71-20

GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

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A COMPUTER PROGRAM FOR FINDING A GENERAL DISTRIBUTION FUNCTION OF SEVERAL SETS OF RANDOM DATA (UNIVAC 1108 — Calcomp 663 — Fortran V.)

J. Soukup

Price, $1.50

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ABSTRACT

Two programs are given for finding a common general distribution. The programs are designed according a new procedure published separately. The common cumulative function is approximated by a truncated Fourier series with coefficients that are polynomials of the parameters. Such an approximation is very flexible and does not depend on any standard type of distribution. The programs were successfully applied in geochemistry and geophysics, but the programs can be used almost generally in every applied science.

RÉSUMÉ

L'auteur propose deux programmes permettant d'obtenir une distribution générale d'application usuelle. Ces programmes sont conçus conformément à une nouvelle procédure déjà publiée. Il obtient par approximation une fonction cumulative usuelle au moyen d'une série de Fourier tronquée, dont les coefficients sont des fonctions polynômes des paramètres. Cette approximation s'avère très souple et ne dépend d'aucun type standard de la distribution. Ces programmes ont été utilisés avec succès dans les domaines de la géochimie et de la géophysique mais, étant donné leur souplesse, ils peuvent servir dans presque toutes les sciences appliquées.

A COMPUTER PROGRAM FOR FINDING A GENERAL DISTRIBUTION FUNCTION OF SEVERAL SETS OF RANDOM DATA (UNIVAC 1108 - Calcomp 663 - Fortran V.)

INTRODUCTION

In applied science there are very often several groups of data that seem to have the same type of distribution. The reason for assuming this can be intuition based on diagrams only, or some deeper knowledge of the problem studied. If we know a formula of the general distribution, it provides a possibility to use analytical expressions and obtain essentially better conclusions. The problem is that, in practice, we almost always have to deal with data having a distribution, which, to some extent, does not fit any of the commonly used standard types of distribution. The reason for this is that we commonly have a mixture of several standard types of distribution. A similar situation in geology motivated the author to develop a new method, which could be generally used without restrictions by a chosen type of distribution. The first few central moments are taken as the parameters which provide a continuity with the commonly used types of distribution.

The cumulative curve is approximated by a truncated Fourier series having coefficients that are algebraic polynomials of the parameters. In method 2, according to Soukup (in press), these coefficients are supposed to be polynomials of some special functions of the parameters. This provides an important improvement in many practical cases.

Why this approximation should or should not be used would require a lengthy discussion. There is no profound theoretical reason. The Fourier approximation is very flexible and provides an approximation of good quality for all particular cases met in practice. The polynomial approximation is the most simple and the improvement according to method 2 gives an accurate result for any 'ideal' shape of the cumulative function. The chosen 'ideal' shape is very similar to the shapes most common in the natural sciences. For the other shapes, a suitable transformation can easily be found. The Kolmogorov criterion, which is used, is based on the maximum absolute difference between two cumulative functions. On the other side, the Fourier approximation as well as polynomial regression are least-square methods. Such a combination assures a generally good approximation and a very critical evaluation of the results. But the most important point seems to be that the method really works.

METHOD ADOPTED

The computational procedure is described very briefly in the following section (see Soukup, in press). The cumulative curve is approximated by

$$F(t, \vec{m}) = \sum_{r=0}^{181} c_r(\vec{m}). \cos (rt)$$

Original manuscript submitted: 14 January, 1971
Final version approved for publication: 1 March, 1971

where

$\vec{m} = (m_1, \ldots, m_s)$ is the vector of parameters. As parameters, the first few central moments are used in method 1. Some functions of these moments are used in method 2.

$$c_r(\vec{m}) =$$

$$g_{1,r} + g_{2,r}\, m_1 + g_{3,r}\, m_2 + \ldots + g_{\ldots,r}\, m_1^{k_1}\, m_2^{k_2} \ldots m_s^{k_s} + \ldots + g_{z,r}\, m_s^{v}$$

where
- s is the number of parameters,
- v is the order of polynomial approximation,
- r is the order of the Fourier coefficient,
- z is the freedom of the approximation.

A flow chart of the program has not been made, because the computer goes through a sequence of various numerical methods.

Method 1

1. Combination of a logarithmic (see data statement TRA) and a linear transformation. All input data are transformed into the interval
$$\left(\frac{\pi}{4}, \frac{3\pi}{4}\right).$$
2. The Fourier analysis (table of the cosine coefficients) for all given groups.
3. The application of the Lanczos sigma-coefficients to suppress the Gibbs phenomena.
4. The polynomial regression for the Fourier coefficients of each order. The variables are several first central moments of the given data for every group.
5. A substitution of the moments back into the result of the polynomial regression and the approximations of the experimental distributions by the truncated Fourier series (Fourier synthesis). The limiting form of that criterion as well as the finite form can be used.
6. This procedure is repeated in the nested do-loop until a prescribed quality of fit is achieved:

   $s = 1, 2, \ldots, s_{max}$ – number of the parameters,
   $v = 1, 2, \ldots, v_{max}$ – order of the polynomial approximation,
   $u = 20, 40, \ldots, u_{max}$ – order of the Fourier approximation.

   It provides a possibility to obtain the simple approximation of the prescribed quality.

Method 2

Method 2 follows almost the same procedure. As parameters, the moments of the transformed data are taken (after item 1 and not before it, as was done in method 1). The regression (4) does not use the algebraic polynomial regression, but the regression by polynomials of the functions

$$\frac{\sin Y}{Y},$$

where $$Y = r.\sqrt[k]{(k+1)m_k} ,$$

r is the order of the Fourier coefficient,
k is the order of the experimental moment m_k.

ACKNOWLEDGMENTS

The investigation was carried out with the support of the National Research Council of Canada and the Geological Survey of Canada through a postdoctorate fellowship. My most sincere thanks are due to Dr. E. M. Cameron who introduced me to the problem and whose continuing interest and advice was invaluable. I am grateful to Dr. F. P. Agterberg and Dr. R. G. Garrett for the help with the text. A portion of the programing was done at the Research Institute of Economics in Mines, Prague, Czechoslovakia, whose support I acknowledge with thanks.

A GUIDE FOR THE USE OF THE PROGRAM

ENTRY

The program is designed as a separate program, which needs in some cases initialization of parameter and data statements.

Parameters integer:

PAR1 is equal or greater than the maximum number of the data in a group. If this value does not agree with input data, the program is automatically driven to STOP.

PAR2 is the maximum order of the used Fourier truncated series. Permissible values: 20, 40, 60, . . . , 180.

