             DISAM
      I=IN-1                                                                    DISAM
      I2=MOD(I,M)                                                               DISAM
     . I1=(I-I2)/M-ML                                                           DISAM
      I2=I2-ML                                                                  DISAM
      PHI(M1,IN)=CMPLX(0.0,0.0)                                                 DISAM
      DO 80 K=3,N2                                                              DISAM
      ARG=TWOPI*(FLOAT(I1)*RANKX(K)+FLOAT(I2)*RANKY(K))*DENOM                   DISAM
      ZARG=CMPLX(0.0,ARG)                                                       DISAM
      PHI(M1,IN)=PHI(M1,IN)+DTIL(K)*CONJG(CEXP(ZARG))                           DISAM
   80 CONTINUE                                                                  DISAM
      PHI(M1,IN)=PHI(M1,IN)/FLOAT(N-6)-DBAR*CONJG(ARGM(I1+M,I2+M))              DISAM
      PHI(IN,M1)=CONJG(PHI(M1,IN))                                              DISAM
   90 CONTINUE                                                                  DISAM
      PHI(M1,M1)=0.0                                                            DISAM
      DO 100 K=3,N2                                                             DISAM
      PHI(M1,M1)=PHI(M1,M1)+DTIL(K)*DTIL(K)                                     DISAM
  100 CONTINUE                                                                  DISAM
      PHI(M1,M1)=PHI(M1,M1)/FLOAT(N-6)-DBAR*DBAR                                DISAM
C                                                                               DISAM
C     CALL ROUTINE CPTENT TO COMPUTE AND PLOT RESIDUAL VARIANCE AND             DISAM
C     DETERMINE THREE MODELS FOR D(U1,U2)                                       DISAM
C                                                                               DISAM
      CALL CPTENT(N,M,PHI,IORD,.'L',COF,MENT)                                   DISAM
C                                                                               DISAM
C     COMPUTE UNIVARIATE DENSITY ESTIMATES USING AUTOREGRESSIVE                 DISAM
C      TECHNIQUE                                                                DISAM
C                                                                               DISAM
      WRITE(6,134)                                                              DISAM
  134 FORMAT('1H1')                                                             DISAM
      CALL AUTDEN(X,N,IDOX,IPLT2,MORD,ALPHX,RVARX,SIGX,NVX,0,4H   X )           DISAM
      WRITE(6,134)                                                              DISAM
      CALL AUTDEN(Y,N,IDOY,IPLT2,MORD,ALPHY,RVARY,SIGY,NVY,1,4H   Y )           DISAM
      WRITE(6,135) NVX,NVY                                                      DISAM
  135 FORMAT(//,10X,'UNIVARIATE BEST ORDERS: NVX =',I3,', NVY =',I3)            DISAM
      DO 200 ITER=1,3                                                           DISAM
      PS(ITER)=0.0                                                              DISAM
      ENT=0.0                                                                   DISAM
      WRITE(6,136) MENT(ITER)                                                   DISAM
  136 FORMAT('1H1',10X,'RESULTS FOR ORDER ',I2,' MODEL:',                       DISAM
     +//,10X,'U1',17X,'U2',15X,'DENT',15X,'DHAT',/,11X,                        DISAM
     +68('-'))                                                                 DISAM
      DDMAX=0.                                                                  DISAM
      LOCIT=1                                                                   DISAM
      IF(ITER.EQ.2) LOCIT=MENT(1)+1                                             DISAM
      IF(ITER.EQ.3) LOCIT=MENT(1)+MENT(2)+1                                     DISAM
      DO 220 I=1,40                                                             DISAM
      U1=(FLOAT(I)-.5)*0.025                                                    DISAM
      DO 220 J=1,40                                                             DISAM
      U2=(FLOAT(J)-0.5)*0.025                                                   DISAM
C                                                                               DISAM
C     COMPUTE VALUES OF UNIVARIATE DENSITY-QUANTILE FUNCTIONS                   DISAM
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C                                                                       BISAM
      FOX=1.0                                                           BISAM
      IF(NVX.GT.0) FOX=ARGST(U1,NVX,RVARX,ALPHX)                        BISAM
      FOX=FOFNC(U1,IBOX)/(FOX*SIGX)                                     BISAM
      FOY=1.0                                                           BISAM
      IF(NVY.GT.0) FOY=ARGST(U2,NVY,RVARY,ALPHY)                        BISAM
      FOY=FOFNC(U2,IBOY)/(FOY*SIGY)                                     BISAM
C                                                                       BISAM
C   COMPUTE BIVARIATE DENSITY QUANTILE BY FORMING PRODUCT               BISAM
C   OF DEPENDENCE DENSITY AND AUTOREGRESSIVE ESTIMATORS                 BISAM
C                                                                       BISAM
      LGDMAT=0.0                                                        BISAM
      KP=MENT(ITER)                                                     BISAM
      LOC=LOCIT                                                         BISAM
      DO 200 K=1,KP                                                     BISAM
      II=IND(LOC)-1                                                     BISAM
      I2=MOD(II,M)                                                      BISAM
      II=(II-I2)/M-ML                                                   BISAM
      I2=I2-ML                                                          BISAM
      ARG=TWOPI*(FLOAT(II)*U1+FLOAT(I2)*U2)                             BISAM
      ZARG=CMPLX(0.0,ARG)                                               BISAM
      LGDMAT=LGDMAT+REAL(COF(LOC)*CEXP(ZARG))                           BISAM
      LOC=LOC+1                                                         BISAM
  200 CONTINUE                                                          BISAM
      IF(LGDMAT.LE.170.) GO TO 202                                      BISAM
      WRITE(6,202) U1,U2,LGDMAT                                         BISAM
  202 FORMAT(/,10X,'LOG DMAT(',F6.5,',',F6.5,') =',E30.6,               BISAM
     +' IN CMPINF. BIVARIATE MODELING TERMINATED.')                     BISAM
      RETURN                                                            BISAM
  203 IF(LGDMAT.LT.-20.) LGDMAT=-20.                                    BISAM
      DMAT=EXP(LGDMAT)                                                  BISAM
      ENT=ENT-LGDMAT*DMAT                                               BISAM
      PSI(ITER)=PSI(ITER)+DMAT                                          BISAM
      DDMT=DMAT*FOX*FOY                                                 BISAM
      AMAT(I,J)=DDMT                                                    BISAM
      IF(DDMT.LE.DOMAX) GO TO 205                                       BISAM
      DOMAX=DDMT                                                        BISAM
      U1MAX=U1                                                          BISAM
      U2MAX=U2                                                          BISAM
  205 CONTINUE                                                          BISAM
      IMOD=MOD(I,6)                                                     BISAM
      JMOD=MOD(J,6)                                                     BISAM
      IF((IMOD.EQ.0).AND.(JMOD.EQ.0)) WRITE(6,210) U1,U2,DDMT,DMAT      BISAM
      IF(IOUTO.EQ.1) WRITE(ITER,210) U1,U2,DDMT,DMAT                    BISAM
  210 FORMAT(2X,4F19.8)                                                 BISAM
C                                                                       BISAM
  220 CONTINUE                                                          BISAM
      PSI(ITER)=PSI(ITER)/1681.0                                        BISAM
      ENT=ENT/1681.0                                                    BISAM
      MD(ITER)=ENT/PSI(ITER)+ALOG(PSI(ITER))                            BISAM
      WRITE(6,224)                                                      BISAM
  224 FORMAT(//,10X,20(4H****),//)                                      BISAM
      WRITE(6,225) MENT(ITER),PSI(ITER)                                 BISAM
  225 FORMAT(/,10X,'INTEGRATING FACTOR FOR ORDER ',I3,' IS ',F10.4)     BISAM
      U1N=U1MAX*FLOAT(N)                                                BISAM
      U2N=U2MAX*FLOAT(N)                                                BISAM
      DOMAX=DOMAX/PSI(ITER)                                             BISAM
      WRITE(6,227) U1MAX,U2MAX,DOMAX,U1N,U2N                            BISAM
  227 FORMAT(/,10X,'MAXIMUM VALUE FOR DEPENDENCE DENSITY QUANTILE:',    BISAM
     +//,T20,'D(',F7.5,',',F7.5,') = ',F15.7,//,T20,'U1*N = ',        BISAM
     +F7.2,5X,'U2*N = ',F7.2)                                           BISAM
      WRITE(6,230)                                                      BISAM
  230 FORMAT(//,10X,'COEFFICIENTS FOR BIVARIATE DEPENDENCE DENSITY:',   BISAM
     +//,12X,'NU1',2X,'NU2',2X,' REAL(COF) IMAG(COF)',/,10X,33(1H-))    BISAM
      LOC=LOCIT                                                         BISAM
      DO 245 I=1,KP                                                     BISAM
      II=IND(LOC)-1                                                     BISAM
      I2=MOD(II,M)                                                      BISAM
      II=(II-I2)/M-ML                                                   BISAM
      I2=I2-ML                                                          BISAM
      WRITE(6,240) II,I2,COF(LOC)                                       BISAM
  240 FORMAT(10X,2I5,2F10.6)                                            BISAM
      LOC=LOC+1                                                         BISAM
  245 CONTINUE                                                          BISAM
C                                                                       BISAM
C   DISPLAY CONTOUR PLOT OF DEPENDENCE DENSITY QUANTILE                 BISAM
C                                                                       BISAM
      WRITE(6,255) LABX,LABY,MENT(ITER)                                 BISAM
  255 FORMAT(1H1,/,10X,20A4,/,10X,20A4,/,10X,'CONTOUR PLOT FOR ',       BISAM
     +'BIVARIATE DENSITY QUANTILE - ORDER = ',I2,//)                    BISAM
      CALL CPLOT(AMAT,40,40,40)                                         BISAM
      WRITE(6,257)                                                      BISAM
  257 FORMAT(//,30X,'ORDINATE IS U1, ABSCISSA IS U2',/,30X,             BISAM
     +'U1 CORRESPONDS TO X (FIRST VARIABLE), U2 TO Y')                  BISAM
  260 CONTINUE                                                          BISAM
C                                                                       BISAM
C   DETERMINE BEST MODEL BY ENTROPY CRITERION                           BISAM
C                                                                       BISAM
      DO 270 I=1,3                                                      BISAM
  270 AIC(I)=(MD(I)-2.*FLOAT(MENT(I))/FLOAT(N))*MD(4)                   BISAM
      AIC(4)=0.                                                         BISAM
      KMOD=1                                                            BISAM
      DO 280 I=2,3                                                      BISAM
  280 IF(AIC(I).GE.0.) KMOD=I                                           BISAM
      WRITE(6,290) MENT(KMOD)                                           BISAM
  290 FORMAT(/,10X,'BEST MODEL BY AIC IS ORDER ',I2,' MODEL.')          BISAM
      LOCO=1                                                            BISAM
      IF(KMOD.EQ.2) LOCO=MENT(1)+1                                      BISAM
      IF(KMOD.EQ.3) LOCO=MENT(1)+MENT(2)+1                              BISAM
      KPARM=MENT(KMOD)                                                  BISAM
      PSIO=PSI(KMOD)                                                    BISAM
C                                                                       BISAM
C   PERFORM QUANTILE REGRESSION                                         BISAM
C                                                                       BISAM
      IF(IREG.EQ.1) CALL QREG(N,M,ML,PSIO,LOCO,KPARM,COF,IND,RADSQ,     BISAM
     +BTIL)                                                             BISAM
      RETURN                                                            BISAM
      END                                                               BISAM
      SUBROUTINE CPLOT(A,IA,M,N)                                        BISAM
C*****************************************************************    BISAM
C                                                                       BISAM
C   SUBROUTINE TO PROVIDE A 10 TIERED CONTOUR PLOT OF THE MATRIX        BISAM
C   A.  THIS ROUTINE IS DESIGNED SPECIFICALLY TO PROVIDE A              BISAM
C   CONTOUR PLOT OF THE DEPENDENCE DENSITY QUANTILE FROM PROGRAM        BISAM
C   BISAM.                                                              BISAM
C                                                                       BISAM
C   INPUT: A - MATRIX TO BE PLOTTED                                     BISAM
C          M,N - ROW AND COLUMN DIMENSIONS OF A                         BISAM
C          IA - ROW DIMENSION OF A IN CALLING PROGRAM                   BISAM
C                                                                       BISAM
C   SUBPROGRAMS CALLED: MINMAX                                          BISAM
C                                                                       BISAM
C   PROGRAMMER: PHIL SPECTOR                                            BISAM
C   MODIFIED BY TERRY J. WOODFIELD                                      BISAM
C                                                                       BISAM
C*****************************************************************    BISAM
      DIMENSION A(IA,N),XNUM(11)                                        BISAM
      DIMENSION ISYMB(6),LINE1(60),LINE2(60),LINE3(60),LINEN(110)       BISAM
      DATA ISYMB/1H.,1H',1H-,1H+,1H0,1HX,1HA/                           BISAM
      DATA IBLANK/1H /                                                  BISAM
      DIVN=1./FLOAT(N)                                                  BISAM
      DIVM=1./FLOAT(M)                                                  BISAM
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      CALL MINMAX(A,IA,M,N,XMIN,XMAX)                                   BISAM
      FACT=(XMAX-XMIN)/10.                                              BISAM
      DO 60 I=1,M                                                       BISAM
      IFLAG=0                                                           BISAM
      IFLAG1=0                                                          BISAM
      DO 10 K=1,80                                                      BISAM
      LINE1(K)=IBLANK                                                   BISAM
      LINE2(K)=IBLANK                                                   BISAM
   10 LINE3(K)=IBLANK                                                   BISAM
      DO 70 J=1,N                                                       BISAM
      ITEMP=IFIX((A(I,J)-XMIN)/FACT)+.5)+1                              BISAM
      INEXT=(ITEMP+2)/3                                                 BISAM
      IF(ITEMP.EQ.1)GO TO 11                                            BISAM
      IF(ITEMP.GE.15)GO TO 15                                           BISAM
      IF((ITEMP.EQ.16).OR.(ITEMP.EQ.17))GO TO 17                        BISAM
      IF((ITEMP.EQ.14).OR.(ITEMP.EQ.15))GO TO 15                        BISAM
      LINE1(J)=ISYMB(INEXT)                                             BISAM
      GO TO 70                                                          BISAM
   11 LINE1(J)=ISYMB(1)                                                 BISAM
      GO TO 70                                                          BISAM
   15 IFLAG=1                                                           BISAM
      IFLAG1=1                                                          BISAM
      LINE1(J)=ISYMB(6)                                                 BISAM
      LINE2(J)=ISYMB(7)                                                 BISAM
      LINE3(J)=ISYMB(8)                                                 BISAM
      GO TO 70                                                          BISAM
   17 IFLAG=1                                                           BISAM
      LINE1(J)=ISYMB(6)                                                 BISAM
      LINE2(J)=ISYMB(7)                                                 BISAM
      GO TO 70                                                          BISAM
   16 IFLAG=1                                                           BISAM
      LINE1(J)=ISYMB(6)                                                 BISAM
      LINE2(J)=ISYMB(3)                                                 BISAM
   70 CONTINUE                                                          BISAM
      U=(FLOAT(I)-0.5)*DIVM                                             BISAM
      WRITE(6,901)U,LINE1                                               BISAM
      IF(IFLAG.EQ.1)WRITE(6,902)LINE2                                   BISAM
      IF(IFLAG1.EQ.1)WRITE(6,902)LINE3                                  BISAM
   60 CONTINUE                                                          BISAM
      INDEX=(N+5)/6                                                     BISAM
      DO 81 I=1,INDEX                                                   BISAM
   81 XNUM(I)=(5.*FLOAT(I)-0.5)*DIVN                                    BISAM
      NEND=INDEX*10                                                     BISAM
      DO 82 I=11,NEND                                                   BISAM
   82 LINEN(I)=ISYMB(3)                                                 BISAM
      DO 83 I=11,NEND,10                                                BISAM
   83 LINEN(I)=ISYMB(5)                                                 BISAM
      NEND=NEND+1                                                       BISAM
      IF(NEND.GE.110)GO TO 85                                           BISAM
      DO 84 I=NEND,110                                                  BISAM
   84 LINEN(I)=IBLANK                                                   BISAM
   85 WRITE(6,903)LINEN                                                 BISAM
      WRITE(6,904)(XNUM(I),I=1,INDEX)                                   BISAM
      RETURN                                                            BISAM
  901 FORMAT(1H ,2X,F5.3,2X,'|',1X,80(A1,1X))                           BISAM
  902 FORMAT(1H+,11X,80(A1,1X))                                         BISAM
  903 FORMAT(1H ,9X,110A1)                                              BISAM
  904 FORMAT(1H ,12X,11(5X,F5.3))                                       BISAM
      END                                                               BISAM
      SUBROUTINE CPTENT(N,M,PHI,IORD,IND,COF,MENT)                      BISAM
C*****************************************************************    BISAM
C                                                                       BISAM
C   SUBPROGRAM TO COMPUTE MAXIMUM ENTROPY ESTIMATES OF                  BISAM
C   THE BIVARIATE DEPENDENT DENSITY.                                    BISAM
C                                                                       BISAM
C   THREE FITTED MODELS WILL BE RETURNED WITH COEFFICIENTS              BISAM
C   IN COF, VARIABLE NAMES (INDICES) IN IND, THE FIRST LOCATION         BISAM
C   OF COEFFICIENTS AND INDICES FOR THE 2ND MODEL IN MENT(1)+1, I.E.,   BISAM
C   COF(MENT(1)+1) CONTAINS COEFFICIENT NUMBER ONE OF THE SECOND        BISAM
C   REGRESSION MODEL CORRESPONDING TO INDEX IND(MENT(1)+1), ETC.        BISAM
C                                                                       BISAM
C   INPUT: N,M - SAMPLE SIZE, UNIVARIATE MAXIMUM ORDER (M**2            BISAM
C                 USED FOR BIVARIATE MAX ORDER)                         BISAM
C          PHI - COVARIANCE MATRIX                                      BISAM
C          IORD - VECTOR OF ORDERED INDICES FOR SEQUENTIAL REGRESSION   BISAM
C                                                                       BISAM
C   AUXILLIARY: NVAR,RVAR,BEST - VECTORS AND MATRIX                     BISAM
C               FROM ROUTINE CSOREG                                     BISAM
C                                                                       BISAM
C   OUTPUT: COF,IND - SEE ABOVE                                         BISAM
C                                                                       BISAM
C   SUBROUTINES CALLED: CSOREG,CSWEEP,CLPLT1                            BISAM
C                                                                       BISAM
C*****************************************************************    BISAM
C                                                                       BISAM
      DIMENSION MENT(3),IND(97)                                         BISAM
      DIMENSION IORD(49),NVAR(49),INDV(1225),RVAR(49)                   BISAM
      COMPLEX PHI(50,50),COF(97),BEST(1225)                             BISAM
      MM=M*M                                                            BISAM
      MM1=MM-1                                                          BISAM
      L=MOD(M,2)                                                        BISAM
      ML=(M-L)/2                                                        BISAM
      TWOPI=8.0*ATAN(1.0)                                               BISAM
C                                                                       BISAM
C   CALL ROUTINE CSOREG TO PERFORM SEQUENTIAL REGRESSION ON PHI         BISAM
C                                                                       BISAM
      CALL CSOREG(PHI,50,MM,IORD,BEST,INDV,1225,RVAR,NVAR,NIVN)         BISAM
      CALL CLPLT1(RVAR,NIVN,1,4HRVAR,41,1)                              BISAM
C                                                                       BISAM
C   PLACE COEFFICIENTS IN COF FOR EACH ORDER                            BISAM
C                                                                       BISAM
C                                                                       BISAM
      LOC=1                                                             BISAM
      DO 180 I=1,3                                                      BISAM
      K=MENT(I)                                                         BISAM
      IF(K.EQ.0) GO TO 180                                              BISAM
      K1=NVAR(K)                                                        BISAM
      DO 170 KK=1,K                                                     BISAM
      IND(LOC)=INDV(K1)                                                 BISAM
      COF(LOC)=BEST(K1)                                                 BISAM
      K1=K1+1                                                           BISAM
      LOC=LOC+1                                                         BISAM
  170 CONTINUE                                                          BISAM
  180 CONTINUE                                                          BISAM
      RETURN                                                            BISAM
      END                                                               BISAM
      SUBROUTINE CSOREG(A,NDIM,NIV,IORD,BEST,INDV,MDIM,RVAR,NVAR,NIVN)  BISAM
C*****************************************************************    BISAM
C                                                                       BISAM
C   SUBPROGRAM TO PERFORM SEQUENTIAL REGRESSION USING COVARIANCE        BISAM
C   OR CORRELATION MATRIX A(NIV+1,NIV+1).                               BISAM
C                                                                       BISAM
C   INPUT: A - COVARIANCE MATRIX (COMPLEX)                              BISAM
C          NDIM - ROW DIMENSION OF A IN CALLING PROGRAM                 BISAM
C          NIV - NUMBER OF INDEPENDENT VARIABLES                        BISAM
C          IORD - INTEGER VECTOR CONTAINING INDICES OF VARIABLES        BISAM
C                 IN THE ORDER THEY ARE TO BE ENTERED INTO THE MODEL    BISAM
C          MDIM - DIMENSION OF BEST IN CALLING PROGRAM                  BISAM
C                                                                       BISAM
C   OUTPUT: A - SWEPT COVARIANCE MATRIX                                 BISAM
C           BEST,INDV - VECTORS OF SUBSET INFORMATION                   BISAM
C                BEST CONTAINS LEAST SQUARES PARAMETER ESTIMATES        BISAM
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C                INDV CONTAINS VARIABLE INDICES                                  BISAM
C            BVAR - VECTOR OF RESIDUAL VARIANCES                                 BISAM
C            IORD - VECTOR CONTAINING INDICES OF VARIABLES IN ORDER              BISAM
C                   THAT THEY WERE ENTERED WITH VALUES CAUSING                   BISAM
C                   SINGULARITIES IN A OMITTED                                   BISAM
C            NIVN - NUMBER OF INDEPENDENT VARIABLES INCLUDED IN                  BISAM
C                   ANALYSIS                                                     BISAM
C                                                                                BISAM
C   SUBPROGRAMS CALLED: CSWEEP                                                   BISAM
C                                                                                BISAM
C*****************************************************************           BISAM
C                                                                                BISAM
      COMPLEX A(NDIM,NDIM),BEST(NDIM)                                            BISAM
      DIMENSION INDV(NDIM),IORD(NIV),BVAR(NIV),NVAR(NIV)                         BISAM
      DATA TOL/1.E-20/                                                           BISAM
      NV=NIV+1                                                                   BISAM
      NIVN=NIV                                                                   BISAM
      VAR=REAL(A(NV,NV))                                                         BISAM
      LOC=1                                                                      BISAM
      LC2=1                                                                      BISAM
      KOUNT=1                                                                    BISAM
      K=1                                                                        BISAM
   10 ID=IORD(K)                                                                 BISAM
      KOUNT=KOUNT+1                                                              BISAM
      TEST=REAL(A(ID,ID))**2+AIMAG(A(ID,ID))**2                                  BISAM
      IF(TEST.LE.TOL) GO TO 40                                                   BISAM
      CALL CSWEEP(A,NDIM,NV,ID,ID)                                               BISAM
      BVAR(K)=REAL(A(NV,NV))/VAR                                                 BISAM
      DO 30 KK=1,K                                                               BISAM
      KID=IORD(KK)                                                               BISAM
      IF(KK.NE.1) GO TO 20                                                       BISAM
      NVAR(LC2)=LOC                                                              BISAM
      LC2=LC2+1                                                                  BISAM
   20 INDV(LOC)=KID                                                              BISAM
      BEST(LOC)=-A(NV,KID)                                                       BISAM
      LOC=LOC+1                                                                  BISAM
   30 CONTINUE                                                                   BISAM
      GO TO 60                                                                   BISAM
   40 NIVN=NIVN-1                                                                BISAM
      DO 50 I=K,NIVN                                                             BISAM
      IORD(I)=IORD(I+1)                                                          BISAM
   50 CONTINUE                                                                   BISAM
      GO TO 10                                                                   BISAM
   60 K=K+1                                                                      BISAM
      IF(KOUNT.LE.NIV) GO TO 10                                                  BISAM
      RETURN                                                                     BISAM
      END                                                                        BISAM
      SUBROUTINE CSWEEP(A,NDIM,N,K1,K2)                                          BISAM
C*****************************************************                           BISAM
C                                                                                BISAM
C   SUBROUTINE TO SWEEP THE NXN COMPLEX MATRIX A ON ITS K1                       BISAM
C   THRU K2 DIAGONAL ELEMENTS (SWP(K)SWP(K)A=A)                                  BISAM
C                                                                                BISAM
C   INPUT :                                                                      BISAM
C            A,N,K1,K2                                                           BISAM
C            NDIM : ROW DIMENSION OF A IN CALLING PROGRAM                        BISAM
C                                                                                BISAM
C   OUTPUT :                                                                     BISAM
C            A                                                                   BISAM
C                                                                                BISAM
C   SUBROUTINES CALLED : NONE                                                    BISAM
C                                                                                BISAM
C*****************************************************                           BISAM
C                                                                                BISAM
      COMPLEX D,A(NDIM,NDIM)                                                     BISAM
      DATA NOUT/6/                                                               BISAM
C                                                                                BISAM
C   FIX DIAGONAL K :                                                             BISAM
C                                                                                BISAM
      DO 50 K=K1,K2                                                              BISAM
C                                                                                BISAM
C   CHECK FOR ZERO :                                                             BISAM
C                                                                                BISAM
      TEST=REAL(A(K,K))**2+AIMAG(A(K,K))**2                                      BISAM
      IF(TEST.LT.1.E-25) GO TO 99                                                BISAM
      D=1./A(K,K)                                                                BISAM
      A(K,K)=1.                                                                  BISAM
C                                                                                BISAM
C   KTH ROW :                                                                    BISAM
C                                                                                BISAM
      DO 10 I=1,N                                                                BISAM
   10 A(K,I)=D*A(K,I)                                                            BISAM
C                                                                                BISAM
C   KTH COLUMN :                                                                 BISAM
C                                                                                BISAM
         DO 20 J=1,N                                                             BISAM
         IF(J.EQ.K) GO TO 20                                                     BISAM
         A(J,K)=-A(J,K)*D                                                        BISAM
   20    CONTINUE                                                                BISAM
C                                                                                BISAM
C   OTHERS :                                                                     BISAM
C                                                                                BISAM
         DO 40 J=1,N                                                             BISAM
         IF(J.EQ.K) GO TO 40                                                     BISAM
            DO 30 I=1,N                                                          BISAM
            IF(I.EQ.K) GO TO 30                                                  BISAM
            A(J,I)=A(J,I)+A(J,K)*A(K,I)/D                                        BISAM
   30       CONTINUE                                                             BISAM
   40    CONTINUE                                                                BISAM
C                                                                                BISAM
C                                                                                BISAM
   50 CONTINUE                                                                   BISAM
C                                                                                BISAM
C                                                                                BISAM
      GO TO 110                                                                  BISAM
   99 WRITE(NOUT,100) K,K1,K2                                                    BISAM
  100 FORMAT(10X,I2,15HTH DIAG OF FROM,1X,I2,1X,2HTO,1X,                         BISAM
     1I2,1X,17HIS ZERO IN CSWEEP)                                                BISAM
  110 RETURN                                                                     BISAM
      END                                                                        BISAM
      SUBROUTINE DATAIN(NTAPE,X,N,L,LAB)                                 DATAIN  BISAM
C*****************************************************************     DATAIN  BISAM
C   SUBROUTINE TO READ A DATA FILE FROM TAPE NTAPE AS FOLLOWS :        DATAIN  BISAM
C                                                                      DATAIN  BISAM
C      CARD1 : LAB1(1),...,LAB(20)  (20A4)                              DATAIN BISAM
C      CARD2 : SAMPLE SIZE N, FORMAT L(1),...,L(S),(I5,4X,5A4)         DATAIN  BISAM
C      CARD3,CARD4,... : DATA X(1),...,X(N) IN L FORMAT                DATAIN  BISAM
C                                                                      DATAIN  BISAM
C*****************************************************************     DATAIN  BISAM
C                                                                      DATAIN  BISAM
      DIMENSION X(1),L(5),LAB(20)                                       DATAIN BISAM
C                                                                      DATAIN  BISAM
      READ(NTAPE,1) LAB                                                DATAIN  BISAM
    1 FORMAT(20A4)                                                     DATAIN  BISAM
      READ(NTAPE,2) N,L                                                DATAIN  BISAM
    2 FORMAT(I5,4X,5A4)                                                DATAIN  BISAM
      READ(NTAPE,L) (X(I),I=1,N)                                       DATAIN  BISAM
C                                                                      DATAIN  BISAM
      RETURN                                                           DATAIN  BISAM
      END                                                              DATAIN  BISAM
      SUBROUTINE DESTAT(X,N,NAME,INHEAD,L,INIT,IOUT,025,050,075,XBAR,SD)         BISAM
C*****************************************************************           BISAM
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      C    SUBROUTINE TO PRINT ORDERED ARRAY BY QUANTILES AND COMPUTE                  BISAM
      C    DESCRIPTIVE STATISTICS.                                                     BISAM
      C    INPUT:                                                                      BISAM
      C          X: ARRAY OF ORDER STATISTICS                                          BISAM
      C          N: DIMENSION OF ARRAY X                                               BISAM
      C          NAME: NAME OF DATA SET.MUST BE ARRAY OF DIMENSION 20 IN               BISAM
      C                CALLING PROGRAM.                                              BISAM
      C          INHEAD: HEADING FOR ANALYSIS                                          BISAM
      C          IUNIT: NUMBER OF UNIT OUTPUT IS DESIRED ON.                           BISAM
      C          INIT: 0 FOR FIRST CALL, 1 THEREAFTER                                  BISAM
      C          IOUT: 1 IF QUANTILES TO BE LISTED, 0 OTHERWISE                        BISAM
      C    OUTPUT: PRINTED OUTPUT IS ON IUNIT.                                         BISAM
      C    NO SUBROUTINES CALLED.                                                      BISAM
      C*****************************************************************************  BISAM
            DIMENSION X(N),NAME(20),SUM(4),SUMSQ(4)                                   BISAM
            DIMENSION ALF(3),L(4)                                                     BISAM
            DIMENSION INHEAD(20)                                                      BISAM
            DATA ALF/.05,.10,.25/                                                     BISAM
            NUNIT = 6                                                                 BISAM
      C     COMPUTE L,THE ARRAY OF QUARTILE SIZES                                     BISAM
            IF(INIT .EQ. 0) GOTO 5                                                    BISAM
            IF(L(4) .EQ. N) GOTO 25                                                   BISAM
        5   LL = N/4                                                                  BISAM
            L1 = LL                                                                   BISAM
            L2 = LL                                                                   BISAM
            L3 = LL                                                                   BISAM
            L4 = LL                                                                   BISAM
            IBRAN = MOD(N,4) + 1                                                      BISAM
            GOTO (20,11,12,13),IBRAN                                                  BISAM
       11   CONTINUE                                                                  BISAM
            L4 = LL + 1                                                               BISAM
            GO TO 20                                                                  BISAM
       12   CONTINUE                                                                  BISAM
            L1 = LL + 1                                                               BISAM
            L4 = LL + 1                                                               BISAM
            GO TO 20                                                                  BISAM
       13   CONTINUE                                                                  BISAM
            L2 = LL + 1                                                               BISAM
            L3 = LL + 1                                                               BISAM
            L4 = LL + 1                                                               BISAM
       20   CONTINUE                                                                  BISAM
            L(1)=L1                                                                   BISAM
            L(2)=L(1) + L2                                                            BISAM
            L(3)=L(2) + L3                                                            BISAM
            L(4)=L(3) + L4                                                            BISAM
      C     PRINT DATA ARRAY - ONE COLUMN FOR EACH QUARTER.                           BISAM
       25   WRITE(NUNIT,1001) NAME                                                    BISAM
            WRITE(NUNIT,1020) INHEAD                                                  BISAM
            IF(IOUT.EQ.0) GOTO 35                                                     BISAM