Data statement:		Type:
BR	(method 2 only) is the starting order of Fourier truncated series plus one. Permissible values: 21, 41, 61, . . . , 181.	integer
IP	(method 2 only) is a switch. IP=0 . . . the table of coefficients g is both printed and punched in cards; IP=1 . . . the table is printed only.	integer
SCY	(method 1 only) is a scale for the data used in the program for the polynomial regression. A recommended value for geological data is SCY=6000.	real

Data statement (cont.):		Type:
QLIM	is the prescribed quality of the approximation, when the Kolmogorov criterion is used in the sense described in the theoretical part. $QLIM \in (0, 1)$, $QLIM \to 1$ represents a high quality approximation.	real
ULIM	is a general upper limit for the given random data. If ULIM=0., the program automatically puts the maximum value in it. Use ULIM>0 only if you suppose, that the result will be applied later to a new group of data containing larger random numbers.	real
NST	is the number of sampling points in the output plot. Recommended value is NST=500.	integer
SW	is a switch for the form of the output. SW=0 ... print only, including all obtained approximation in NST sampling points, SW=1 ... the same as for SW=0, but also plotting, SW=2 ... print of the most important results, obtained approximations in the plot only.	integer
XLEN	is the length of the X-axis in inches.	real
YLEN	is the length of the Y-axis in inches.	real
MOM	is the maximum number of the parameters (moments) taken into account. If this number exceeds the possibilities of the method, the program makes a corresponding correction automatically. $MOM \geq 1$.	integer
GIB	is a switch for a method, which is used to suppress the Gibb's phenomena. GIB=1 ... no improvement is used (original Fourier coef.), GIB=2 ... Lanczos sigma-coefficients, GIB=3 ... Féjer's method.	integer
HIS	(method 2 only) is a switch for plotting a numerical derivative of the obtained approximation. These curves can be interpreted as histograms, but usually their shapes have no practical value. HIS=0 ... no plotting, HIS=1 ... plotting with an automatic accommodation of the Y-scale.	integer
VAR	(method 1 only) is a switch for the scaling inside the program – see data value SCY. VAR=1 ... no scaling, VAR=4 ... automatic scaling plus use of SCY. Note: In method 2 no scaling need to be used, because the program uses the moments of the transformed data from $(0, \pi)$.	integer

Data statement (cont.): Type:

KOL	is a switch for the type of Kolmogorov criterion. KOL=1 ... the limit case (continuous function), KOL=2 ... the non-limit case (step function).	integer
LG	is a switch for the logarithmic scale in the plot. LG=1 ... linear scales in the plot, LG=2 ... a logarithmic scale for X-axis.	integer
TRA	is a switch for the transformation of input data. TRA=0 ... LOG (X+1), TRA=1 ... LOG (LOG (X+1) +1).	integer
POW	(method 2 only) is the power, by which the number of data in each group is taken to be a weighting coefficient in the polynomial regression. Use POW=0. for no improvement.	real

RESTRICTIONS

Program is designed for maximally N=16 sets of input data, plus one set of 'unfinished data'. The values from this set have no influence on the result, but they are compared with the obtained general distribution.

The available memory gives the second restriction:

$$N. PAR1 \leq 6400.$$

SPECIAL CONSIDERATIONS

(a) For every method, a special program was designed. The difference between methods affects the basic do-loop structure of the program.
(b) Sometimes it is difficult to choose the suitable program and transformation (TRA=0 or TRA=1), and this leads to several computations, maximally four - for both programs and for both the transformations.
(c) Programs should be safe against such troubles, as a slow convergence, singular systems of equations, errors in input data etc.

OTHER SUBPROGRAMS REQUIRED

GJR - Math-Pack, System of simultaneous equations,
DGJR - Math-Pack, System of simultaneous equations in the double precision arithmetic,
PLT - Calcomp routine for Univac 1108.

Note: There has been an error in DGJR routine in Math-Pack for the Univac. I recommend to use DGJR from the SSDO93 tape.

STOP BY ERROR

A stop can occur in connection with the input or output only. A corresponding message is typed on the line printer in such a case.

STORAGE

When all parameters are used, PAR1≥400, PAR2=180, the whole available memory of a Univac 1108 is used (about 50k).

INPUT DATA

Input data consist of cards with given random data and of auxiliary cards, which denote the beginning and the end of each group of data:

Number of cards		Format
1	Header card (name of the problem, date, ...)	12A6
1	Format of the data (number of the sample A6, value)	20A4
1	Header card of group 1	12A6
L(1)	Data group 1	given
1	blank card	-
1	Header card of the group 2	12A6
L(2)	Data group 2	given
1	blank card	-
....		
1	Header card of the group N-1	12A6
L(N-1)	Data group N-1	given
1	blank card	-
1	Header card of the last group	12A6
L(N)	Data - last group	given
1	card: FULLbb	1X, A6
1	Header card of the unfinished group	12A6
L(N+1)	Data - unfinished group	given
1	card: TESTbb	1X, A6

Sets of data denoted by } can be processed in sequence. Every set represents a new problem, which is solved separately. The end of the input is denoted by

1	card: STAR	A4

If you prepare the data, the best way is to follow the appendid brief example.

Note: The blank card denotes the end of the group. But only the name of the sample is checked - see given format, A6. It means, that all data cards must contain some letter or number in these columns (for example the number of the sample).

OUTPUT

The output print contains a list of input data, all details about the method and parameters used, partial results and results; see the example later. The switch SW can influence printing or plotting of the curves, representing an application of the obtained general distribution back to the given data.

The plot includes also the main information about the method, parameters, names of the groups, etc.

The possibility of the output in the cards is designed for the case that the general distribution is supposed to be used later for some other purposes.

APPROXIMATE TIMING

The computer time depends on many parameters and varies from 1 to 20 minutes. The time can be essentially shortened if a higher value of BR is chosen in method 2. Examples:

	Method 1	Method 2
Test example, 5 groups, 3-5 samples, PAR2=181, BR=21	1'27"	4'54"
Geochemistry data (Coppermine River Belt), 5 groups, 9-350 samples, PAR2=181, BR=21	6'27"	
Geochemistry data (Noranda and Yellowknife), 4 groups, 197-701 samples, PAR2=181, BR=21	3'43"	
Density of rock samples (Sudbury), 11 groups, 42-348 samples, PAR2=180, BR=181		17'52"

TEST EXAMPLE

A very simple example was used for both methods. The input data are presented just in the Fortran form; the programs, output prints and plots follow. The computations were done with slightly different parameters:

Parameter	PAR1	PAR2	BR	IP	SCY	QLIM	ULIM
Method 1	400	180	21		6.E3	0.9	0.
Method 2	400	180		1		0.9	0.

Parameter	NST	SW	XLEN	YLEN	MOM	GIB	HIS
Method 1	500	2	10.	5.	4	2	
Method 2	500	2	10.	5.	4	2	0

Parameter	VAR	KOL	LG	TRA	POW
Method 1	4	1	2	0	
Method 2		1	1	0	1.

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1961: Kurs teorii verojatnostej, Moscow; pp. 349-354, 395, 396.