            WRITE(NUNIT,1002)                                                         BISAM
            WRITE(NUNIT,1003)                                                         BISAM
            DO 30 I = 1,LL                                                            BISAM
       30   WRITE(NUNIT,1004) I,X(I),X(L(1) + I),X(L(2)+I),X(L(3) + I)                BISAM
            WRITE(NUNIT,1005)                                                         BISAM
            IF(L1 .GT. LL) WRITE(NUNIT,1006) X(L(1))                                  BISAM
            IF(L2 .GT. LL) WRITE(NUNIT,1007) X(L(2))                                  BISAM
            IF(L3 .GT. LL) WRITE(NUNIT,1008) X(L(3))                                  BISAM
            IF(L4 .GT. LL) WRITE(NUNIT,1009) L4,X(L(4))                               BISAM
       35   IF(INIT .EQ. 1) RETURN                                                    BISAM
      C     COMPUTE AND PRINT DESCRIPTIVE STATISTICS.                                 BISAM
            K = 1                                                                     BISAM
            S = 0.                                                                    BISAM
            SSQ = 0.                                                                  BISAM
            DO 50 I = 1,4                                                             BISAM
            SI = 0.0                                                                  BISAM
            SQI = 0.0                                                                 BISAM
            KK = L(I)                                                                 BISAM
            DO 40 J = K,KK                                                            BISAM
            SI = SI + X(J)                                                            BISAM
            SQI = SQI + X(J)*X(J)                                                     BISAM
       40   CONTINUE                                                                  BISAM
            K = 1 + L(I)                                                              BISAM
            S = S + SI                                                                BISAM
            SSQ = SSQ + SQI                                                           BISAM
            SUM(I) = SI                                                               BISAM
            SUMSQ(I) = SQI                                                            BISAM
       50   CONTINUE                                                                  BISAM
            IF(IOUT.EQ.0) GO TO 55                                                    BISAM
            WRITE(NUNIT,1010) (SUM   (I),I=1,4)                                       BISAM
            WRITE(NUNIT,1011) (SUMSQ (I),I=1,4)                                       BISAM
       55   XBAR = S/FLOAT(N)                                                         BISAM
            VAR = (SSQ -S*XBAR)/FLOAT(N-1)                                            BISAM
            SD = SQRT(VAR)                                                            BISAM
            Q25 = QFIND(X,N,.25)                                                      BISAM
            Q50 = QFIND(X,N,.50)                                                      BISAM
            Q75 = QFIND(X,N,.75)                                                      BISAM
            Q10 = Q75 - Q25                                                           BISAM
            XBARIQ = (XBAR - Q50) / (2. * Q10)                                        BISAM
            SDIQ   = SD / (2. * Q10)                                                  BISAM
            SDIQLG = ALOG(SDIQ)                                                       BISAM
            SSQN=SSQ/FLOAT(N)                                                         BISAM
            TRIMN = (Q25+2.*Q50+Q75)*.25                                              BISAM
            GASTY = .3*QFIND(X,N,1./3.)+.4*Q50+.3*QFIND(X,N,2./3.)                    BISAM
            WRITE(NUNIT,1012)                                                         BISAM
            WRITE(NUNIT,1013) N,Q25,Q50,Q75,Q10,TRIMN,GASTY                           BISAM
            WRITE(NUNIT,1014) SSQN,XBAR,VAR,SD,XBARIQ,SDIQ,SDIQLG                    BISAM
            WRITE(NUNIT,1016)                                                         BISAM
            DO 60 I = 1,3                                                             BISAM
            IG = INT(ALF(I)*FLOAT(N))                                                 BISAM
            N = N -2*IG                                                               BISAM
            NMGM1 = N - IG - 1                                                        BISAM
            IGP2 = IG + 2                                                             BISAM
            TRM = X(IG+1)+X(N-IG)                                                     BISAM
            WMN = X(IG+1)*FLOAT(IG) + X(N-IG)*FLOAT(IG)                               BISAM
            DO 70 J = IGP2,NMGM1                                                      BISAM
            TRM = TRM + X(J)                                                          BISAM
            WMN = WMN + X(J)                                                          BISAM
       70   CONTINUE                                                                  BISAM
            TRM = TRM/N                                                               BISAM
            WMN = WMN/FLOAT(N)                                                        BISAM
            WRITE(NUNIT,1017) ALF(I),WMN,TRM                                          BISAM
       60   CONTINUE                                                                  BISAM
        999 CONTINUE                                                                  BISAM
            RETURN                                                                    BISAM
       1001 FORMAT(///T20,20A4)                                                       BISAM
       1002 FORMAT(/T40,'ORDER STATISTICS IN QUARTERS'/T40,25(1H=))                   BISAM
       1003 FORMAT(T20,' SEQUENCE'/T20,'   WITHIN'/T20,' QUARTILE   ',               BISAM
           +'FIRST QUARTER  SECOND QUARTER   THIRD QUARTER  FOURTH QUARTER'          BISAM
           +,/T21,8(1H=),2(3X,13(1H=),2X,14(1H=)))                                  BISAM
       1004 FORMAT(T20,I8 , 4(1X,F15.4))                                          BISAM
       1005 FORMAT(1X)                                                            BISAM
       1006 FORMAT(1H+,T29,F15.4)                                                 BISAM
       1007 FORMAT(1H+,T45,F15.4)                                                 BISAM
       1008 FORMAT(1H+,T61,F15.4)                                                 BISAM
       1009 FORMAT(1H+,T20,I8,T77,F15.4)                                          BISAM
       1010 FORMAT(1HO,T20,'SUM',5X,4(1X,F15.4))                                  BISAM
       1011 FORMAT(1HO,T20,'SUM OF'/T20,' SQUARES',1X,4(1X,F15.4))                BISAM
       1012 FORMAT(///T45,'DESCRIPTIVE  STATISTICS'/T45,23(1H=))                  BISAM
       1013 FORMAT(//' SUMSTAT',T20,'SAMPLE',T35,'   LOWER',T52,'   UPPER  ',     BISAM
           +       T64,'INT_QUARTL',T88,'EASTWIRTHS'/' SUMSTAT',T20,' SIZE'      BISAM
           +      ,T35,' QUARTILE',T69,'   MEDIAN',T82,' QUARTILE',              BISAM
           +       T64,'   RANGE',T78,' TRIMEAN',T86,' ESTIMATE'                  BISAM
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      *       ,//' SUMSTAT',T20,I5,T29,6(G11.4,1X))                    BISAM
1014  FORMAT(///' SUMSTAT',T20,'SUMSQ/N',T40,' MEAN',T60,' VARIANCE',T82,  BISAM
     *       ' STD DEV',T96,'MEAN 10',T116,'STD DEV 10',T88,           BISAM
     *       'LOG STD 10'//' SUMSTAT',T10,7(G11.4,1X))                 BISAM
1016  FORMAT(///T40,'TRUNCATION',T82,'WINSORIZED',T84,'  TRIMMED'/      BISAM
     *       T40,'  POINT',T82,'   MEAN',T84,'   MEAN'/)                BISAM
1017  FORMAT(T40,F7.3,T82,2(G11.4,1X))                                 BISAM
 1030 FORMAT(T20,20A4)                                                 BISAM
      END                                                              BISAM
      SUBROUTINE FCDBEA(X,IFORM,NAME)                                  BISAM
C*****************************************************               BISAM
C   SUBROUTINE TO CONVERT REAL VARIABLE X                              BISAM
C   WHICH HAS 4 CHARACTER F-FORMAT IFORM                               BISAM
C   TO 8 CHARACTER ALPHAMERIC ARRAY NAME WHICH IS                      BISAM
C   IN A FORMAT.                                                       BISAM
C   INPUT  : NSCRCH : SCRATCH TAPE NUMBER                              BISAM
C            X, IFORM                                                  BISAM
C   OUTPUT : NAME(1),NAME(2) : 4 CHARACTERS EACH                       BISAM
C*****************************************************               BISAM
      DIMENSION NAME(2),IFORM(2)                                       BISAM
      NSCRCH = 11                                                      BISAM
      REWIND NSCRCH                                                    BISAM
      WRITE(NSCRCH,IFORM)X                                             BISAM
      REWIND NSCRCH                                                    BISAM
      READ(NSCRCH,10)NAME                                              BISAM
   10 FORMAT(2A4)                                                      BISAM
      RETURN                                                           BISAM
      END                                                              BISAM
      SUBROUTINE FORIER(F,U,N,A,MA)                                    BISAM
C*****************************************************************   BISAM
C   SUBROUTINE TO COMPUTE THE FOURIER TRANSFORM                        BISAM
C   PHI(V) OF A DENSITY DEFINED ON (0,1) FOR V=0,1,...,M               BISAM
C   INPUT :                                                            BISAM
C           F,U,N : VECTORS OF LENGTH N CONTAINING F(U),U              BISAM
C           MA  : MAXIMUM VALUE OF V FOR WHICH PHI(V) IS COMPUTED      BISAM
C   OUTPUT : A  : COMPLEX-VALUED VECTOR CONTAINING THE PHI'S           BISAM
C   SUBROUTINES CALLED : NONE                                          BISAM
C*****************************************************************   BISAM
      DIMENSION F(N),U(N)                                              BISAM
      COMPLEX A(MA),Z                                                  BISAM
      TWOPI=8.*ATAN(1.)                                                BISAM
      FN=FLOAT(N)                                                      BISAM
      DO 20 IM=1,MA                                                    BISAM
      FIM=IM-1                                                         BISAM
      A(IM)=CMPLX(0.,0.)                                               BISAM
      DO 10 I=1,N                                                      BISAM
         Z=CMPLX(0.,TWOPI*FIM*U(I))                                    BISAM
   10    A(IM)=A(IM)+F(I)*CEXP(Z)                                      BISAM
      A(IM)=A(IM)/FLOAT(N)                                             BISAM
   20 CONTINUE                                                         BISAM
      A(1)=CMPLX(1.,0.)                                                BISAM
      RETURN                                                           BISAM
      END                                                              BISAM
      FUNCTION FOFNC(X,IDON)                                           BISAM
C*****************************************************               BISAM
C  ROUTINE TO COMPUTE THE VARIOUS DENSITY-QUANTILE FUNCTIONS           BISAM
C       INPUT:                                                         BISAM
C             X - VALUE AT WHICH THE FUNCTION IS TO BE COMPUTED        BISAM
C             IDON - INDICATOR FOR THE DESIRED FUNCTION,               BISAM
C                    MUST BE IN THE EXCLUSIVE RANGE 1-11               BISAM
C*****************************************************               BISAM
      COMMON /PARM/ BETAP,BETAW                                        BISAM
      GO TO(1,2,3,4,5,6,7,8,9,10,11),IDON                              BISAM
C  COMPUTE THE NORMAL                                                  BISAM
    1 CONTINUE                                                         BISAM
      IF( X .LT. .001) GO TO 101                                       BISAM
      IF( X .GT. .999) GO TO 101                                       BISAM
      PI=4.*ATAN(1.0)                                                  BISAM
      CALL MDNRIS(X,Y,IER)                                             BISAM
      FOOO=EXP(-0.5*Y**2)/(SQRT(2.*PI))                                BISAM
      FOFNC = FOOO                                                     BISAM
      GO TO 99                                                         BISAM
  101 FOOO=0.                                                          BISAM
      FOFNC = FOOO                                                     BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE EXPONENTIAL                                             BISAM
    2 CONTINUE                                                         BISAM
      FOOO=1.-X                                                        BISAM
      FOFNC = FOOO                                                     BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE LOGISTIC                                                BISAM
    3 CONTINUE                                                         BISAM
      FOFNC = X*(1. - X)                                               BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE DOUBLE EXPONENTIAL                                      BISAM
    4 CONTINUE                                                         BISAM
      IF(X .LE. .5) FOFNC = X                                          BISAM
      IF(X .GT. .5) FOFNC = 1. - X                                     BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE UNIFORM RECIPROCAL                                      BISAM
    5 CONTINUE                                                         BISAM
      FOFNC = (1. - X)**2                                              BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE CAUCHY                                                  BISAM
    6 CONTINUE                                                         BISAM
      PI = 4.*ATAN(1.0)                                                BISAM
      FOFNC = SIN(PI*X)**2/PI                                          BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE EXTREME VALUE                                           BISAM
    7 CONTINUE                                                         BISAM
      IF(X .EQ. 1.) GO TO 102                                          BISAM
      FOFNC = (X - 1.)*ALOG(1. - X)                                    BISAM
      GO TO 99                                                         BISAM
  102 CONTINUE                                                         BISAM
      FOFNC = 0.                                                       BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE LOG NORMAL                                              BISAM
    8 CONTINUE                                                         BISAM
      IF(X .EQ. 1.) GO TO 102                                          BISAM
      IF(X .EQ. 0.) GO TO 103                                          BISAM
      CALL MDNRIS(X,Y,IER)                                             BISAM
      PI = 4.*ATAN(1.0)                                                BISAM
      FOFNC = (-0.5*Y**2-Y)/SQRT(2.*PI)                                BISAM
      FOFNC = EXP(FOFNC)                                               BISAM
      GO TO 99                                                         BISAM
  103 FOFNC = 0.0                                                      BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE PARETO                                                  BISAM
    9 CONTINUE                                                         BISAM
      FOFNC = (1.-X)**(1./BETAP)/BETAP                                 BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE WEIBULL                                                 BISAM
   10 CONTINUE                                                         BISAM
      IF(X .EQ. 1.) GO TO 104                                          BISAM
      FOFNC = (1.-X)*(-ALOG(1.-X))**(1./BETAW)/BETAW                   BISAM
      GO TO 99                                                         BISAM
  104 CONTINUE                                                         BISAM
      FOFNC = 0.                                                       BISAM
      GO TO 99                                                         BISAM
C  COMPUTE THE HALF LOGISTIC                                           BISAM
   11 CONTINUE                                                         BISAM
      FOFNC=1.-X**2                                                    BISAM
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      99    RETURN                                                          01SAM
            END                                                             01SAM
            SUBROUTINE FYSRP(U,V,X,F,N,M)                                   01SAM
      C*****************************************************************  01SAM
      C                                                                     01SAM
      C   SUBROUTINE TO PERFORM LINEAR INTERPOLATION ON V TO                01SAM
      C   OBTAIN F AT THE M X VALUES                                        01SAM
      C                                                                     01SAM
      C     INPUT: U - VECTOR OF VALUES AT WHICH V EVALUATED                01SAM
      C            V - FUNCTION VALUES TO INTERPOLATE                       01SAM
      C            X - VALUES AT WHICH INTERPOLATED FUNCTION TO BE          01SAM
      C                EVALUATED                                            01SAM
      C            N - DIMENSION OF VECTORS U AND V                         01SAM
      C            M - DIMENSION OF VECTORS X AND F                         01SAM
      C                                                                     01SAM
      C   NOTE: ALL ABSCISSA VECTORS MUST BE ORDERED                        01SAM
      C                                                                     01SAM
      C   OUTPUT: F - INTERPOLATED FUNCTION VALUES                          01SAM
      C                                                                     01SAM
      C*****************************************************************  01SAM
            DIMENSION U(N),V(N),X(M),F(M)                                   01SAM
            IF(N.EQ.M) GO TO 100                                            01SAM
            II=1                                                            01SAM
            DO 60 I=1,M                                                     01SAM
        10  IF(X(I)-U(II))20,40,50                                          01SAM
        20  IF(II.NE.1) GO TO 30                                            01SAM
            F(I)=V(1)+(V(2)-V(1))*(X(I)-U(1))/(U(2)-U(1))                   01SAM
            GO TO 60                                                        01SAM
        30  F(I)=V(II-1)+(V(II)-V(II-1))*(X(I)-U(II-1))/(U(II)-U(II-1))     01SAM
            GO TO 60                                                        01SAM
        40  F(I)=V(II)                                                      01SAM
            GO TO 60                                                        01SAM
        50  II=II+1                                                         01SAM
            IF(II.LT.N) GO TO 10                                            01SAM
            II=N                                                            01SAM
            GO TO 30                                                        01SAM
        60  CONTINUE                                                        01SAM
       100  RETURN                                                          01SAM