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1961: Applied analysis, Russian translation, Moscow; pp. 230-236.

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1969: Semi-numerical algorithms, vol. 2, The art of computer programming; Stanford Univ., pp. 41-51.

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APPENDIX 1

Computer Program, Method 1

```
      PARAMETER PAR1=400
      PARAMETER PAR2=180
      PARAMETER PAR3=6400/PAR1
      PARAMETER PAR4=PAR1+1
      PARAMETER PAR5=PAR2+1
      PARAMETER PAR6=PAR3+1
      PARAMETER PAR7=PAR5+20
      COMMON P(15,17)
      INTEGER SX,SW,SS,GIB,VAR,TRA
      REAL MAX
      DOUBLE PRECISION AD,PBD
      DIMENSION A(PAR4,PAR6),L(PAR6),C(PAR5,PAR3),B(15,15),BB(15,PAR5),
     1INF(12),W(PAR6,PAR5),CC(PAR5,PAR6),
     2SS(12,PAR6),SX(12),QQ(PAR6),QQR(PAR6),BUF(3000),
     3PB(2),AQ(PAR3,PAR7),JC(2),WR(PAR6,PAR5),CR(PAR5,PAR6),IFMT(20),
     4AD(PAR3,PAR7),PBD(2),IBCX(1)/6HVALUE /,IBCY(2)/6HPROBAB,6HILITY /,
     5INST(1)/4HNST=/,INU(1)/4HNU= /,IMOM(1)/4HMOM=/,IGIB(1)/4HGIB=/,
     6IVAR(1)/4HVAR=/,IKOL(1)/4HKOL=/,IRES(4)/6HRESULT,6H AFTER,6H CORRE
     7,6HCTION=/,ISCY(1)/4HSCY=/,IBXX(2)/6HLOG OF,6H VALUE/,ITR(1)/4HTRA
     8=/
      DATA KK/6H      /,KF/6HFULL  /,KFA/6HTEST  /,IEND/4HSTAR/,
     1LIM/PAR1/,SCY/6.E3/,IOUT/3/,QLIM/0.8 /,ULIM/0./,NST/500/,NU/PAR5/,
     2SW/2/,XLEN/10./,YLEN/ 5./,MOM/4/,GIB/2/,VAR/4/,KOL/1/,LG/2/,TRA/0/
      READ(1,02)(INF(I),I=1,12)
      WRITE(IOUT,2054)(INF(I),I=1,12)
 2054 FORMAT(1H0///1H ,12A6)
      IF(SW)499,499,2037
 2037 CALL PLOTS(BUF,3000)
      CALL SYMBOL(0.,0.,0.21,INF,90.,72)
      CALL SYMBOL(1.,9.,0.21,INST,0.,4)
      CALL NUMBER(2.05,9.,0.21,FLOAT(NST),0.,-1)
      CALL SYMBOL(1.,8.5,0.21,INU,0.,4)
      CALL NUMBER(2.05,8.5,0.21,FLOAT(NU),0.,-1)
      CALL SYMBOL(1.,8.,0.21,IMOM,0.,4)
      CALL NUMBER(2.05,8.,0.21,FLOAT(MOM),0.,-1)
      CALL SYMBOL(1.,7.5,0.21,IGIB,0.,4)
      CALL NUMBER(2.05,7.5,0.21,FLOAT(GIB),0.,-1)
      CALL SYMBOL(1.,7.,0.21,IVAR,0.,4)
      CALL NUMBER(2.05,7.,0.21,FLOAT(VAR),0.,-1)
      CALL SYMBOL(1.,6.5,0.21,IKOL,0.,4)
      CALL NUMBER(2.05,6.5,0.21,FLOAT(KOL),0.,-1)
      CALL SYMBOL(1.,6.,0.21,ISCY,0.,4)
      CALL NUMBER(2.05,6.,0.21,SCY,0.,4)
      CALL SYMBOL(1.,5.5,0.21,ITR,0.,4)
      CALL NUMBER(2.05,5.5,0.21,FLOAT(TRA),0.,-1)
      CALL PLOT(7.,0.0,-3)
C     TRA IS THE SWITCH FOR BASIC TRANSFORMATION
C     TRA=0 CORRESPONDS TO (LOG(X+1))
C     TRA=1 CORRESPONDS TO (LOG(LOG(X+1)+1))
C     TRA=1 USE FOR VERY SHARP DISTRIBUTIONS WITH A FLAT END
C     LG IS A SWITCH FOR THE X-AXIS IN THE PLOT
C     LG=1 LINEAR SCALE,LG=2 LOGARITHMIC SCALE
C     GIB IS A SWITCH,WHICH INFLUENCES THE GIBB'S PHENOMENA=
C     GIB=1 NO SPECIAL PROCEDURE,GIB=2 LANCZOS SIGMA-COEFFICIENTS,.
C     GIB=3 FEJER'S COEFFICIENTS
C     VAR IS A SWITCH,WHICH CORRESPONDS TO THE VARIANTS  OF THE PROGRAM
C     VAR=1 LOGARITH.SCALE-NO SCALE S, VAR=4 FULL LOGARITTH.SCALE
C     KOL IS A SWITCH FOR KOLMOGOROW CRITERION.KOL=1 CONTINUOUS CRITER.,
C     KOL=2 EXPERIMENTAL STEP DISTRIB.CURVE, FOR RUNNING SUPPPOSED KOL=2
C     SW IS A SWITCH FOR OUTPUT FORM.
C     SW=0 PRINT,SW=1 PRINT AND PLOT,SW=2 PLOT ONLY (ONLY THE MAIN
C     NUMBER OF BLOCKS IN THE PLOT IS 2*P+2,WHERE P IS NUMBER OF GROUPS
C     RESULTS PRINTED).
C     AT ALL EXAMPLES.
C     XLEN IS THE LENGTH OF THE PLOT (X - AXIS)
C     YLEN IS THE HIGH OF THE PLOT (Y - AXIS)
C     READING OF THE CARDS.INPUT CARDS=INFORMATION CARD,FORMAT CARD OF
C     THE FIRST EXAMPLE,HEAD CARD,SAMPLES OF THE GROUP 1,BLANC CARD,
C     HEAD CARD,SAMPLES OF THE GROUP 2,BLANC CARD, ... ,HEAD CARD,
C     SAMPLES OF THE LAST GROUP,''FULL''CARD,HEAD CARD,SAMPLES OF THE
```

```
C     UNFINISHED GROUP,''TEST'' CARD,FORMAT CARD OF THE SECOND EXAMPLE,
C     HEAD CARD, ... ,''TEST''CARD OF THE LAST EXAMPLE,''STAR''CARD.
C     ALLOWED MAXIMALLY 17 GROUPS OF SAMPLES (TILL 500 SAMPLES EACH)=
C     16 GIVEN GROUPS, 1 UNFINISHED GROUP
C     INFORMATION CARD CONTAINS THE GENERAL INFORMATION ABOUT THE RUNNIN
C     G (E.G.DATE,NAME,NAME OF THE PROGRAMMER,...).THIS INFORMATION IS
C     PRINTED AND ALSO PLOTTED (IF SW.GT.0)
  499 READ(1,427)(IFMT(I),I=1,20)
      IF(IFMT(1).EQ.IEND)GO TO 4991
C     MAXIMUM L=500,LIMITED BY THE DIMENSION OF A(I,J)
C     HELPING SCALE SCY HAS SOME INFLUENCE TO THE QUALITY  OF
C     APPROXIMATION. EXPERIENCE RECOMENDS SCY=  1. IF SCY CHOSEN SO BIG,
C     THAT THERE COULD BE TROUBLES WITH SOLVING OF LINEAR SYSTEM FOR
C     REGRESSION,THE VALUE IS AUTOMATICALLY PUSHED DOWN BY THE PROGRAM.
  427 FORMAT(20A4)
C     FORMAT CARD SERVES FOR READING OF THE NAME OF THE SAMPLE (A6)
C     AND OF THE MEASURED VALUE (REAL).
C     NAMES (FULL  ),(      ),(TEST  ),(STAR)  ARE RESERVED FOR
C     ORGANISATION - PURPOSES,SEE ABOVE
C     QLIM IS GIVEN LEVEL FOR KOLMOGOROW,S CRITERIUM
C     FOR RUNNING SUPPOSED Q=0.5
C     ULIM IS THE PRACTICAL UPPER LIMIT FOR THE VALUES A(I\J).
C     IF THIS CHOSEN TOO HIGH,FOURIER,S SERIE CONVERGES VERY SLOWLY.
C     USE THIS VALUE IN THE CASE ONLY THAT YOU SHOULD GUESS A NEW
C     DISTRIBUTION AND THE SAMPLES OF THE NEW GROUP YOU HAVE
C     CONTAINS RELATIVELY HIGH VALUES.
C     NST IS MINIMUM NUMBER OF THE POINTS FOR FOURIER,S SYNTHESIS IN OUT
C     PUT PRINT OR PLOT.THIS VALUE HAS NO INFLUENCE TO THE RESULTS.
C     MAXIMUM NST IS NOT LIMITED,BUT TAKE IN ACCOUNT THAT THE RESULTS
C     ARE EQUIDISTANT FROM THE POINT OF VIEW OF THE FOURIER SYNTHESIS,IT
C     MEANS WITH AN APPROXIMATELY LOGARITHMIC SCALE.IF NST IS TOO SMALL
C     THE RESULTING Q-COEFFICIENTS COULD BE A LITTLE WORSE= THEY CORRES-
C     POND THEN TO THE PURE FOURIER SYNHESIS WITHOUT A CORRECTION FOR
C     MONOTONICITY.
C     NU IS THE NUMBER OF THE MEMBERS OF THE FOURIER,S APPROXIMATION.
C     MAXIMUM NU=181
C     MOM IS A MAXIMUM NUMBER OF THE FIRST CENTRAL MOMENTS,WHICH ARE
C     TESTED AS THE PARAMETERS OF THE DISTRIBUTION.VALUE OF MOM IS
C     AUTOMATICALLY LIMITED ACCORDING TO THE NUMBER OF GROUPS.NORMALLY
C     MOM.GT.3 HAS NO SENSE,BUT IF YOU SUPPOSE THE DISTRIBUTION COULD BE
C     A SUPERPOSITION OF TWO DISTRIBUTIONS(EACH HAVING TWO PARAMETERS),
C     MOM=4 OR GREATER IS NECESSARY A.S.O.
   01 FORMAT(1X,A6,12X,F6.0)
   02 FORMAT(1H0,12A6)
  498 FORMAT(1H1,'ANALYSIS OF THE GENERAL TYPE OF THE DISTRIBUTION'/1H ,
     1'------------------------------------------------'/1H ,'METHOD 1
     2'/1H0)
      WRITE(IOUT,498)
      N=0
   03 N=N+1
      L(N)=1
      READ(1,02)(SS(I,N),I=1,12)
      WRITE(IOUT,02)(SS(I,N),I=1,12)
   04 LL=L(N)
      READ(1,IFMT)JJ,A(LL,N)
      IF(JJ.EQ.KK)GO TO 03
      IF(JJ.EQ.KFA)GO TO 432
      IF(JJ.EQ.KF)GO TO 431
      IF(L(N).GT.(LIM+1))GO TO 474
      L(N)=L(N)+1
      GO TO 04
  474 WRITE(IOUT,475)
  475 FORMAT(1H ,'TOO MANY SAMPLES IN THIS GROUP,SEE PARAMETER LIM')
      GO TO 477
  431 NY=N
      WRITE(IOUT,434)
  434 FORMAT(1H0,'UNFINISHED DATA='/1H )
      GO TO 03
  432 IF(L(N).EQ.1)GO TO 433
      NX=N
```

```
      GO TO 05
  433 NX=N-1
   05 N=NY
      MOM=MINO(MOM,N-1)
      DO 713 J=1,NX
  713 L(J)=L(J)-1
      WRITE(IOUT,709)
  709 FORMAT(1H0,'LIST OF THE INPUT DATA'/1H )
  708 FORMAT(1H ,17E9.3)
      DO 707 J=1,LIM
      JJ=0
      DO 706 I=1,NX
      LL=L(I)+1
      IF(J-LL)705,704,704
  704 A(J,I)=-0.1
      GO TO 706
  705 JJ=1
  706 CONTINUE
      IF(JJ.EQ.0)GO TO 703
  707 WRITE(IOUT,708)(A(J,I),I=1,NX)
  703 CONTINUE
C     ORDERING OF THE VALUES A(I,J)
      DO 06 J=1,NX
      LL=L(J)
      DO 06 I=1,LL
      DO 06 IS=1,I
      IF(A(I,J).LT.A(IS,J))GO TO 07
      GO TO 06
   07 AA=A(I,J)
      INN=I-IS
      DO 08 IB=1,INN
   08 A(I+1-IB,J)=A(I-IB,J)
      A(IS,J)=AA
   06 CONTINUE
C     COMPUTING OF THE MOMENTS
C     COMPUTING MAX
      MAX=ULIM
      DO 09 J=1,NX
      DO 2000 IB=1,MOM
 2000 P(IB,J)=0.
      LL=L(J)
      DO 2035 I=1,LL
 2035 P(1,J)=P(1,J)+A(I,J)
      P(1,J)=P(1,J)/LL
      IF(MOM-2)09,2036,2036
 2036 DO 2001 IB=2,MOM
      DO 10 I=1,LL
   10 P(IB,J)=P(IB,J)+(A(I,J)-P(1,J))**IB
 2001 P(IB,J)=P(IB,J)/LL
   09 MAX=AMAX1(MAX,A(LL,J))
      WRITE(IOUT,420)MOM
  420 FORMAT(1H0,'FIRST ',I2,' CENTRAL MOMENTS (POSSIBLE PARAMETERS OF T
     1HE DISTRIBUTION)'/1H )
      DO 421 J=1,NX
  421 WRITE(IOUT,422)(P(I,J),I=1,MOM)
  422 FORMAT(1H ,15E8.3)
      WRITE(IOUT,423)
  423 FORMAT(1H0///1H ,80HPARTIAL RESULTS OBTAINED QUALITY FOR (NUMBER O
     1F MOMENTS/ORDER OF THE POLYNOMIAL)   /1H ,'NUMBERS IN BRACKETS DEN
     2OTE THE ORDERING OF USED MOMENTS FOR POLYNOMIAL APPROXIMATION' /1H
     30,2X)
      WRITE(IOUT,426)
  426 FORMAT(1H ,'ON THE END OF EACH ROW A MINIMUM VALUE')
      IF(VAR-1)2045,2045,2046
 2045 SC=1.
      GO TO 2044
 2046 SC=0.
      SCY=AMIN1(SCY,1.0E30**(1./(N-1)))
      DO 449 J=1,NX
      DO 449 I=1,MOM
```

```
  449 SC=AMAX1(SC,ABS(P(I,J))**(1./FLOAT(I)))
  481 SC=SC/SCY
  482 MAX=MAX/SC
      DO 450 J=1,NX
      DO 2003 I=1,MOM
 2003 P(I,J)=(ABS(P(I,J))**(1./I)/SC)**I*P(I,J)/ABS(P(I,J))
      LL=L(J)
      DO 450 I=1,LL
  450 A(I,J)=A(I,J)/SC
 2044 MAX=ALOG(MAX+1.)
      IF(TRA.EQ.1)MAX=ALOG(MAX+1.)
      DO 194 J=1,NX
      LL=L(J)
      DO 194 I=1,LL
      IF(TRA.EQ.1)A(I,J)=ALOG(A(I,J)+1.)
  194 A(I,J)=ALOG(A(I,J)+1.)+MAX/2.
      MAX=2.*MAX
C     TRANSFORMATION TO THE INTERVAL (0,PI)
      DO 13 J=1,NX
      LL=L(J)
      DO 13 I=1,LL
   13 A(I,J)=A(I,J)*3.1415926/MAX
C     ARRANGE FOR MULTIPLIED STEPS
      DO 413 J=1,NX
      LL=L(J)
      DO 413 I=2,LL
      IF(A(I,J)-A(I-1,J))414,414,413