            END                                                             01SAM
            SUBROUTINE ICODEA(K,IFORM,NAME)                                 01SAM
      C*****************************************                           01SAM
      C   SUBROUTINE TO CONVERT INTEGER VARIABLE K                         01SAM
      C   WHICH HAS A CHARACTER I-FORMAT IFORM                             01SAM
      C   TO A CHARACTER ALPHAMERIC ARRAY NAME WHICH IS                    01SAM
      C   IN A-FORMAT.                                                     01SAM
      C   INPUT  : NSCRCH : SCRATCH TAPE NUMBER                           01SAM
      C            K, IFORM                                               01SAM
      C   OUTPUT : NAME(1),NAME(2) : 4 CHARACTERS EACH                     01SAM
      C*****************************************                           01SAM
            DIMENSION NAME(2),IFORM(2)                                      01SAM
            NSCRCH=11                                                       01SAM
            REWIND NSCRCH                                                   01SAM
            WRITE(NSCRCH,IFORM)K                                            01SAM
            REWIND NSCRCH                                                   01SAM
            READ(NSCRCH,10)NAME                                             01SAM
        10 FORMAT(2A4)                                                      01SAM
            RETURN                                                          01SAM
            END                                                             01SAM
            SUBROUTINE KENDAL(N,TAUA,TAUB,SOMER,NC,ND,NIND,NDEP,NPAIRS)     01SAM
      C                                                                     01SAM
      C*****************************************************************  01SAM
      C                                                                     01SAM
      C   SUBROUTINE TO COMPUTE KENDALL'S TAU-A AND TAU-B (FOR TIED        01SAM
      C   RANKS), AND SOMER'S D.                                           01SAM
      C                                                                     01SAM
      C   INPUT: RANKX - THE VECTOR OF RANKS OF THE INDEPENDENT VARIABLE    01SAM
      C          RANKY - THE VECTOR OF RANKS OF THE DEPENDENT VARIABLE      01SAM
      C          N - NUMBER OF PAIRED OBSERVATIONS.                         01SAM
      C                                                                     01SAM
      C   OUTPUT: TAUA - KENDALL'S TAU-A ASSUMING NO TIES.                  01SAM
      C           TAUB - KENDALL'S TAU-B FOR TIED RANKS.                    01SAM
      C           SOMER - SOMER'S D FOR TIED RANKS IN THE DEPENDENT         01SAM
      C                   VARIABLE.                                         01SAM
      C           NC - NUMBER OF CONCORDANT PAIRS                           01SAM
      C           ND - NUMBER OF DISCORDANT PAIRS                           01SAM
      C           NIND - NUMBER OF PAIRS WITH TIES IN THE INDEPENDENT       01SAM
      C                  VARIABLE BUT NOT IN THE DEPENDENT VARIABLE         01SAM
      C           NDEP - NUMBER OF PAIRS WITH TIES IN THE DEPENDENT         01SAM
      C                  VARIABLE BUT NOT IN THE INDEPENDENT VARIABLE       01SAM
      C           NPAIRS - NUMBER OF PAIRS OF BIVARIATE OBSERVATIONS        01SAM
      C                                                                     01SAM
      C   SUBROUTINES CALLED: ORD2                                         01SAM
      C                                                                     01SAM
      C*****************************************************************  01SAM
      C                                                                     01SAM
            COMMON /DATAR/ X(500),Y(500),RANKX(500),RANKY(500)              01SAM
            DIMENSION T1(500,2)                                             01SAM
            DO 10 I=1,N                                                     01SAM
            T1(I,1)=RANKX(I)                                                01SAM
            T1(I,2)=RANKY(I)                                                01SAM
        10  CONTINUE                                                        01SAM
      C                                                                     01SAM
      C   INITIALIZE NC,ND,NIND,NDEP AND BEGIN COUNTING PROCEDURE          01SAM
      C                                                                     01SAM
            NC=0                                                            01SAM
            ND=0                                                            01SAM
            NIND=0                                                          01SAM
            NDEP=0                                                          01SAM
            I=1                                                             01SAM
        20  K=I+1                                                           01SAM
        30  IF(K.GT.N) GO TO 60                                             01SAM
      C                                                                     01SAM
      C   CHECK IF RANKS ARE EQUAL                                         01SAM
      C                                                                     01SAM
      C   TOLERANCE FOR REAL ARITHMETIC: ASSUME X=0 IF ABS(X).LE.0.E-6     01SAM
      C                                                                     01SAM
            TEST1=ABS(T1(I,1)-T1(K,1))                                      01SAM
            IF(TEST1.GT.0.E-6) GO TO 40                                     01SAM
            TEST2=ABS(T1(I,2)-T1(K,2))                                      01SAM
            IF(TEST2.GT.0.E-6) NIND=NIND+1                                  01SAM
            K=K+1                                                           01SAM
            GO TO 30                                                        01SAM
      C                                                                     01SAM
      C   COUNT NUMBER OF CONCORDANT AND DISCORDANT PAIRS                   01SAM
      C                                                                     01SAM
        40  DO 50 J=K,N                                                     01SAM
            IF(T1(J,2)-T1(I,2).GT.0.E-6) NC=NC+1                            01SAM
            IF(T1(J,2)-T1(I,2).LT.-0.E-6) ND=ND+1                           01SAM
        50  CONTINUE                                                        01SAM
        60  I=I+1                                                           01SAM
            IF(I.LT.N) GO TO 20                                             01SAM
      C                                                                     01SAM
      C   SWITCH COLUMNS OF T1                                             01SAM
      C                                                                     01SAM
            DO 70 I=1,N                                                     01SAM
            T1(I,2)=RANKX(I)                                                01SAM
            T1(I,1)=RANKY(I)                                                01SAM
        70  CONTINUE                                                        01SAM
      C                                                                     01SAM
      C   ORDER BY V VALUES AND COMPUTE NDEP                               01SAM
      C                                                                     01SAM
            CALL ORD2(T1,N,500)                                             01SAM
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      I=1
   80 K=I+1
   90 IF(K.GT.N) GO TO 100
      TEST1=ABS(T1(I,1)-T1(K,1))
      IF(TEST1.GT.5.E-6) GO TO 100
      TEST2=ABS(T1(I,2)-T1(K,2))
      IF(TEST2.GT.5.E-6) NDEP=NDEP+1
      K=K+1
      GO TO 90
  100 I=I+1
      IF(I.LT.N) GO TO 80
C
C    COMPUTE NONPARAMETRIC CORRELATION COEFFICIENTS BASED ON
C    NUMBER OF CONCORDANT AND DISCORDANT PAIRS
C
      XNUM=FLOAT(NC-ND)
      NPAIRS=N*(N-1)/2
      ADENOM=FLOAT(NPAIRS)
      BDENOM=SQRT(FLOAT(NC+ND+NDEP)*FLOAT(NC+ND+NIND))
      SDENOM=FLOAT(NC+ND+NDEP)
      TAUA=XNUM/ADENOM
      TAUB=XNUM/BDENOM
      SOMER=XNUM/SDENOM
      RETURN
      END
      SUBROUTINE KSD(D,U,N,DM,UM,DP,UP)
C*****************************************************
C    SUBROUTINE TO COMPUTE KOMOLGOROV-SMIRNOFF STATISTIC FOR
C    THE DEVIATIONS D(U)-U.  UPPER AND LOWER BOUNDS ARE GIVEN.
C    INPUT : D,U,N
C    OUTPUT :
C           DP,UP : MAX (+) DEVIATION, DP, WHICH IS AT U=UP
C           DM,UM : MAX (-) DEVIATION, DM, WHICH IS AT U=UM
C    SUBROUTINES CALLED : NONE
C*****************************************************
      DIMENSION D(N),U(N)
      SQN = SQRT(FLOAT(N))
      DP = (D(1) - U(1))
      UP = U(1)
      DM = DP
      UM = UP
      DO 10   I = 2,N
      DT = (D(I) - U(I) )
      IF(DT .LE. DP) GOTO 1
      UP = U(I)
      DP = DT
      GOTO 10
1     IF(DT .GE. DM) GOTO 10
      UM = U(I)
      DM = DT
   10 CONTINUE
      DP = SQN*DP
      DM = SQN*DM
      RETURN
      END
      SUBROUTINE MAX(X,N,XMAX,IND)
C*****************************************************
C
C    SUBROUTINE TO FIND THE MAXIMUM VALUE (XMAX) AND THE
C    INDEX OF THE MAXIMUM VALUE (IND) OF A VECTOR X OF
C    LENGTH N.
C
C    INPUT :
C           N,X(1),...,X(N)
C
C    OUTPUT :
C           XMAX,IND
C
C    SUBROUTINES CALLED : NONE
C
C*****************************************************
C
      DIMENSION X(N)
C
      XMAX=X(1)
      IND=1
      IF(N.EQ.1) RETURN
C
      DO 1 I=2,N
      IF(XMAX.LT.X(I)) IND=I
    1 XMAX=X(IND)
C
      RETURN
      END
      SUBROUTINE MORRIS (P,Y,IER)
C    QUANTILE FUNCTION FOR N(0,1)
      DIMENSION A(65),C(17),D(25),E(23)
      EQUIVALENCE (A(24),C(1)),(A(41),D(1)),  (A(1),E(1)) )
      DATA E/.99288537665180040,.12046751614310 4,
     +      .01607819934210 0,.00258870443716 2,
     +      .00043963473023 5,.00007885021859 9,
     +      .00000203581276 4,.00000432727161 8,
     +      .00000052808141 3,.00000020673472 1,
     +      .00000004615965 9,.00000001041868 0,
     +      .00000000237150 1,.00000000054302 6,
     +      .00000000012554 9,.00000000002913 6,
     +      .00000000000679 5,.00000000000159 1,
     +      .00000000000037 4,.00000000000008 8,
     +      .00000000000002 1,.00000000000000 5,
     +      .00000000000000 1/
      DATA C/.91215880341785 4,-.01626628186768 4,
     +      .00043355647294 9,.00021443587007 4,
     +      .00000262575810 7 6,-.00000302109105 0,
     +      -.00000001240606 2,.00000000624066 9,
     +      -.00000000054012 5,-.00000000142320 8,
     +      .00000000003438 4,.00000000002358 5,
     +      -.00000000000145 8,-.00000000000081 0,
     +      .00000000000005 3,.00000000000002 0,
     +      -.00000000000000 2/
      DATA D/.95667970902049 3,-.02310700430906 5,
     +      -.00437423609750 8,-.00057650342265 1,
     +      -.00001096102230 7,.00002510854702 5,
     +      .00001056233604 8,.00000275441233 0,
     +      .00000043248449 6,-.00000002053023 7,
     +      -.00000004389153 7,-.00000001768401 0,
     +      -.00000000399128 9,-.00000000018693 2,
     +      .00000000027292 3,.00000000013261 7,
     +      .00000000003183 4,.00000000000167 0,
     +      -.00000000000203 6,-.00000000000096 5,
     +      -.00000000000022 0,-.00000000000001 0,
     +      .00000000000001 3,.00000000000000 6,
     +      .00000000000000 1/
      DATA N1,N2,N3,N4,N5/-1.64881304233 3,
     +      2.6564001231478,-.55945763132082,
     +      2.2879187182634,-1.4142135623731/
      XINF=2**31-1
      X = 1.-P-P
      IER = 0
      SIGMA = SIGN(1.,X)
      IF( .NOT.(X.GT.-1..AND.X.LT.1.)) GO TO 45
      Z = ABS(X)
      IF(Z .GT. .8) GO TO 25
```

```
      W = 2*Z/.32-1.                                                    01SAM
      N = 32                                                            01SAM
      IPP = 1                                                           01SAM
      L = 1                                                             01SAM
   10 LB2 = 1                                                           01SAM
      H3 = 1.                                                           01SAM
      H4 = W                                                            01SAM
      H5 = A(IPP)                                                       01SAM
   15 H5 = H5 + A(IPP+LB2) * H4                                         01SAM
      H5 = H5 * W + 2.*H3                                               01SAM
      H3 = H4                                                           01SAM
      H4 = H5                                                           01SAM
      LB2 = LB2 + 1                                                     01SAM
      IF(LB2 .LE. N) GO TO 15                                           01SAM
      GO TO (20,25),L                                                   01SAM
   20 Y = Z * H5 * SIGMA                                                01SAM
      GO TO 40                                                          01SAM
   25 Z = SQRT(-ALOG(1.-Z*Z))                                           01SAM
      IF(Z .GT. .0975) GO TO 30                                         01SAM
      W = W*Z+H2                                                        01SAM
      IPP = 24                                                          01SAM
      L = 2                                                             01SAM
      N = 16                                                            01SAM
      GO TO 10                                                          01SAM
   30 W = H3 * Z + H4                                                   01SAM
      IPP = 41                                                          01SAM
      N = 24                                                            01SAM
      L = 2                                                             01SAM
      GO TO 10                                                          01SAM
   35 Y = Z * H6 * SIGMA                                                01SAM
   40 Y = H2*Y                                                          01SAM
      RETURN                                                            01SAM
   45 Y = SIGMA*XINF                                                    01SAM
      ISR = 129                                                         01SAM
      WRITE(6,101)                                                      01SAM
  101 FORMAT(//////////1X,35H*****ERROR CONDITION IN NORRIS*****  ///)  01SAM
      RETURN                                                            01SAM
      END                                                               01SAM
      SUBROUTINE MIN(X,N,XMIN,IND)                                      MIN   01SAM
C*****************************************************                MIN   01SAM
C                                                                       MIN   01SAM
C   SUBROUTINE TO FIND THE MINIMUM VALUE (XMIN) AND THE                 MIN   01SAM
C   INDEX OF THE MINIMUM VALUE (IND) OF A VECTOR X OF                   MIN   01SAM
C   LENGTH N.                                                           MIN   01SAM
C                                                                       MIN   01SAM
C   INPUT :                                                             MIN   01SAM
C           N,X(1),....,X(N)                                            MIN   01SAM
C                                                                       MIN   01SAM
C   OUTPUT :                                                            MIN   01SAM
C           XMIN,IND                                                    MIN   01SAM
C                                                                       MIN   01SAM
C   SUBROUTINES CALLED : NONE                                           MIN   01SAM
C                                                                       MIN   01SAM
C*****************************************************                MIN   01SAM
C                                                                       MIN   01SAM
      DIMENSION X(N)                                                    MIN   01SAM
C                                                                       MIN   01SAM
      XMIN=X(1)                                                         MIN   01SAM
      IND=1                                                             MIN   01SAM
      IF(N.EQ.1) RETURN                                                 MIN   01SAM
C                                                                       MIN   01SAM
      DO 1 I=2,N                                                        MIN   01SAM
      IF(XMIN.GT.X(I)) IND=I                                            MIN   01SAM
    1 XMIN=X(IND)                                                       MIN   01SAM
C                                                                       MIN   01SAM
      RETURN                                                            MIN   01SAM
      END                                                               MIN   01SAM
      SUBROUTINE MINMAX(A,IA,M,N,XMIN,XMAX)                             01SAM
C*****************************************************************    01SAM
C                                                                       01SAM
C   ROUTINE TO FIND THE MINIMUM AND MAXIMUM VALUES OF A MATRIX          01SAM
C                                                                       01SAM
C   INPUT: N,M,A(N,M),IA=ROW DIMENSION OF A IN CALLING PROGRAM          01SAM
C                                                                       01SAM
C   OUTPUT: XMIN,XMAX                                                   01SAM
C                                                                       01SAM
C   SUBROUTINES CALLED: NONE                                            01SAM
C                                                                       01SAM
C*****************************************************************    01SAM
C                                                                       01SAM
      DIMENSION A(IA,N)                                                 01SAM
      XMIN=A(1,1)                                                       01SAM
      XMAX=A(1,1)                                                       01SAM
      DO 10 I=1,M                                                       01SAM
      DO 10 J=1,N                                                       01SAM
      IF(A(I,J).GT.XMAX)XMAX=A(I,J)                                     01SAM
      IF(A(I,J).LT.XMIN)XMIN=A(I,J)                                     01SAM
   10 CONTINUE                                                          01SAM
      RETURN                                                            01SAM
      END                                                               01SAM
      SUBROUTINE SRD2(X,N,NDIM)                                         01SAM
C                                                                       01SAM
C*****************************************************                01SAM
C                                                                       01SAM
C   SUBROUTINE TO SORT THE NX2-MATRIX X FROM SMALLEST TO                01SAM
C   LARGEST VALUE OF THE FIRST COLUMN. X IS SORTED IN PLACE.            01SAM
C                                                                       01SAM
C   THE SORTING ALGORITHM IS DUE TO D. L. SHELL (COMM. ACM,             01SAM
C   JULY 1959), AND IS FOUND IN KIRCH, A.(1972)                         01SAM
C   'INTRO. TO STATISTICS WITH FORTRAN',NEW YORK:                       01SAM
C   HOLT,RINEHART, AND WINSTON. P. 347.                                 01SAM
C                                                                       01SAM
C*****************************************************                01SAM
C                                                                       01SAM
      DIMENSION X(NDIM,2)                                               01SAM
      L=N                                                               01SAM
    1 L=L/2                                                             01SAM
      IF(L)2,2,3                                                        01SAM
    2 RETURN                                                            01SAM
    3 M=N-L                                                             01SAM
      DO 6 I=1,M                                                        01SAM
      J=I                                                               01SAM
    4 JJ=J+L                                                            01SAM
      IF(X(J,1)-X(JJ,1))6,6,5                                           01SAM
C                                                                       01SAM
C   REPLACE ABOVE BY                                                    01SAM
C                                                                       01SAM
C     IF(X(J,1)-X(JJ,1))6,6,6                                           01SAM
C                                                                       01SAM
C   TO ORDER COLUMN 1 IN DESCENDING ORDER                               01SAM
C                                                                       01SAM
    5 X1=X(J,1)                                                         01SAM
      X2=X(J,2)                                                         01SAM
      X(J,1)=X(JJ,1)                                                    01SAM
      X(J,2)=X(JJ,2)                                                    01SAM
      X(JJ,1)=X1                                                        01SAM
      X(JJ,2)=X2                                                        01SAM
      J=J-L                                                             01SAM
      IF(J)6,6,4                                                        01SAM
    6 CONTINUE                                                          01SAM
      GO TO 1                                                           01SAM
      END                                                               01SAM
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      SUBROUTINE PAR2(RVAR,M,N,CAT,NORD)                                BISAM
C*****************************************************************    BISAM
C   SUBROUTINE TO DETERMINE THE ORDER OF AN AUTOREGRESSIVE            BISAM
C   PROCESS BY PARZENS CAT CRITERIA                                   BISAM
C   INPUT :                                                           BISAM
C           M,RVAR(1),...,RVAR(M) : STANDARDIZED RES VAR              BISAM
C           FOR ORDERS 1 THRU M.                                      BISAM
C           N : SAMPLE SIZE                                           BISAM
C   OUTPUT :                                                          BISAM
C           NORD : DETERMINED ORDER                                   BISAM
C           CAT(1),....,CAT(M)                                        BISAM
C   SUBROUTINES CALLED : MIN                                          BISAM
C*****************************************************************    BISAM
      DIMENSION RVAR(M),CAT(M)                                        BISAM
      ON=FLOAT(N)                                                     BISAM
      DO 1 J=1,M                                                      BISAM
         C=0.                                                         BISAM
         DO 2 J=1,J                                                   BISAM
    2    C=C+(1.-(FLOAT(J)/ON))/RVAR(J)                               BISAM
         C=C/ON                                                       BISAM
    1  CAT(I)=C-((1.-(FLOAT(I)/ON))/RVAR(I))                          BISAM
      CALL MIN(CAT,M,CATMI,NORD)                                      BISAM
      IF(CATMI.GT.-1.-3./ON) NORD=0                                   BISAM
      RETURN                                                          BISAM
      END                                                             BISAM
      SUBROUTINE PEARSN(N,R)                                          BISAM
C                                                                     BISAM
C*****************************************************************    BISAM
C                                                                     BISAM
C   SUBROUTINE TO COMPUTE PEARSON'S PRODUCT MOMENT CORRELATION        BISAM
C   COEFFICIENT.                                                      BISAM
C                                                                     BISAM
C   INPUT: X - THE VECTOR OF VALUES OF THE INDEPENDENT VARIABLE       BISAM
C          Y - THE VECTOR OF VALUES OF THE DEPENDENT VARIABLE         BISAM
C          N - THE NUMBER OF BIVARIATE OBSERVATIONS                   BISAM
C                                                                     BISAM
C   OUTPUT: R - PEARSON'S PRODUCT MOMENT CORRELATION COEFFICIENT      BISAM
C                                                                     BISAM
C*****************************************************************    BISAM
C                                                                     BISAM
      COMMON /DATAR/ X(500),Y(500),RANKX(500),RANKY(500)              BISAM
C                                                                     BISAM
C   INITIALIZE VALUES                                                 BISAM
C                                                                     BISAM
      SUMX=0.                                                         BISAM
      SUMY=0.                                                         BISAM
      SUMXY=0.                                                        BISAM
      SUMXX=0.                                                        BISAM
      SUMYY=0.                                                        BISAM
C                                                                     BISAM
C   COMPUTE SUMS OF SQUARES AND CROSS PRODUCTS                        BISAM
C                                                                     BISAM
      DO 10 I=1,N                                                     BISAM
      SUMX=SUMX+X(I)                                                  BISAM
      SUMY=SUMY+Y(I)                                                  BISAM
      SUMXY=SUMXY+X(I)*Y(I)                                           BISAM
      SUMXX=SUMXX+X(I)*X(I)                                           BISAM
      SUMYY=SUMYY+Y(I)*Y(I)                                           BISAM
   10 CONTINUE                                                        BISAM
C                                                                     BISAM
C   COMPUTE R                                                         BISAM
C                                                                     BISAM
      SXY=SUMXY-SUMX*SUMY/FLOAT(N)                                    BISAM
      SXX=SUMXX-SUMX*SUMX/FLOAT(N)                                    BISAM
      SYY=SUMYY-SUMY*SUMY/FLOAT(N)                                    BISAM
      R=SXY/SQRT(SXX*SYY)                                             BISAM
      RETURN                                                          BISAM
      END                                                             BISAM
      SUBROUTINE PLINE(NR,NC,NL,STRT,END,CHARL,PARRAY,VMIN,VMAX,VINC) BISAM
      DIMENSION STRT(NL),END(NL),CHARL(NL),PARRAY(NR,NC)              BISAM
      NCM1 = NC - 1                                                   BISAM
      FNC = 1. / FLOAT(NCM1)                                          BISAM
      NRP1 = NR + 1                                                   BISAM
C                                                                     BISAM
      DO 10 IL = 1,NL                                                 BISAM
      IF ( STRT(IL) - END(IL) ) 20,20,40                              BISAM
   20 STRT(IL) = AMAX1(STRT(IL),VMIN)                                 BISAM
      END(IL)  = AMIN1(END(IL) ,VMAX)                                 BISAM
      GOTO 60                                                         BISAM
   40 STRT(IL) = AMIN1(STRT(IL),VMAX)                                 BISAM
      END(IL)  = AMAX1(END(IL) ,VMIN)                                 BISAM
   60 DS = (END(IL) - STRT(IL)) * FNC * VINC                          BISAM
      S  = (STRT(IL) - VMIN   ) * VINC + 1.5                          BISAM
      IND = INT(S)                                                    BISAM
      DO 60 I = 2,NCM1                                                BISAM
      S = S + DS                                                      BISAM
      IF ( INT(S) .EQ. IND ) GOTO 60                                  BISAM
      IND = INT(S)                                                    BISAM
      PARRAY(NRP1-IND,I) = CHARL(IL)                                  BISAM
   60 CONTINUE                                                        BISAM
      GOTO 10                                                         BISAM
   30 IF ( STRT(IL) .LE. VMIN .OR. STRT(IL) .GE. VMAX) GOTO 10        BISAM
      IND = (STRT(IL) - VMIN) * VINC + 1.5                            BISAM
      DO 70 I = 2,NCM1                                                BISAM
      PARRAY(NRP1-IND,I) = CHARL(IL)                                  BISAM
   70 CONTINUE                                                        BISAM
   10 CONTINUE                                                        BISAM
      RETURN                                                          BISAM
      END                                                             BISAM
      SUBROUTINE PLOTXY(X,Y,N,CAPT,NAMX,NAMY,IOPT)                    BISAM
C*****************************************************************    BISAM
C                                                                     BISAM
C   SUBROUTINE TO PRINT AND PRINTER PLOT THE N-VECTOR Y AS A          BISAM
C   FUNCTION OF X.                                                    BISAM
C                                                                     BISAM
C   INPUT : N,X,Y - X IS ORDERED ON INPUT AND Y(I)=Y(X(I))            BISAM
C           CAPT - LITERAL CONSTANT FOR TITLE OF PLOT IN 20A4 FORMAT  BISAM
C           NAMX,NAMY : 4 CHARACTER LITERAL CONSTANTS GIVING          BISAM
C                       LABELS FOR X AND Y                            BISAM
C           IOPT : 1,2 (POINT OR BAR PLOT)                            BISAM
C                                                                     BISAM
C   SUBROUTINES CALLED : FTERP,MAX,MIN                                BISAM
C                                                                     BISAM
C*****************************************************************    BISAM
C                                                                     BISAM
      DIMENSION X(N),Y(N),T(46),YI(46),CAPT(20),AL(101)               BISAM
      DATA NOUT/6/                                                    BISAM
      DATA BLANK,DOT,Z,SL,PLUS/1H ,1H.,1H0,1H|,1H+/                   BISAM
C                                                                     BISAM
      NM=81                                                           BISAM
      IOPTY=0                                                         BISAM
      IF(N.GT.10) GO TO 11                                            BISAM
      WRITE(NOUT,10) N                                                BISAM
   10 FORMAT(10H,'SAMPLE SIZE OF ',I2,' IS TOO SMALL TO PERFORM ',    BISAM
     +'INTERPOLATION IN PLOTXY.')                                     BISAM
      GO TO 100                                                       BISAM
   11 CONTINUE                                                        BISAM
      WRITE(NOUT,13) CAPT                                             BISAM
   13 FORMAT(1H1,23X,20A4,/)                                          BISAM
C                                                                     BISAM
C   CREATE T VECTOR OF EQUALLY SPACED X AND INTERPOLATE TO OBTAIN     BISAM
C   CORRESPONDING Y VALUES                                            BISAM
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C                                                                       01SAM
      DEC=(X(N)-X(1))/46.0                                              01SAM
      DO 15 I=1,46                                                      01SAM
      T(I)=X(1)+FLOAT(I-1)*DEC                                          01SAM
   15 CONTINUE                                                          01SAM
      CALL PYBAP(X,V,Y,YI,N,46)                                         01SAM
C                                                                       01SAM
C  INITIALIZE AL :                                                      01SAM
C                                                                       01SAM
      BN=(MM-1)/2                                                       01SAM
      DO 20 J=1,MM                                                      01SAM
   20 AL(J)=DOT                                                         01SAM
      WRITE(NOUT,25) NAMX,NAMY,(AL(J),J=1,MM)                           01SAM
   25 FORMAT(/,10X,A6,6X,A4/10X,20(1H-),2X,101A1)                       01SAM
      DO 30 J=1,MM                                                      01SAM
   30 AL(J)=BLANK                                                       01SAM
      AL(1)=BL                                                          01SAM
      AL(MM)=BL                                                         01SAM
C                                                                       01SAM
C  FIND MAX AND MIN :                                                   01SAM
C                                                                       01SAM
      CALL MAX(V,46,YMAX,IND)                                           01SAM
      CALL MIN(V,46,YMIN,IND)                                           01SAM
      RY=1.2*(YMAX-YMIN)                                                01SAM
      IF(RY.LT.1.E-20) IOPTY=1                                          01SAM
C                                                                       01SAM
C  PLOT :                                                               01SAM
C                                                                       01SAM
      DO 40 J=1,46                                                      01SAM
      IF(IOPTY.EQ.1) GO TO 36                                           01SAM
      C1=(YI(J)-YMIN)/RY                                                01SAM
      C1=2.*(C1-.5)                                                     01SAM
      GO TO 37                                                          01SAM
   36 C1=0.                                                             01SAM
   37 K=BN*(C1+1.)+2.5                                                  01SAM
      AL(K)=I                                                           01SAM
      IF(IOPT.EQ.1) GO TO 35                                            01SAM
      DO 39 I=1,K                                                       01SAM
   39 AL(I)=I                                                           01SAM
   35 CONTINUE                                                          01SAM
      WRITE(NOUT,38) T(J),YI(J),(AL(I),I=1,MM)                          01SAM
   38 FORMAT(10X,F10.4,1X,F9.4,2X,101A1)                                01SAM
      AL(K)=BLANK                                                       01SAM
      IF(IOPT.EQ.1) GO TO 40                                            01SAM
      DO 41 I=2,K                                                       01SAM
   41 AL(I)=BLANK                                                       01SAM
   40 CONTINUE                                                          01SAM
      DO 50 I=1,MM                                                      01SAM
   50 AL(I)=DOT                                                         01SAM
      AL(1)=PLUS                                                        01SAM
      AL(MM)=PLUS                                                       01SAM
      WRITE(NOUT,60) (AL(I),I=1,MM)                                     01SAM
   60 FORMAT(10X,20(1H-),2X,101A1)                                      01SAM
C                                                                       01SAM
C                                                                       01SAM
      YMAX=RY+YMIN                                                      01SAM
      WRITE(NOUT,70) YMIN,YMAX                                          01SAM
   70 FORMAT(27X,F10.4,70X,F10.4)                                       01SAM
  100 CONTINUE                                                          01SAM
      RETURN                                                            01SAM
      END                                                               01SAM
      SUBROUTINE PPLOT(X,Y,IY,N,NFUN,CHAR,CAPT1,XNAME,YNAME,IOPT)       01SAM
C*****************************************************************    01SAM
C                                                                       01SAM
C  SUBROUTINE PPLOT PLOTS UP TO 5 FUNCTIONS ON THE SAME AXIS USING      01SAM
C  A DIFFERENT SYMBOL FOR EACH.                                         01SAM
C                                                                       01SAM
C  INPUT: X - VECTOR OF X VALUES, LENGTH=N                              01SAM
C         Y - VECTOR OR MATRIX OF Y VALUES, SIZE=N BY NFUN              01SAM
C         IY - ROWS ALLOCATED TO Y IN CALLING PROGRAM                   01SAM
C         N - NUMBER OF X-VALUES                                        01SAM
C         NFUN - NUMBER OF FUNCTIONS TO BE PLOTTED (<=5)                01SAM
C         CHAR - VECTOR OF LENGTH 5 CONTAINING CHARACTERS TO BE         01SAM
C                USED IN THE PLOT. (CHAR(1) IS USED FOR THE FIRST       01SAM
C                FUNCTION, CHAR(2) FOR THE SECOND, ETC.)                01SAM
C         CAPT1 - VECTOR OF LENGTH 20 TO BE USED FOR                    01SAM
C                 CAPTION ABOVE THE PLOT (20A4 FORMAT)                  01SAM
C         XNAME,YNAME - 2 VECTORS OF LENGTH 20 TO BE USED FOR           01SAM
C                 LABELS ON THE X AND Y AXES (20A1 FORMAT)              01SAM
C         IOPT - IOPT=0 --> SMALLEST POINT WILL BE DIRECTLY ON AXIS     01SAM
C                IOPT=1 --> SMALLEST POINT WILL BE SLIGHTLY AWAY        01SAM
C                FROM THE AXIS                                          01SAM
C                                                                       01SAM
C  SUBROUTINES CALLED: MINMAX                                           01SAM
C                                                                       01SAM
C  PROGRAMMER: PHIL SPECTOR                                             01SAM
C                                                                       01SAM
C*****************************************************************    01SAM
      DIMENSION PARRAY(56,76),XJ(16),YJ(16),INDY(5),CHAR(5),CAPT1(20),  01SAM
     &XNAME(20),YNAME(20),YNAME1(56),X(N),Y(IY,NFUN)                    01SAM
      DATA CAP1,PLUS,DASH,BM,BLANK/1H1,1H+,1H-,1HM,1H /                 01SAM
      DO 1 I=1,19                                                       01SAM
    1 YNAME1(I)=BLANK                                                   01SAM
      DO 2 I=1,20                                                       01SAM
    2 YNAME1(19+I)=YNAME(I)                                             01SAM
      DO 3 I=1,18                                                       01SAM
    3 YNAME1(38+I)=BLANK                                                01SAM
      LN=76                                                             01SAM
      LV=56                                                             01SAM
      LVP1=LV+1                                                         01SAM
      LVM1=LV-1                                                         01SAM
      CALL MINMAX(Y,IY,N,NFUN,YMIN,YMAX)                                01SAM
      CALL MINMAX(X,N,5,1,XMIN,XMAX)                                    01SAM
      IF(IOPT.EQ.1)YMIN=YMIN-1.1*((YMAX-YMIN)/FLOAT(LV-1))              01SAM
      IF(IOPT.EQ.1)XMIN=XMIN-1.1*((XMAX-XMIN)/FLOAT(LN-1))              01SAM
      YINC=(YMAX-YMIN)/FLOAT(LV-1)                                      01SAM
      XINC=(XMAX-XMIN)/FLOAT(LN-1)                                      01SAM
      IF(YINC.EQ.0.0)GO TO 99                                           01SAM
      DO 10 I=1,LV                                                      01SAM
      PARRAY(I,1)=CAP1                                                  01SAM
      DO 5 J=2,LN                                                       01SAM
      PARRAY(I,J)=BLANK                                                 01SAM