  414 A(I,J)=A(I-1,J)+0.000001
  413 CONTINUE
      NUX=1
      MR=1
      MMR=1
      QR=0.
      NUXR=21
  441 NUX=NUX+20
      IF(NUX-NU)444,443,442
  442 IF(NUX-20-NU)443,446,446
  443 NUX=NU
  444 WRITE(IOUT,445)NUX
  445 FORMAT(1H0,'DEGREE OF THE FOURIER,S SERIES =',I3)
C     FOURIER ANALYSIS ...  C(K,J)
      DO 14 J=1,N
      LL=L(J)
      DO 14 IB=1,NUX
      K=IB-1
      C(K+1,J)=0.
      DO 15 I=1,LL
      C(K+1,J)=C(K+1,J)+SIN(K*A(I,J))
      IF(K)16,16,15
   16 C(K+1,J)=C(K+1,J)+A(I,J)
   15 CONTINUE
      C(K+1,J)=-C(K+1,J)/(LL*3.1415926)
      IF(K)17,17,18
   17 C(K+1,J)=1+C(K+1,J)
      GO TO 14
   18 GO TO(2041,2042,2043),GIB
 2041 C(K+1,J)=2*C(K+1,J)/K
      GO TO 14
 2043 C(K+1,J)=2*C(K+1,J)*(NUX+1-K)/FLOAT(K*(NUX+1))
C     GIBB'S PHENOMENA PUSHED DOWN BY FEJER'S METHOD,SEE CARSLAW=FOURIER
C     SERIES,P.234
      GO TO 14
 2042 C(K+1,J)=2*C(K+1,J)*NUX*SIN(K*3.1415926/NUX)/(3.1415926*K*K)
C     GIBB'S PHENOMENA PUSHED DOWN BY ''SIGMA'' COEFFICIENTS
C     SEE LANCZOS=APPLIED MATHEMATICS,P.236
   14 CONTINUE
C     BEGINING OF THE REGRESSION, DEGREE OF THE REGR. POLYNOMIAL
   19 DO 20 M=1,MOM
      NM=N-2
      DO 20 MM=1,NM
      IF(M-2)21,22,2006
```

```
   21 IF(MM-N+2)24,24,20
   22 IF(MM-1)20,25,26
   25 IF(N-4)20,24,24
   26 IF(MM-3)27,28,29
   27 IF(N-7)20,24,24
   28 IF(N-11)20,24,24
   29 IF(MM-4)20,30,20
   30 IF(N-16)20,24,24
 2006 IF(M-4)23,2004,2005
   23 IF(MM-1)20,31,32
   31 IF(N-5)20,24,24
   32 IF(MM-3)33,20,20
   33 IF(N-11)20,24,24
   24 IF(M-5)2007,2007,60
 2007 IF(MM-1)20,56,60
 2004 IF(MM-2)2010,2008,20
 2008 IF(N-16)20,24,24
 2005 IF(MM-1)20,2010,20
 2010 IF(N-MM-2)20,24,24
C      MATRIX FOR REGRESSION
   56 LL=N-1
      IF(M-2)41,42,43
   41 LS=LL
      GO TO 40
   42 LS=MINO(15,LL)
      GO TO 40
   43 IF(M-4)44,45,46
   44 LS=MINO(10,LL)
      GO TO 40
   45 LS=MINO(15,LL)
      GO TO 40
   46 LS=MINO(M+1,LL)
   40 DO 38 I=1,LS
      DO 38 K=I,LS
      B(I,K)=0.
      DO 38 J=1,N
   38 B(I,K)=B(I,K)+F(M,I,J)*F(M,K,J)
      DO 39 I=1,LS
      LLL=I-1
      DO 39 K=1,LLL
   39 B(I,K)=B(K,I)
      DO 47 I=1,LS
      DO 47 K=1,NUX
      BB(I,K)=0.
      DO 47 J=1,N
   47 BB(I,K)=BB(I,K)+C(K,J)*F(M,I,J)
   60 CONTINUE
C      INPUT TO THE SYSTEM OF THE LINEAR EQUATION
      IF(M-2)311,312,313
  311 LL=MM+1
      GO TO 318
  312 IF(MM-1)20,319,320
  319 LL=3
      GO TO 318
  320 IF(MM-3)321,322,323
  321 LL=6
      GO TO 318
  322 LL=10
      GO TO 318
  323 LL=15
      GO TO 318
  313 IF(MM-1)20,324,325
  324 LL=4
      GO TO 318
  325 LL=10
  318 LLS=LL+NUX
      PB(1)=4.
      DO 314 I=1,LL
      DO 315 J=1,LL
  315 AQ(I,J)=B(I,J)
```

```
      DO 314 J=1,NUX
  314 AQ(I,LL+J)=BB(I,J)
      CALL GJR(AQ,201,16,LL,LLS,$464,JC,PB)
  316 DO 317 I=1,LL
      DO 317 J=1,NUX
  317 W(I,J)=AQ(I,LL+J)
C     FOURIER,S COEFFICIENTS
  468 DO 64 K=1,NUX
      DO 64 I=1,NX
   64 CC(K,I)=0
      IF(M-2)61,62,2020
 2020 IF(M-4)63,2024,2025
C     FOURIER COEFFICIENTS AS A RESULT OF REGRESSION,M=1
   61 DO 65 K=1,NUX
      LL=MM+1
      DO 65 I=1,LL
      DO 65 J=1,NX
   65 CC(K,J)=CC(K,J)+W(I,K)*P(1,J)**(I-1)
      GO TO 70
  464 DO 465 I=1,LL
      DO 466 J=1,LL
  466 AD(I,J)=DBLE(B(I,J))
      DO 465 J=1,NUX
  465 AD(I,LL+J)=DBLE(BB(I,J))
      PBD(1)=4.
      CALL DGJR(AD,201,16,LL,LLS,$447,JC,PBD)
      DO 467 I=1,LL
      DO 467 J=1,NUX
  467 W(I,J)=SNGL(AD(I,LL+J))
      GO TO 468
  447 WRITE(IOUT,448)M,MM
      GO TO 190
  448 FORMAT(1H ,I2,1H/,I2,2X,'LINEAR SYSTEM FOR REGRESSION HAS NO SOLUT
     1ION EVEN IN DOUBLE PRECISION ARITHMETIC')
C     FOURIER COEFFICIENTS AS A RESULT OF REGRESSION,M=2
   62 DO 66 K=1,NUX
      DO 66 J=1,NX
      S=P(1,J)
      T=P(2,J)
      CC(K,J)=CC(K,J)+W(1,K)+W(2,K)*S+W(3,K)*T
      IF(MM-2)66,67,67
   67 CC(K,J)=CC(K,J)+W(4,K)*S*S+W(5,K)*S*T+W(6,K)*T*T
      IF(MM-3)66,68,68
   68 CC(K,J)=CC(K,J)+W(7,K)*S**3+W(8,K)*S*S*T+W(9,K)*S*T*T+W(10,K)*T**3
      IF(MM-4)66,69,20
   69 CC(K,J)=CC(K,J)+W(11,K)*S**4+W(12,K)*S**3*T+W(13,K)*S*S*T*T
     1+W(14,K)*S*T**3+W(15,K)*T**4
   66 CONTINUE
      GO TO 70
C     FOURIER COEFFICIENTS AS A RESULT OF REGRESSION,M=3
   63 DO 71 K=1,NUX
      DO 71 J=1,NX
      S=P(1,J)
      T=P(2,J)
      U=P(3,J)
      CC(K,J)=CC(K,J)+W(1,K)+W(2,K)*S+W(3,K)*T+W(4,K)*U
      IF(MM-2)71,72,20
   72 CC(K,J)=CC(K,J)+W(5,K)*S*S+W(6,K)*T*T+W(7,K)*U*U+W(8,K)*S*T
     1+W(9,K)*S*U+W(10,K)*T*U
   71 CONTINUE
      GO TO 70
 2024 DO 2021 K=1,NUX
      DO 2021 J=1,NX
      S=P(1,J)
      T=P(2,J)
      U=P(3,J)
      V=P(4,J)
      CC(K,J)=CC(K,J)+W(1,K)+W(2,K)*S+W(3,K)*T+W(4,K)*U+W(5,K)*V
      IF(MM-2)2021,2023,2023
 2023 CC(K,J)=CC(K,J)+W(6,K)*S**2+W(7,K)*S*T+W(8,K)*S*U+W(9,K)*S*V+W(10,
```

```
     1K)*T**2+W(11,K)*T*U+W(12,K)*T*V+W(13,K)*U**2+W(14,K)*U*V+W(15,K)*