    5 CONTINUE                                                          01SAM
   10 CONTINUE                                                          01SAM
      PARRAY(1,1)=PLUS                                                  01SAM
      DO 11 I=1,LN                                                      01SAM
   11 PARRAY(1,I)=DASH                                                  01SAM
      J=0                                                               01SAM
      DO 12 I=1,LN,5                                                    01SAM
      J=J+1                                                             01SAM
      XJ(J)=XMIN+FLOAT(J)*5.*XINC                                       01SAM
   12 PARRAY(1,I)=PLUS                                                  01SAM
      J=0                                                               01SAM
      DO 13 I=1,LV,5                                                    01SAM
      J=J+1                                                             01SAM
      YJ(J)=YMIN+FLOAT(J)*5.*YINC                                       01SAM
   13 PARRAY(I,1)=PLUS                                                  01SAM
      DO 45 K=1,N                                                       01SAM
      INDX=(X(K)-XMIN)/XINC+1.0                                         01SAM
      DO 44 L=1,NFUN                                                    01SAM
   44 INDY(L)=(Y(K,L)-YMIN)/YINC+1.0                                    01SAM
      PARRAY(INDY(1),INDX)=CHAR(1)                                      01SAM
```

```
      IF(NPUN.EQ.1)GO TO 45                                              BISAM
      DO 44 I=2,NPUN                                                     BISAM
      IF(PARRAY(INDY(I),INDX).NE.BLANK)GO TO 49                          BISAM
      PARRAY(INDY(I),INDX)=CHAR(I)                                       BISAM
      GO TO 44                                                           BISAM
   49 PARRAY(INDY(I),INDX)=XM                                            BISAM
   44 CONTINUE                                                           BISAM
   45 CONTINUE                                                           BISAM
      WRITE(6,903)CAPT1                                                  BISAM
      K=4                                                                BISAM
      KOUNT=1                                                            BISAM
      DO 55 I=1,LVM1                                                     BISAM
      K=K+1                                                              BISAM
      IF(K.EQ.5)GO TO 50                                                 BISAM
      WRITE(6,906)VNAME1(I),(PARRAY(LVP1-I,J),J=1,LN)                    BISAM
      GO TO 55                                                           BISAM
   50 WRITE(6,906)VNAME1(I),VJ(12-KOUNT),(PARRAY(LVP1-I,J),J=1,LN)       BISAM
      KOUNT=KOUNT+1                                                      BISAM
      K=0                                                                BISAM
   55 CONTINUE                                                           BISAM
      WRITE(6,906)BLANK,VMIN,(PARRAY(1,J),J=1,LN)                        BISAM
      WRITE(6,915)HMIN,(HJ(I),I=2,16,2)                                  BISAM
      WRITE(6,915)(HJ(I),I=1,15,2)                                       BISAM
      WRITE(6,920)HNAME                                                  BISAM
      GO TO 100                                                          BISAM
   99 WRITE(6,901)                                                       BISAM
  100 CONTINUE                                                           BISAM
  901 FORMAT(1H ,'ERROR IN PPLOT: RANGE OF Y VALUES TOO SMALL')          BISAM
  902 FORMAT(1H1,20X,20A4)                                               BISAM
  905 FORMAT(2X,A1,15X,100A1)                                            BISAM
  906 FORMAT(2X,A1,3X,F10.3,2X,100A1)                                    BISAM
  915 FORMAT(12X,13(F9.4,1X))                                            BISAM
  916 FORMAT(15X,9(F9.4,1X))                                             BISAM
  920 FORMAT(46X,20A1)                                                   BISAM
      RETURN                                                             BISAM
      END                                                                BISAM
      FUNCTION QFIND(Q,N,QUANT)                                          BISAM
C*****************************************************************     BISAM
C     PURPOSE:  TO FIND THE PERCENTILE VALUE OF Q                       BISAM
C               AT QUANT.                                               BISAM
C     INPUT:                                                            BISAM
C           Q - VECTOR OF SIZE N                                        BISAM
C           N - NUMBER OF VALUES IN Y                                   BISAM
C           QUANT - QUANTILE VALUE                                      BISAM
C*****************************************************************     BISAM
      DIMENSION Q(N)                                                     BISAM
      P = FLOAT(N+1) * QUANT                                             BISAM
      I = INT(P)                                                         BISAM
      P = P-I                                                            BISAM
      IF(I .NE. 0) GOTO 1                                                BISAM
      QFIND = Q(1)                                                       BISAM
      RETURN                                                             BISAM
    1 IF(I .LT. N) GOTO 2                                                BISAM
      QFIND = Q(N)                                                       BISAM
      RETURN                                                             BISAM
    2 QFIND = (1.-P) * Q(I) + P * Q(I+1)                                 BISAM
      RETURN                                                             BISAM
      END                                                                BISAM
      SUBROUTINE QPLOT(X,Y,NY,XCHAR,XZ,Z,NZ,IZ,ZCHAR,IQRD,YMN,YMX,      BISAM
     &                 NLINE,STRT,END,CHARL,LX,LY,LC,LI)                 BISAM
C*****************************************************************     BISAM
C     ROUTINE TO DISPLAY PRINTER QUANTILE-BOX PLOT                      BISAM
C     INPUT :                                                           BISAM
C           X - VECTOR CONTAINING THE VALUES J/(NY+1) WHERE             BISAM
C               J=1,2,3,....,NY                                         BISAM
C           Y - VECTOR OF SIZE NY TO BE PLOTTED                         BISAM
C           XCHAR - CHARACTER FOR Y IN PLOT                             BISAM
C           LX,LY - VECTORS OF SIZE 2 CONTAINING THE LABELS             BISAM
C                   FOR X AND Y RESPECTIVELY                            BISAM
C           LC - VECTOR OF SIZE 20 CONTAINING THE CAPTION FOR           BISAM
C                THE PLOT                                               BISAM
C           Z - OPTIONAL VECTOR OF SIZE NZ TO BE PLOTTED                BISAM
C           XZ - ABSCISSA FOR Z                                         BISAM
C           NLINE,STRT,END - VALUES FOR SUB. PLINE WHEN Z IS A LINE     BISAM
C           YMN,YMX - MIN AND MAX VALUES FOR ORDINATE OF PLOT           BISAM
C           IBOX - EQUAL ZERO IF BOX PLOTS ARE NOT WANTED               BISAM
C           IZ - EQUAL 1 IF VECTOR Z IS TO BE PLOTTED                   BISAM
C           ZCHAR - PLOTTING CHARACTER TO BE USED FOR THE               BISAM
C                   Z VECTOR. MUST BE DIFFERENT FROM Q.                 BISAM
C           LI - OPTIONAL LABEL TO FOLLOW CAPTION                       BISAM
C           IQRD = 1  IF Y IS ORDERED FROM MIN TO MAX                   BISAM
C                = 0  IF Y IS NOT ORDERED                               BISAM
C                = 2 FOR HORIZONTAL ZERO-LINE (FOR IQ PLOT)    .        BISAM
C*****************************************************************     BISAM
      DIMENSION PARRAY(61,61),CHAR(10),X(NY),Y(NY),LX(2),LY(2),          BISAM
     &    LC(20),HJ(11),Z(NZ),LI(20),XZ(NZ),STRT(1),END(1),CHARL(1)      BISAM
      DATA BLANK,DASH,PLUS,CAPI,ZERO / ' ','-','+','I','0' /            BISAM
      DATA CHAR1,CHAR/'0','0','1','2','3','4','5','6','7','8','9','M'/  BISAM
      DATA EPS / 1.E-10 /                                                BISAM
      JINC = 6                                                           BISAM
      KINC = 6                                                           BISAM
      NR = 1 + 10 * JINC                                                 BISAM
      NC = 1 + 10 * KINC                                                 BISAM
      NRP1 = NR + 1                                                      BISAM
      NRM1 = NR - 1                                                      BISAM
      NCM1 = NC - 1                                                      BISAM
      FC = FLOAT(NCM1)                                                   BISAM
      NUMIT = 6                                                          BISAM
      CHAR(1) = XCHAR                                                    BISAM
      IF ( CHAR(1) .EQ. BLANK ) CHAR(1) = CHAR1                          BISAM
      IF(IQRD-1) 2,3,4                                                   BISAM
    2 CALL MIN(Y,NY,YMIN,IER)                                            BISAM
      CALL MAX(Y,NY,YMAX,IER)                                            BISAM
      IF(IZ .EQ. 0 ) GO TO 1                                             BISAM
      CALL MIN(Z,NZ,ZMIN,IER)                                            BISAM
      CALL MAX(Z,NZ,ZMAX,IER)                                            BISAM
      IF(ZMIN.LT.YMIN)YMIN=ZMIN                                          BISAM
      IF(ZMAX.GT.YMAX)YMAX=ZMAX                                          BISAM
      GOTO 1                                                             BISAM
    3 YMIN = Y(1)                                                        BISAM
      YMAX = Y(NY)                                                       BISAM
      IF(IZ .EQ. 0) GOTO 1                                               BISAM
      ZMIN = Z(1)                                                        BISAM
      ZMAX = Z(NZ)                                                       BISAM
      IF(ZMIN .LT. YMIN) YMIN = ZMIN                                     BISAM
      IF(ZMAX .GT. YMAX) YMAX = ZMAX                                     BISAM
      GOTO 1                                                             BISAM
    4 YMIN = YMN                                                         BISAM
      YMAX = YMX                                                         BISAM
    1 CONTINUE                                                           BISAM
      RANGE = YMAX - YMIN                                                BISAM
      IF ( RANGE .LT. EPS ) GOTO 99                                      BISAM
      YINC = FLOAT(NRM1) / RANGE                                         BISAM
      DO 10 I= 2,NRM1                                                    BISAM
      PARRAY(I,1)=CAPI                                                   BISAM
      PARRAY(I,NC) = CAPI                                                BISAM
      DO 9 J=2,NCM1                                                      BISAM
      PARRAY(I,J)=BLANK                                                  BISAM
    9 CONTINUE                                                           BISAM
   10 CONTINUE                                                           BISAM
      DO 20 J=1,NC                                                       BISAM
      PARRAY(1,J) = DASH                                                 BISAM
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2104.           PARRAY(NR,J)=BASH                                              BISAM
2105.    20     CONTINUE                                                       BISAM
2106.    15     J=0                                                            BISAM
2107.           S=0.0                                                          BISAM
2108.           DO 25 I=1,NC,KINC                                              BISAM
2109.           J=J+1                                                          BISAM
2110.           XJ(J) = S                                                      BISAM
2111.           S = S + .1                                                     BISAM
2112.           PARRAY(NR,I)=PLUS                                              BISAM
2113.    25     CONTINUE                                                       BISAM
2114.           DO 30 I = 1,NR,JINC                                            BISAM
2115.           PARRAY(NRP1-I,1) = PLUS                                        BISAM
2116.    30     CONTINUE                                                       BISAM
2117.           IF ( NLINE .GE. 1 ) CALL PLINE(NR,NC,NLINE,STRT,END,CHARL,     BISAM
2118.          &                                PARRAY,YMIN,YMAX,YINC)         BISAM
2119.    60     CONTINUE                                                       BISAM
2120.           DO 65 K=1,NY                                                   BISAM
2121.           INDX=X(K)*FC + 1.5                                             BISAM
2122.           INDY=(Y(K)-YMIN)*YINC + 1.5                                    BISAM
2123.           IF(I2.NE.1)GO TO 70                                            BISAM
2124.           INDZ=(Z(K)-YMIN)*YINC + 1.5                                    BISAM
2125.           PARRAY(NRP1-INDY,INDX)=CHAR(1)                                 BISAM
2126.           PARRAY(NRP1-INDZ,INDX)=ZCHAR                                   BISAM
2127.           IF(INDZ.EQ.INDY)PARRAY(NRP1-INDY,INDX)=CHAR(10)                BISAM
2128.           GO TO 65                                                       BISAM
2129.    70     CONTINUE                                                       BISAM
2130.           IF ( CHAR(1) .EQ. XCHAR ) GOTO 44                              BISAM
2131.           DO 42 I=1,10                                                   BISAM
2132.           IF(PARRAY(NRP1-INDY,INDX).EQ.CHAR(I))GO TO 43                  BISAM
2133.    42     CONTINUE                                                       BISAM
2134.    44     PARRAY(NRP1-INDY,INDX)=CHAR(1)                                 BISAM
2135.           GO TO 65                                                       BISAM
2136.    43     IF(I.EQ.10)I=I-1                                               BISAM
2137.           PARRAY(NRP1-INDY,INDX)=CHAR(I+1)                               BISAM
2138.    65     CONTINUE                                                       BISAM
2139.           IF ( I2 .NE. 2 ) GOTO 47                                       BISAM
2140.           DO 47 I = 1,NZ                                                 BISAM
2141.           INDXZ = XZ(I) * FC + 1.5                                       BISAM
2142.           INDZ  = (Z(I) - YMIN) * YINC + 1.5                             BISAM
2143.           IF ( PARRAY(NRP1-INDZ,INDXZ) .EQ. CHAR(1) ) GOTO 48            BISAM
2144.           PARRAY(NRP1-INDZ,INDXZ) = ZCHAR                                BISAM
2145.           GOTO 47                                                        BISAM
2146.    48     PARRAY(NRP1-INDZ,INDXZ) = CHAR(10)                             BISAM
2147.    47     CONTINUE                                                       BISAM
2148.           WRITE(NUNIT,100)LC,LI                                          BISAM
2149.           DYX = (FLOAT(JINC) / FLOAT(NRM1)) * RANGE                      BISAM
2150.           YXALUE = YMAX + DYX                                            BISAM
2151.           DO 300 I=1,NR,JINC                                             BISAM
2152.           IF(PARRAY(NRP1-I,1).NE.PLUS) PARRAY(NRP1-I,1)=ZERO             BISAM
2153.    300    CONTINUE                                                       BISAM
2154.           DO 55 I=1,NRM1                                                 BISAM
2155.           IF((PARRAY(I,1).EQ.PLUS).OR.(PARRAY(I,1).EQ.ZERO)) GO TO 50    BISAM
2156.           WRITE(NUNIT,105)(PARRAY(I,J),J=1,NC)                           BISAM
2157.           GO TO 55                                                       BISAM
2158.    50     YXALUE = YXALUE - DYX                                          BISAM
2159.           WRITE(NUNIT,110)YXALUE,(PARRAY(I,J),J=1,NC)                    BISAM
2160.    55     CONTINUE                                                       BISAM
2161.           WRITE(NUNIT,110)YMIN,(PARRAY(NR,J),J=1,NC)                     BISAM
2162.           WRITE(NUNIT,115)XJ                                             BISAM
2163.           WRITE(NUNIT,120)LX,LY                                          BISAM
2164.           GO TO 999                                                      BISAM
2165.    99     CONTINUE                                                       BISAM
2166.           WRITE(NUNIT,195)LC                                             BISAM
2167.           WRITE(NUNIT,200)                                               BISAM
2168.    200    FORMAT(' X VALUES')                                            BISAM
2169.           WRITE(NUNIT,205)(X(I),I=1,NY)                                  BISAM
2170.    205    FORMAT(1X,10F10.5)                                             BISAM
2171.           WRITE(NUNIT,210)                                               BISAM
2172.    210    FORMAT(' Y VALUES')                                            BISAM
2173.           WRITE(NUNIT,205)(Y(I),I=1,NY)                                  BISAM
2174.    195    FORMAT(' ERROR IN OPLOT FOR THE PLOT OF ',20A4)                BISAM
2175.    999    RETURN                                                         BISAM
2176.    100    FORMAT(1H1,15X,20A4,/,15X,20A4,/)                              BISAM
2177.    105    FORMAT(132X,61A1)                                              BISAM
2178.    110    FORMAT(1X,F10.3,2X,61A1)                                       BISAM
2179.    115    FORMAT(12X,11(F3.1,3X))                                        BISAM
2180.    120    FORMAT(15X,'ABSCISSA IS ',2A4,4X,' , ORDINATE IS ',2A4)        BISAM
2181.           END                                                            BISAM
2182.           SUBROUTINE QREG(N,M,ML,PSIQ,LOCQ,KPARM,CQF,IND,RQ,E)           BISAM
2183.    C*************************************************************       BISAM
2184.    C                                                                     BISAM
2185.    C   SUBROUTINE TO PERFORM QUANTILE REGRESSION                         BISAM
2186.    C                                                                     BISAM
2187.    C   INPUT: N - SAMPLE SIZE                                            BISAM
2188.    C          X,Y - IN COMMON BLOCK                                      BISAM
2189.    C          PSIQ - INTEGRATING FACTOR FOR DHAT                         BISAM
2190.    C          LOCQ - LOCATION OF FIRST COEFFICIENT IN CQF FOR BEST       BISAM
2191.    C                 MODEL                                               BISAM
2192.    C          KPARM - NUMBER OF PARAMETERS IN BEST MODEL                 BISAM
2193.    C          CQF,IND - VECTOR OF COEFFICIENTS AND INDICES FOR BEST      BISAM
2194.    C                    MODEL                                            BISAM
2195.    C                                                                     BISAM
2196.    C   OUTPUT: RQ - VECTOR CONTAINING REGRESSION QUANTILE FUNCTION        BISAM
2197.    C                                                                     BISAM
2198.    C   AUXILLIARY: E                                                     BISAM
2199.    C                                                                     BISAM
2200.    C   SUBPROGRAMS CALLED: PPLOT,QUENT,DESTAT,MAX,MIN,MINMAX,GTOPQ,     BISAM
2201.    C                       OFIND,QUICK,WSPACE,POPNC                      BISAM
2202.    C                                                                     BISAM
2203.    C*************************************************************       BISAM
2204.           COMMON /DATAR/ X(500),Y(500),RANKX(500),RANKY(500)             BISAM
2205.           DIMENSION IND(1),RQ(1),E(1)                                    BISAM
2206.           DIMENSION T(500,3),U(500),QY(500)                              BISAM
2207.           DIMENSION LABR[20],LABRQ[20],                                  BISAM
2208.          +YNAME[20],YNAME1[20],YNAME2[20],XNAME(20),CHAR(8)              BISAM
2209.           COMPLEX CEXP,CMPLX,ZARG,CQF(97)                                BISAM
2210.           DATA NYBIN/500/                                                BISAM
2211.           DATA CHAR/'*','+','.',',','X','O'/                             BISAM
2212.           DATA LABR/'REGR','ESS','ON P','UNCT','ION',',' + '-',' OBS',   BISAM
2213.          +'ERVE','D, ','  ',' - P','RED)','CTED',8*' '/                   BISAM
2214.           DATA LABRQ/'REGR','ESS','ON Q','UANT','ILE ','FUNC','TION',    BISAM
2215.          +',  + ','- OB','SERV','ED, ','(Y ',' - ','PRED','ICTE','D  ',6*' '    */  BISAM
2216.           DATA XNAME/8*' ','U',',1',10*' '/                              BISAM
2217.           DATA ZNAME/8*' ','Z',',1',8*' '/                               BISAM
2218.           DATA YNAME/7*' ','R','O','.','Y',9*' '/                        BISAM
2219.           DATA YNAME1/8*' ','R','-','Y',9*' '/                           BISAM
2220.           REAL LSDHAT                                                    BISAM
2221.           TWOPI=8.0*ATAN(1.0)                                            BISAM
2222.    C                                                                     BISAM
2223.    C   ORDER Y AS RAW ESTIMATE OF QUANTILE FUNCTION                      BISAM
2224.    C                                                                     BISAM
2225.           DO 10 I=1,N                                                    BISAM
2226.      10   QY(I)=Y(I)                                                     BISAM
2227.           CALL QUICK(N,QY)                                               BISAM
2228.           DIVN=1./FLOAT(N)                                               BISAM
2229.           DO 40 I=1,N                                                    BISAM
2230.           U1=(FLOAT(I)-.5)*DIVN                                          BISAM
2231.           RQ(I)=0.                                                       BISAM
2232.           DO 30 J=1,N                                                    BISAM
2233.           U2=(FLOAT(J)-.5)*DIVN                                          BISAM
2234.           LSDHAT=0.0                                                     BISAM
2235.           LOC=LOCQ                                                       BISAM
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      DO 15 K=1,KPARM                                                   GISAM
      I1=IND(LOC)-1                                                     GISAM
      I2=MOD(II,M)                                                      GISAM
      I1=(II-I2)/M+ML                                                   GISAM
      I2=I2+ML                                                          GISAM
      ARG=TWOPI*(FLOAT(I1)*U1+FLOAT(I2)*U2)                             GISAM
      ZARG=CMPLX(0.0,ARG)                                               GISAM
      LGDMAT=LGDMAT+REAL(CSF(LOC)*CEXP(ZARG))                           GISAM
      LOC=LOC+1                                                         GISAM
   15 CONTINUE                                                          GISAM
      IF(LGDMAT.LE.170.) GO TO 25                                       GISAM
      WRITE(6,20) U1,U2,LGDMAT                                          GISAM
   20 FORMAT(/,10X,'LOG DMAT(',F8.5,',',F8.5,')=',E20.6,               GISAM
     +' IN GREG. QUANTILE REGRESSION TERMINATED.')                      GISAM
      RETURN                                                            GISAM
   25 IF(LGDMAT.LT.-20.) LGDMAT=-20.                                    GISAM
      DMAT=EXP(LGDMAT)/PSIQ                                             GISAM
      RQ(I)=RQ(I)+QV(J)*DMAT                                            GISAM
   30 CONTINUE                                                          GISAM
      RQ(I)=RQ(I)*DIVN                                                  GISAM
   40 CONTINUE                                                          GISAM
      U(1)=(FLOAT(1)-0.5)*DIVN                                          GISAM
      T(1,1)=Y(1)                                                       GISAM
      T(1,2)=RQ(1)                                                      GISAM
      DO 60 I=2,N                                                       GISAM
      U(I)=U(I-1)+DIVN                                                  GISAM
      T(I,1)=Y(I)                                                       GISAM
      T(I,2)=RQ(I)                                                      GISAM
   60 CONTINUE                                                          GISAM
      CALL PPLOT(U,T,NTDIM,N,2,CHAR,LABRQ,UNAME,YNAME,1)                GISAM
      CALL PPLOT(X,T,NTDIM,N,2,CHAR,LABR,XNAME,YNAME,1)                 GISAM
      SMSQ1=0.                                                          GISAM
      DO 70 I=1,N                                                       GISAM
      E(I)=Y(I)-RQ(I)                                                   GISAM
   70 SMSQ1=SMSQ1+E(I)*E(I)                                             GISAM
      SMSQ1=SMSQ1/FLOAT(N-1)                                            GISAM
      WRITE(6,100) SMSQ1                                                GISAM
  100 FORMAT(/,10X,'RESIDUAL VARIANCE = ',F15.6)                        GISAM
      RETURN                                                            GISAM
      END                                                               GISAM
      SUBROUTINE QTOPQ(Q,U,N,XS,SPCFAC)                                 GISAM
C*****************************************************************    GISAM
C   SUBROUTINE TO COMPUTE LITTLE Q(U) FROM                              GISAM
C   THE EMPIRICAL QUANTILE FN CAP Q(U) AND THE U VALUES.                GISAM
C   INPUT : Q,U,NQ                                                      GISAM
C   OUTPUT : XS : SPACINGS=LITTLE Q(U)                                  GISAM
C*****************************************************************    GISAM
      DIMENSION Q(N),U(N),XS(N)                                         GISAM
      S = 1.E10                                                         GISAM
      EPS = 1.E-8                                                       GISAM
      DU = 1. / (U(N) - U(N-1))                                         GISAM
      XS(1) = (Q(3) - Q(1)) / (U(3) - U(1))                             GISAM
      IF(XS(1) .GT. EPS) S = XS(1)                                      GISAM
      XS(N-1) = (Q(N) - Q(N-1)) * DU                                    GISAM
      IF(XS(N-1) .LT. S .AND. XS(N-1) .GT. EPS) S = XS(N-1)             GISAM
      DU = DU * .5                                                      GISAM
      NM2 = N-2                                                         GISAM
      DO 10 I = 2,NM2                                                   GISAM
      XS(I) = (Q(I+2) - Q(I)) * DU                                      GISAM
      IF(XS(I) .LT. S .AND. XS(I) .GT. EPS) S = XS(I)                   GISAM
   10 CONTINUE                                                          GISAM
      NM1 = N-1                                                         GISAM
      S = S * SPCFAC                                                    GISAM
      DO 20 I = 1,NM1                                                   GISAM
      IF(XS(I) .LE. EPS) XS(I) = S                                      GISAM
   20 CONTINUE                                                          GISAM
      RETURN                                                            GISAM
      END                                                               GISAM
      SUBROUTINE QUENT(N,X,NAME,LAB,INUL,NDIM,X25,X50,X75,XBAR,SD)      GISAM
C*****************************************************************    GISAM
C                                                                       GISAM
C   SUBROUTINE TO COMPUTE QUANTILE AND ENTROPY STATISTICS FOR           GISAM
C   DATA SET X.                                                         GISAM
C                                                                       GISAM
C   INPUT: X,N - DATA SET X OF LENGTH N                                 GISAM
C          NAME - NAME FOR ANALYSIS IN 20A4 FORMAT                      GISAM
C          LAB - LABEL FOR DATA SET IN 20A4 FORMAT                      GISAM
C          INUL - NULL DISTRIBUTIONS FOR X (SEE FOFNC)                  GISAM
C          NDIM - DIMENSION OF X IN CALLING PROGRAM                     GISAM
C                                                                       GISAM
C   OUTPUT: X25,X50,X75 - LOWER QUARTILE, MEDIAN, AND UPPER QUARTILE    GISAM
C           XBAR,SD - SAMPLE MEAN AND STANDARD DEVIATION                GISAM
C                                                                       GISAM
C   SUBPROGRAMS CALLED: QUICK,DESTAT,PPLOT,FOFNC,WSPACE,KSD,FCODEA      GISAM
C                                                                       GISAM
C*****************************************************************    GISAM
      COMMON /PARM/ BETAP,BETAW                                         GISAM
      DIMENSION NAME(20),IFORM(20),LICASE(22)                           GISAM
      DIMENSION X(NDIM),Y(552),QN(552),U(552),FQ(552),D(552),           GISAM
     &          WK1(552),WK2(552),WK3(552)                              GISAM
      DIMENSION LAB(20),LAB1(20),LAB2(20),LAB3(20),LAB10(20)            GISAM
      DIMENSION NAMW(2),NAM10(2),NAMCWS(2),ICASE(2)                     GISAM
      DIMENSION LQUART(4),EXIQ(6),EXU(6),STRT(2),END(2),CHARL(2)        GISAM
      DATA EXU / 0.01,0.05,0.10,0.25,0.75,0.90,0.95,0.99 /              GISAM
      DATA LICASE/4HNORM,4HAL  ,4HEXPO,4HNRTAL,4HLOGI,4HSTIC,           GISAM
     &            4HGDSL ,4HEXP ,4HUN R,4HECIP,4HCAUC,4HNY  ,         GISAM
     &            4HEX V,4HALUE,4HLOG ,4HNORM,4HPARE,4HTO  ,          GISAM
     &            4HMEID,4HULL ,4HNALF,4H LOG/                        GISAM
      DATA BLK/' '/                                                     GISAM
      DATA STRT,END,CHARL /-5.0...5.0,'*','-'/                          GISAM
      DATA ASTER/1H=/                                                   GISAM
      DATA LAB1/'INPU','RMAT','IVE ','QUAN','TILE',' -  ',14*'    '/    GISAM
      DATA LAB2/4HD+ *,2*4H    ,4H AT ,4HU = ,2*4H    ,4H.  0,         GISAM
     *4H- * ,2*4H    ,4H AT ,4HU = ,7*4H    /                          GISAM
      DATA LAB10/4HRAW ,4H DIS,4HTRIB,4HUTIO,4HN D(,4HU)  ,             GISAM
     *      2*4H    ,4H CAS,4HE   ,9*4H    /                          GISAM
      DATA NAMW,NAM10/ 4H    ,4H   U,4H  10,4H(U) /                     GISAM
      DATA NAMCWS/4H    ,4HD(U)/                                        GISAM
      DATA SPCFAC/0.1/                                                  GISAM
      NUNIT = 6                                                         GISAM
      DO 5 I=1,12                                                       GISAM
    5 LAB1(I+6)=LAB(I)                                                  GISAM
      WRITE(NUNIT,1000)                                                 GISAM
 1000 FORMAT(///,T50,'FULLY  NON-PARAMETRIC  ANALYSIS'/T50,31(1H=))     GISAM
C   OBTAIN DESCRIPTIVE STATISTICS FOR UNGROUPED DATA                    GISAM
      BIGG = 1.E+10                                                     GISAM
      PI = 4.*ATAN(1.)                                                  GISAM
      TWOPI = PI * PI                                                   GISAM
      RPI = 1./PI                                                       GISAM
      RSQTPI = 1./SQRT(TWOPI)                                           GISAM
C                                                                       GISAM
      NO=N-1                                                            GISAM
      NOP1=N                                                            GISAM
      DO 10 I=1,N                                                       GISAM
   10 Y(I)=X(I)                                                         GISAM
      CALL QUICK(N,Y)                                                   GISAM
      YMIN=Y(1)                                                         GISAM
      CALL DESTAT(Y,N,NAME,LAB,LQUART,0,1,X25,X50,X75)                  GISAM
      FN=1./FLOAT(N)                                                    GISAM
      U(1)=.5*FN                                                        GISAM
      DO 20 I=1,N                                                       GISAM
      U(I+1)=U(I)+FN                                                    GISAM
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      20  ON(I)=Y(I)                                                       81SAM
          TIO=1./(2.*(X75-X25))                                             81SAM
          DO 30 I=1,N                                                       81SAM
          ON(I)=(ON(I)-X50)*TIO                                             81SAM
          WK1(I)=U(I)-.5                                                    81SAM
      30  WK2(I)=ON(I)                                                      81SAM
          DO 40 I=1,N                                                       81SAM
          IF(WK2(I).GE.-1.) GOTO 50                                         81SAM
      40  WK2(I)=-1.                                                        81SAM
      50  DO 60 I=1,N                                                       81SAM
          IF(WK2(N-I+1).LE.1.) GOTO 70                                      81SAM
      60  WK2(N-I+1)=1.                                                     81SAM
      70  CONTINUE                                                          81SAM
          CALL OPLOT(U,WK2,NOP1,BLK,0.,0.,1,0,BLK,2,-1.,1.,2,STRT,FND,      81SAM
     &               CHARL,NAMU,NAMIO,NAME,LAB1)                          81SAM
          DO 75 I = 1,8                                                     81SAM
          EXIO(I) = OFIND(ON,NOP1,EXU(I))                                   81SAM
      75  CONTINUE                                                          81SAM
          WRITE(NUNIT,80) EXU,EXIO                                          81SAM
      80  FORMAT(///710,' U   ',3X,8(F8.5,1X),                             81SAM
     *         /710,'IO(U)',3X,8(F8.5,1X),///)                            81SAM
          KASE=INUL*2                                                       81SAM
          ICASE(1)=LICASE(KASE-1)                                           81SAM
          ICASE(2)=LICASE(KASE)                                             81SAM
C     COMPUTE AND PLOT RAW SPACINGS (+0) AND RAW FO (+1./0)                 81SAM
          CALL QTOFO(ON,U,NOP1,WK1,SPCFAC)                                  81SAM
C     COMPUTE AND PLOT WEIGHTED SPACINGS FOR CASE ICASE                     81SAM
          DO 100 I = 1,NO                                                   81SAM
          WK2(I) = FOFNC(U(I+1),INUL)                                       81SAM
  100     CONTINUE                                                          81SAM
          CALL WSPACE(WKS,D,NOP1,WK1,WK2,U,SW)                              81SAM
C     PLOT CUMULATIVE WEIGHTED SPACINGS WITH D+ AND D-                      81SAM
          CALL KSD(D,U,NOP1,DM,UM,DP,UP)                                    81SAM
          CALL FCODEA(DP,8H(F7.4)   ,LAB9(2))                               81SAM
          CALL FCODEA(UP,8H(F7.4)   ,LAB9(6))                               81SAM
          CALL FCODEA(DM,8H(F7.4)   ,LAB9(10))                              81SAM
          CALL FCODEA(UM,8H(F7.4)   ,LAB9(14))                              81SAM
          LAB10(8)=ICASE(1)                                                 81SAM
          LAB10(9 )=ICASE(2)                                                81SAM
          CALL OPLOT(U,D,NOP1,BLK,0.,0.,1,0,BLK,2,0.,1.,1,0.,1.,ASTER,      81SAM
     &               NAMU,NAMCWS,LAB10,LAB9)                              81SAM
          WRITE(NUNIT,130)                                                  81SAM
  130     FORMAT(///////)                                                   81SAM
          RETURN                                                            81SAM
          END                                                               81SAM
          SUBROUTINE QUICK(N,T)                                             81SAM
C*****************************************************************        81SAM
C     QUICK SORT.THIS ALGORITH IS ALSO REFERRED TO AS A PARTITIONED         81SAM
C     EXCHANGE SORT.EXPECTED RUNTIME IS PROPORTIONAL TO N*LOG2(N)           81SAM
C     ALTHOUGH THE WORST CASE IS PROPORTIONAL TO N**2.                      81SAM
C     REFERENCE: DONALD E. KNUTH- THE ART OF COMPUTER PROGRAMMING VOL 3.    81SAM
C     INPUT :                                                               81SAM
C             N,N : VECTOR TO BE SORTED OF LENGTH N                         81SAM
C     OUTPUT :                                                              81SAM
C             N : SORTED VECTOR                                             81SAM
C     SUBROUTINES CALLED : NONE                                             81SAM
C*****************************************************************        81SAM
          REAL T(N),Y                                                       81SAM
          INTEGER IP,LV(16),IV(16),LP,IUP                                   81SAM
          LV(1)=1                                                           81SAM
          IV(1)=N                                                           81SAM
          IP=1                                                              81SAM
       10 IF(IP.LT.1) GO TO 75                                              81SAM
       15 IF((IV(IP)-LV(IP)).LT.1) GO TO 20                                 81SAM
          GO TO 25                                                          81SAM
       20 IP=IP-1                                                           81SAM
          GO TO 10                                                          81SAM
       25 LP=LV(IP)-1                                                       81SAM
          IUP=IV(IP)                                                        81SAM
          Y=T(IUP)                                                          81SAM
       30 IF((IUP-LP).LT.2) GO TO 45                                        81SAM
          LP=LP+1                                                           81SAM
          IF(T(LP).LE.Y) GO TO 30                                           81SAM
          T(IUP)=T(LP)                                                      81SAM
       35 IF((IUP-LP).LT.2) GO TO 40                                        81SAM
          IUP=IUP-1                                                         81SAM
          IF(T(IUP).GE.Y) GO TO 35                                          81SAM
          T(LP)=T(IUP)                                                      81SAM
          GO TO 30                                                          81SAM
       40 IUP=IUP-1                                                         81SAM
       45 T(IUP)=Y                                                          81SAM
          IF((IUP-LV(IP)).LT.(IV(IP)-IUP)) GO TO 55                         81SAM
          GO TO 60                                                          81SAM
       55 LV(IP+1)=LV(IP)                                                   81SAM
          IV(IP+1)=IUP-1                                                    81SAM
          LV(IP)=IUP+1                                                      81SAM
          GO TO 70                                                          81SAM
       60 LV(IP+1)=IUP+1                                                    81SAM
          IV(IP+1)=IV(IP)                                                   81SAM
          IV(IP)=IUP-1                                                      81SAM
       70 IP=IP+1                                                           81SAM
          GO TO 15                                                          81SAM