     2V**2
 2021 CONTINUE
      GO TO 70
 2025 DO 2022 K=1,NUX
      DO 2022 J=1,NX
      CC(K,J)=W(1,K)
      DO 2022 I=1,M
 2022 CC(K,J)=CC(K,J)+W(I+1,K)*P(I,J)
   70 CONTINUE
C     FOURIER SYNTHESIS
      QM=1.
      DO 73 J=1,N
      WMAX=0.
      LL=L(J)
      DO 74 I=1,LL
      AA=0.
      DO 75 K=1,NUX
   75 AA=AA+CC(K,J)*COS((K-1)*A(I,J))
      R=FLOAT(I)/LL-AA
      S=AA-FLOAT(I-1)/LL
   74 WMAX=AMAX1(WMAX,R,S)
C     KOLMOGOROW,S TEST
      IF(KOL-1)2049,2049,2047
 2049 QQ(J)=FKC(WMAX,LL)
      GO TO 2048
 2047 QQ(J)=FK(WMAX,LL)
 2048 IF(QQ(J)-QM)85,73,73
   85 QM=QQ(J)
   73 CONTINUE
      WRITE(IOUT,428)M,MM,(QQ(J),J=1,N),QM
  428 FORMAT(1H ,I2,1H/,I2,20(F5.2))
C     ITEM 9
      IF(QM-QR)87,87,86
   86 QR=QM
      DO 300 J=1,N
  300 QQR(J)=QQ(J)
      DO 196 J=1,NX
      DO 196 I=1,NUX
      CR(I,J)=CC(I,J)
  196 WR(J,I)=W(J,I)
      MR=M
      MMR=MM
      NUXR=NUX
   87 IF(QR-QLIM)20,88,88
  190 CONTINUE
   20 CONTINUE
      GO TO 441
C     PRINT,IF THE GIVEN QUALITY HASNT BEEN REACHED
   89 FORMAT(1H1,19HGIVEN QUALITY   Q= ,F6.4,23H  HAS NOT BEEN ACHIEVED/
     11H ,19HTHE BEST RESULT Q= ,F6.4///1H )
  446 WRITE(IOUT,89)QLIM,QR
      NUX=NUX-20
      GO TO 90
C     PRINT OF THE RESULTS
   91 FORMAT(1H0,10HRESULT Q= ,F6.4///1H )
   88 WRITE(IOUT,91)QR
   90 XAXX=0.5*MAX
      IF(TRA)3010,3010,3011
 3011 XAX=(EXP(EXP(XAXX)-1.)-1.)*SC
      GO TO 3012
 3010 XAX=(EXP(XAXX)-1.)*SC
 3012 NUX=NUXR
      WRITE(IOUT,445)NUX
      IF(TRA.EQ.0)WRITE(IOUT,92)XAXX,SC,XAX
      IF(TRA.EQ.1)WRITE(IOUT,3092)XAXX,SC,XAX
   92 FORMAT(1H0,'GENERAL FORM OF THE CUMMULATIVE CURVE='/1H ,'F(Z)=MAX
     1FF(T)  FOR T=(0,Z),F(Z) LESS 1.'/1H ,'WHERE FF(T) IS AN EVEN FOURI
     2ER SUM'/1H ,        42HFF(T)=A(0)+A(1)*COS(X)+A(2)*COS(2*X)...  /1
     3H ,'WHERE X=3.14165926*(ALOG(T/S+1)+MAX/2)/(2*MAX)'/1H ,12HWHERE
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```
    4MAX= ,E11.6,' ,S= ',E11.6,'  IS THE SCALE FACTOR'
    5           /1H ,E11.6,51H   IS THE SUSPECTED MAXIMUM VALUE FOR INP
    6UT VALUES,/1H ,60HIF YOU LIKE TO CHANGE IT,PUT IN THE MAXIMUM AS P
    7ARAMETR ULIM)
3092 FORMAT(1H0,'GENERAL FORM OF THE CUMMULATIVE CURVE='/1H ,'F(Z)=MAX
    1FF(T)  FOR T=(0,Z),F(Z) LESS 1,'/1H ,'WHERE FF(T) IS AN EVEN FOURI
    2ER SUM'/1H ,          42HFF(T)=A(0)+A(1)*COS(X)+A(2)*COS(2*X)...  /1
    3H ,'WHERE X=3.14165926*(ALOG(ALOG(T/S+1)+1)+MAX/2)/(2*MAX)'/1H ,
    4                                                       12HWHERE
    5MAX= ,E11.6,' ,S= ',E11.6,'  IS THE SCALE FACTOR'
    6           /1H ,E11.6,51H   IS THE SUSPECTED MAXIMUM VALUE FOR INP
    7UT VALUES,/1H ,60HIF YOU LIKE TO CHANGE IT,PUT IN THE MAXIMUM AS P
    8ARAMETR ULIM)
     WRITE(IOUT,96)
  96 FORMAT(1H0,55HPOLYNOMIAL APPROXIMATION AFTER THIS TRANSFORMATION F
    1OR:)
  98 WRITE(IOUT,99)
  99 FORMAT(1H ,  'U=M1(X)/S    ... SCALED FIRST CENTRAL MOMENT')
     IF(MR-2)97,101,101
  95 FORMAT(1H ,  'V=M2(X)/S**2 ... SCALED SECOND CENTRAL MOMENT')
 101 WRITE(IOUT,95)
     IF(MR-3)97,102,102
  94 FORMAT(1H ,     'W=M3(X)/S**3 ... SCALED THIRD CENTRAL MOMENT')
 102 WRITE(IOUT,94)
     IF(MR-4)97,2026,2026
2026 WRITE(IOUT,2027)
2027 FORMAT(1H ,'Z=M4(X)/S**4 ... SCALED FORTH CENTRAL MOMENT')
     IF(MR-5)97,2028,2028
2029 FORMAT(1H ,6X,17('.')/1H ,'AND SO ONE,FOR ',I2,' MOMENTS')
2028 WRITE(IOUT,2029)MR
  93 FORMAT(1H0,30HGENERAL FORM OF THE POLYNOMIAL)
  97 WRITE(IOUT,93)
     IF(MR-2)106,107,2030
2030 IF(MR-4)108,2031,2032
 211 FORMAT(1H , 50HA(K)=G(K,1)+G(K,2)*U+G(K,3)*U**I+...+G(K,19)*U**18)
 106 WRITE(IOUT,211)
     GO TO 105
 110 FORMAT(1H ,104HA(K)=G(K,1)+G(K,2)*U+G(K,3)*V+G(K,4)*U**2+G(K,5)*U*
    1V+G(K,6)*V**2+G(K,7)*U**3+G(K,8)*U**2*V+G(K,9)*U*V**2/1H ,
    2 86HG(K,10)*V**3+G(K,11)*U**4+G(K,12)*U**3*V+G(K,13)*U**2*V**2+G(K
    3,14)*U*V**3+G(K,15)*V**4)
 107 WRITE(IOUT,110)
     GO TO 105
2031 WRITE(IOUT,2033)
2033 FORMAT(1H ,'A(K)=G(K,1)+G(K,2)*U+G(K,0)*V+G(K,4)*W+G(K,5)*Z+G(K,6)
    1*U**2+G(K,7)*U*V+G(K,8)*U*W+G(K,9)*U*Z+G(K,10)*V**2+G(K,11)*V*W+G(
    2K,12)*V*Z+G(K,13)*W**2+G(K,14)*W*Z+G(K,15)*Z**2')
     GO TO 105
2032 WRITE(IOUT,2034)MR,MR,MR
     GO TO 105
2034 FORMAT(1H ,'A(K)=G(K,1)+G(K,2)*U+G(K,3)*V+ ... +G(K,',I2,')*M',I2,
    1'(X)/S**',I2)
 410 FORMAT(1H ,108HA(K)=G(K,1)+G(K,2)*U+G(K,3)*V+G(K,4)*W+G(K,5)*U**2+
    1G(K,6)*V**2+G(K,7)*W**2+G(K,8)*U*V+G(K,9)*U*W+G(K,10)*V*W)
 108 WRITE(IOUT,410)
 105 NUXX=NUX-1
     WRITE(IOUT,112)MMR,NUXX
 112 FORMAT(1H ,11HUSED ORDER:,I2///1H ,'LIST G(K,J)FOR K=0,...,',I3)
 115 IF(MR-2)117,118,119
 117 LOK=MMR+1
     GO TO 116
 118 IF(MMR-2)120,121,122
 120 LOK=3
     GO TO 116
 121 LOK=6
     GO TO 116
 122 IF(MMR-3)123,123,124
 123 LOK=10
     GO TO 116
 124 LOK=15
```

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      GO TO 116
  119 IF(MMR-2)125,126,126
  125 LOK=4
  126 LOK=10
  116 CONTINUE
      DO 127 K=1,LOK
  127 WRITE(IOUT,128)(WR(K,J),J=1,NUX)
  128 FORMAT(1H ,20(/1H ,10E11.6))
      QR=1.
      DO 130 K=1,NX
      WRITE(IOUT,129)(SS(J,K),J=1,12),L(K)
  129 FORMAT(1H ////1H ,12A6/1H ,                                   23HNU
     1MBER OF THE SAMPLES: ,I4///1H ,27HVALUE       ORIG.    APPROX./1H )
      I=0
      LL=L(K)
      X=0.
      Y=0.
      YP=0.
      AY=0.
      WMAX=0.
      IF(SW.EQ.0)GO TO 606
      WRITE(IOUT,607)
  607 FORMAT(1H ,'(CURVES ON THE PLOTTER)')
      IF(LG.EQ.1)TIC=XAX/XLEN
      IF(LG.EQ.2)TIC=ALOG(XAX)/XLEN
      TAC=1./YLEN
      IF(LG.EQ.1)CALL AXIS(0.,0.,IBCX,-5,XLEN,0.,0.,TIC)
      IF(LG.EQ.2)CALL AXIS(0.,0.,IBXX,-12,XLEN,0.,0.,TIC)
      CALL AXIS(0.,0.,IBCY,11,YLEN,90.,0.,TAC)
      DO 601 J=1,12
  601 SX(J)=SS(J,K)
      X=0.5*XLEN
      Y=0.3*YLEN
      S=XLEN/2.
      S=AMAX1(S,YLEN)
      S=S/3.
      J=IFIX(S)
      BCD=0.07*J
      CALL SYMBOL(X,Y,BCD    ,SX,0.,72)
      X=A(1,K)
      S=EXP(X*MAX/3.1415926-MAX/4.)-1.
      IF(TRA.EQ.1)S=EXP(S)-1.
      IF(LG.EQ.1)S=S*SC/TIC
      IF(LG-2)3014,3015,3015
 3015 IF(S*SC-1.)3016,3016,3017
 3016 S=0.
      GO TO 3014
 3017 S=ALOG(S*SC)/TIC
 3014 CALL PLOT(S,0,3)
      LLL=LL-1
      DO 602 J=1,LLL
      Y=YLEN*J/FLOAT(LL)
      X=A(J,K)
      S=EXP(X*MAX/3.1415926-MAX/4.)-1.
      IF(TRA.EQ.1)S=EXP(S)-1.
      IF(LG.EQ.1)S=S*SC/TIC
      IF(LG-2)3024,3025,3025
 3025 IF(S*SC-1.)3026,3026,3027
 3026 S=0.
      GO TO 3024
 3027 S=ALOG(S*SC)/TIC
 3024 CALL PLOT(S,Y,2)
      X=A(J+1,K)
      S=EXP(X*MAX/3.1415926-MAX/4.)-1.
      IF(TRA.EQ.1)S=EXP(S)-1.
      IF(LG.EQ.1)S=S*SC/TIC
      IF(LG-2)3034,3035,3035
 3035 IF(S*SC-1.)3036,3036,3037
 3036 S=0.
      GO TO 3034
```