       75 RETURN                                                            81SAM
          END                                                               81SAM
          SUBROUTINE RANK(X,N,XR)                                           81SAM
C                                                                           81SAM
C*************************************************************            81SAM
C                                                                           81SAM
C   SUBROUTINE TO RANK THE N-VECTOR X WITH RANKS PLACED IN                  81SAM
C   THE N-VECTOR XR.                                                        81SAM
C                                                                           81SAM
C   TIED VALUES ARE GIVEN AVERAGE RANKS.                                    81SAM
C                                                                           81SAM
C   SUBROUTINE CALLED: SRD2                                                 81SAM
C                                                                           81SAM
C*************************************************************            81SAM
C                                                                           81SAM
          DIMENSION X(N),XR(N),W1(500,2),W2(500,2),V(500)                   81SAM
C                                                                           81SAM
C   CREATE MATRIX W1 WHOSE FIRST COLUMN CONTAINS THE VECTOR X               81SAM
C   AND WHOSE SECOND COLUMN CONTAINS THE OBSERVATION NUMBER                 81SAM
C                                                                           81SAM
          DO 10 I=1,N                                                       81SAM
          W1(I,1)=X(I)                                                      81SAM
          W1(I,2)=FLOAT(I)                                                  81SAM
       10 CONTINUE                                                          81SAM
          CALL SRD2(W1,N,500)                                               81SAM
C                                                                           81SAM
C   CREATE MATRIX W2 WHOSE FIRST COLUMN CONTAINS SORTED X VALUES            81SAM
C   AND WHOSE SECOND COLUMN CONTAINS THE RANKS OF THE X VALUES              81SAM
C   BEFORE CORRECTING FOR TIES.                                             81SAM
C                                                                           81SAM
          DO 20 I=1,N                                                       81SAM
          W2(I,1)=W1(I,1)                                                   81SAM
          W2(I,2)=FLOAT(I)                                                  81SAM
       20 CONTINUE                                                          81SAM
C                                                                           81SAM
C   CORRECT FOR TIES BY REPLACING RANKS OF TIED VALUES BY                   81SAM
C   AVERAGE RANK                                                            81SAM
C                                                                           81SAM
          I=1                                                               81SAM
       30 K=I+1                                                             81SAM
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```
      40 IF(K.GT.N) GO TO 50                                                    BISAM
C                                                                               BISAM
C   REAL ARITHMETIC TOLERANCE FACTOR: ASSUME X*0 IF ABS(X).LE.5.E-6             BISAM
C                                                                               BISAM
         WTEST=ABS(W2(1,1)-W2(K,1))                                             BISAM
         IF(WTEST.GT.5.E-6) GO TO 50                                            BISAM
         K=K+1                                                                  BISAM
         GO TO 40                                                               BISAM
   50 K2=K-1                                                                    BISAM
      K3=K-1                                                                    BISAM
      IF(K3.LE.1) GO TO 80                                                      BISAM
      SUM=0.                                                                    BISAM
      DO 60 J=1,K2                                                              BISAM
      SUM=SUM+W2(J,2)                                                           BISAM
   60 CONTINUE                                                                  BISAM
      DO 70 J=1,K2                                                              BISAM
      V(J)=SUM/FLOAT(K3)                                                        BISAM
   70 CONTINUE                                                                  BISAM
      GO TO 90                                                                  BISAM
   80 V(1)=W2(1,2)                                                              BISAM
   90 I=K                                                                       BISAM
      IF(I.LT.N) GO TO 30                                                       BISAM
      WTEST2=ABS(W2(N,1)-W2(N-1,1))                                             BISAM
      IF(WTEST2.LT.5.E-6) GO TO 100                                             BISAM
      V(N)=FLOAT(N)                                                             BISAM
C                                                                               BISAM
C   CREATE VECTOR RR CONTAINING RANKS CORRECTED FOR TIES                        BISAM
C                                                                               BISAM
  100 DO 110 I=1,N                                                              BISAM
      KW=W1(I,2)+0.5                                                            BISAM
      RR(KW)=V(I)                                                               BISAM
  110 CONTINUE                                                                  BISAM
      RETURN                                                                    BISAM
      END                                                                       BISAM
      SUBROUTINE SPRHO(N,RHO,SUMD)                                              BISAM
C                                                                               BISAM
C***************************************************************              BISAM
C                                                                               BISAM
C   SUBROUTINE TO COMPUTE SPEARMAN'S RHO.                                       BISAM
C                                                                               BISAM
C   INPUT: RANKX - THE VECTOR OF RANKS OF THE INDEPENDENT VARIABLE              BISAM
C          RANKY - THE VECTOR OF RANKS OF THE DEPENDENT VARIABLE                BISAM
C          N - THE NUMBER OF PAIRED OBSERVATIONS                                BISAM
C                                                                               BISAM
C   OUTPUT: RHO - SPEARMAN'S RANK CORRELATION COEFFICIENT.                      BISAM
C                                                                               BISAM
C***************************************************************              BISAM
C                                                                               BISAM
      COMMON /DATAR/ X(500),Y(500),RANKX(500),RANKY(500)                        BISAM
C                                                                               BISAM
C   COMPUTE SQUARE OF RANK DIFFERENCES                                          BISAM
C                                                                               BISAM
      SUMD=0.                                                                   BISAM
      DO 10 I=1,N                                                               BISAM
      DIF=RANKX(I)-RANKY(I)                                                     BISAM
      SUMD=SUMD+DIF*DIF                                                         BISAM
   10 CONTINUE                                                                  BISAM
C                                                                               BISAM
C   COMPUTE SPEARMAN'S RANK CORRELATION COEFFICIENT                             BISAM
C                                                                               BISAM
      SNUM=6.*SUMD                                                              BISAM
      SDENOM=FLOAT(N)*(FLOAT(N*N)-1.)                                           BISAM
      RHO=1.-SNUM/SDENOM                                                        BISAM
      RETURN                                                                    BISAM
      END                                                                       BISAM
      SUBROUTINE TRIM(X,Y,XMED,YMED,KDEL,N,NEWN)                                BISAM
C***************************************************************              BISAM
C                                                                               BISAM
C   SUBPROGRAM TO TRIM A BIVARIATE DATA SET OF AT MOST                          BISAM
C   KDEL "EXTREME" POINTS BASED ON DISTANCE FROM THE                            BISAM
C   MEDIAN IN THE X AND Y DIRECTIONS ONLY.                                      BISAM
C                                                                               BISAM
C   INPUT: X,Y - DATA OF SIZE N                                                 BISAM
C          XMED,YMED - MEDIANS OF X AND Y                                       BISAM
C          KDEL - MAXIMUM NUMBER OF POINTS TO DELETE FROM DATA SET              BISAM
C                                                                               BISAM
C   OUTPUT: X,Y - TRIMMED DATA OF SIZE NEWN                                     BISAM
C                                                                               BISAM
C   SUBPROGRAMS CALLED: MAX,MIN,QUICK,ORD2                                      BISAM
C                                                                               BISAM
C***************************************************************              BISAM
      DIMENSION X(N),Y(N),DELM(20,2),KDEL(20),IDEL(20),YY(500)                  BISAM
      NEWN=N                                                                    BISAM
      IF(KDEL.LE.0) RETURN                                                      BISAM
      KCHK=0                                                                    BISAM
      IF(KDEL.NE.1) GO TO 3                                                     BISAM
      KCHK=1                                                                    BISAM
      KDEL=2                                                                    BISAM
    3 IF(KDEL.LT.N) GO TO 5                                                     BISAM
      WRITE(6,5)                                                                BISAM
    5 FORMAT(10X,'KDEL IS GREATER THAN OR EQUAL TO N',/,                        BISAM
     +10X,'KDEL HAS BEEN SET EQUAL TO 4.')                                      BISAM
      KDEL=4                                                                    BISAM
    6 IF(KDEL.GT.20) KDEL=20                                                    BISAM
      KMOD=MOD(KDEL,2)                                                          BISAM
      IF(KMOD.EQ.1) KDEL=KDEL-1                                                 BISAM
      KDIM=KDEL                                                                 BISAM
      KHALF=KDEL/2                                                              BISAM
      DO 10 I=1,KHALF                                                           BISAM
      J=N-I+1                                                                   BISAM
      DELM(I,1)=XMED-X(I)                                                       BISAM
      DELM(I,2)=FLOAT(I)                                                        BISAM
      DELM(KDEL-I+1,1)=X(J)-XMED                                                BISAM
      DELM(KDEL-I+1,2)=FLOAT(J)                                                 BISAM
   10 CONTINUE                                                                  BISAM
      CALL ORD2(DELM,KDEL,20)                                                   BISAM
      DO 20 I=1,KHALF                                                           BISAM
      IDEL(I)=IFIX(DELM(KHALF+1,2)+0.5)                                         BISAM
   20 CONTINUE                                                                  BISAM
      IF(KCHK.EQ.1) GO TO 65                                                    BISAM
      DO 30 I=1,N                                                               BISAM
      YY(I)=Y(I)                                                                BISAM
   30 CONTINUE                                                                  BISAM
      CALL MIN(Y,N,YMIN,IMIN)                                                   BISAM
      CALL MAX(Y,N,YMAX,IMAX)                                                   BISAM
      DO 40 I=1,KHALF                                                           BISAM
      DELM(I,1)=YMED-YMIN                                                       BISAM
      DELM(I,2)=FLOAT(IMIN)                                                     BISAM
      Y(IMIN)=YMAX                                                              BISAM
      CALL MIN(Y,N,YMIN,IMIN)                                                   BISAM
   40 CONTINUE                                                                  BISAM
      DO 50 I=1,N                                                               BISAM
      Y(I)=YY(I)                                                                BISAM
   50 CONTINUE                                                                  BISAM
      CALL MIN(Y,N,YMIN,IMIN)                                                   BISAM
      DO 60 I=1,KHALF                                                           BISAM
      DELM(KDEL-I+1,1)=YMAX-YMED                                                BISAM
      DELM(KDEL-I+1,2)=FLOAT(IMAX)                                              BISAM
      Y(IMAX)=YMIN                                                              BISAM
      CALL MAX(Y,N,YMAX,IMAX)                                                   BISAM
   60 CONTINUE                                                                  BISAM
      DO 66 I=1,N                                                               BISAM
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      66  Y(I)=YY(I)                                                    BISAM
          CALL ORD2(DELM,KDEL,20)                                       BISAM
          DO 70 I=1,KHALF                                               BISAM
          IDEL(KHALF+I)=IFIX(DELM(KHALF+1,2)+0.5)                       BISAM
      70  CONTINUE                                                      BISAM
          KM1=KHALF+1                                                   BISAM
          DO 80 I=1,KHALF                                               BISAM
          DO 80 J=KM1,KDIM                                              BISAM
          IF(IDEL(I).NE.IDEL(J)) GO TO 80                               BISAM
          IDEL(J)=N+1                                                   BISAM
          KDEL=KDEL-1                                                   BISAM
      80  CONTINUE                                                      BISAM
          DO 82 I=1,KDIM                                                BISAM
      82  KDEL(I)=FLOAT(IDEL(I))                                        BISAM
          CALL QUICK(KDIM,KDEL)                                         BISAM
          DO 84 I=1,KDIM                                                BISAM
      84  IDEL(I)=IFIX(KDEL(I)+0.5)                                     BISAM
      88  CONTINUE                                                      BISAM
          IF(KCHK.EQ.1) KDEL=1                                          BISAM
          NN1=N-1                                                       BISAM
          DO 100 I=1,KDEL                                               BISAM
          IND=IDEL(KDEL-I+1)                                            BISAM
          NEWN=NEWN-1                                                   BISAM
          IF(IND.EQ.N) GO TO 92                                         BISAM
          DO 90 J=IND,NN1                                               BISAM
          X(J)=X(J+1)                                                   BISAM
          Y(J)=Y(J+1)                                                   BISAM
      90  CONTINUE                                                      BISAM
      92  X(NEWN+1)=0.0                                                 BISAM
          Y(NEWN+1)=0.0                                                 BISAM
          NN1=NEWN                                                      BISAM
     100  CONTINUE                                                      BISAM
          WRITE(6,110)                                                  BISAM
     110  FORMAT(10X,'THE FOLLOWING POINTS WERE DELETED FROM THE DATA SET:')  BISAM
          WRITE(6,120) (IDEL(I),I=1,KDEL)                               BISAM
     120  FORMAT(10X,8I5)                                               BISAM
          WRITE(6,130) KDEL,NEWN                                        BISAM
     130  FORMAT(/,10X,I5,' POINTS WERE DELETED LEAVING ',I5,' POINTS ',  BISAM
         +'IN THE DATA SET.')                                           BISAM
          RETURN                                                        BISAM
          END                                                           BISAM
          SUBROUTINE WSPACE(WKS,CWKS,NOP1,XS,FOOQ,U,SIGQ,AVLWK)         BISAM
C*************************************************************        BISAM
C   SUBROUTINE TO COMPUTE Q(U), CUMULATIVE Q'S, AND SIGMAQ              BISAM
C   FOR THE MODEL Q(U)=MU+SIGMA*QQ(U)                                   BISAM
C   INPUT :                                                           BISAM
C            XS,NQ : VECTOR OF LENGTH NQ CONTAINING LITTLE Q(U)       BISAM
C            FOOQ : HYPOTHESIZED DENSITY QUANTILE FUNCTION            BISAM
C            U : VECTOR OF LENGTH NQ CONTAINING U VALUES              BISAM
C   OUTPUT :                                                          BISAM
C            WKS : VECTOR OF LENGTH NQ CONTAINING Q(U)                BISAM
C            CWKS : VECTOR OF LENGTH NQ CONTAINING THE                BISAM
C                   CUMULATIVE Q'S                                    BISAM
C            SIGQ : COMPUTED VALUE OF SIGMAQ * CWKS(NQ)               BISAM
C                                                                     BISAM
C   SUBROUTINES CALLED : NONE                                         BISAM
C*************************************************************        BISAM
          DIMENSION FOOQ(NOP1),XS(NOP1),U(NOP1),WKS(NOP1),CWKS(NOP1)    BISAM
          NQ=NOP1-1                                                     BISAM
          CWKS(1)=0.                                                    BISAM
          DO 10 I= 1,NQ                                                 BISAM
          WKS(I) = FOOQ(I) * XS(I)                                      BISAM
          CWKS(I+1) = CWKS(I) + WKS(I)                                  BISAM
       10 CONTINUE                                                      BISAM
          FN = FLOAT(NQ)                                                BISAM
          D1 = 1./CWKS(NOP1)                                            BISAM
          D2 = D1 * FN                                                  BISAM
          DO 20 I=1,NQ                                                  BISAM
          WKS(I)=WKS(I) * D2                                            BISAM
          CWKS(I)=CWKS(I) * D1                                          BISAM
       20 CONTINUE                                                      BISAM
          CWKS(NOP1)=1.                                                 BISAM
          SIGQ = 1./D2                                                  BISAM
          RETURN                                                        BISAM
          END                                                           BISAM
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