```
3037 S=ALOG(S*SC)/TIC
3034 CALL PLOT(S,Y,2)
 602 CONTINUE
     CALL PLOT(S,YLEN,2)
     CALL PLOT(XLEN,YLEN,2)
     CALL PLOT(0.0,0.0,-3)
     DO 603 I=1,NST
     X=I*3.1415926/NST
     S=EXP(X*MAX/3.1415926-MAX/4.)-1.
     IF(TRA.EQ.1)S=EXP(S)-1.
     IF(LG.EQ.1)S=S*SC/TIC
     IF(LG-2)3044,3045,3045
3045 IF(SC*S-1.)3046,3046,3047
3047 S=ALOG(S*SC)/TIC
3044 IF(S)3046,3046,609
3046 S=0.
 609 IF(S-XLEN)604,604,603
 604 AA=0.
     DO 605 LH=1,NUX
 605 AA=AA+CR(LH,K)*COS((LH-1)*X)*YLEN
     AY=AMAX1(AY,AA)
     AY=AMIN1(AY,YLEN)
     CALL PLOT(S,AY,2)
 603 CONTINUE
     CALL PLOT(XLEN*1.25,0.0,-3)
     I=0
     X=0.
     Y=0.
     YP=0.
     AY=0.
     WMAX=0.
 606 DO 133 J=1,LL
 134 FORMAT(1H ,E 8.3,2X,F6.4,2X,F6.4)
 135 AA=0.
     DO 136 LH=1,NUX
 136 AA=AA+CR(LH,K)*COS((LH-1)*X)
 193 S=EXP(X*MAX/3.1415926-MAX/4.)-1.
     IF(TRA.EQ.0)S=S*SC
     IF(TRA.EQ.1)S=(EXP(S)-1.)*SC
     AY=AMAX1(AY,AA)
     AY=AMIN1(AY,1.)
 440 IF(SW.LT.2)WRITE(IOUT,134)S,Y,AY
     YP=Y
     WMAX=AMAX1(WMAX,Y-AY,AY-YP)
     IF(3.1415926*(I+1)/FLOAT(NST)-A(J,K))137,138,139
 138 I=I+1
     GO TO 139
 137 IF(I-NST)141,140,140
 141 I=I+1
     AA=0.
     X=3.1415926*I/FLOAT(NST)
     DO 192 LH=1,NUX
 192 AA=AA+CR(LH,K)*COS((LH-1)*X)
     GO TO 193
 139 X=A(J,K)
     Y=Y+1./LL
 133 CONTINUE
 199 AA=0.
     DO 197 LH=1,NUX
 197 AA=AA+CR(LH,K)*COS((LH-1)*X)
     S=EXP(X*MAX/3.1415926-MAX/4.)-1.
     IF(TRA.EQ.0)S=S*SC
     IF(TRA.EQ.1)S=(EXP(S)-1.)*SC
     AY=AMAX1(AY,AA)
     AY=AMIN1(AY,1.)
 438 IF(SW.LT.2)WRITE(IOUT,134)S,Y,AY
     YP=Y
     WMAX=AMAX1(WMAX,Y-AY,AY-YP)
     IF(I-NST)198,140,140
 198 I=I+1
```

```
      X=I*3.1415926/NST
      GO TO 199
  140 CONTINUE
  608 IF(KOL-1)2052,2052,2050
 2052 X=FKC(WMAX,LL)
      GO TO 2051
 2050 X=FK(WMAX,LL)
 2051 IF(K.LE.N)QR=AMIN1(QR,X)
      IF(K.LE.N)WRITE(IOUT,144)QQR(K),X
      IF(K.GT.N)WRITE(IOUT,4492)X
 4492 FORMAT(1H0/1H ,'RESULTING QUALITY Q= ',F6.4)
  144 FORMAT(1H0/1H ,11HQUALITY Q= ,F6.4,'  IN THE FIRST APPROACHING'
     1/1H ,11X,F6.4,'  AFTER CORRECTION FOR MONOTONICITY')
  130 CONTINUE
  477 WRITE(IOUT,145)QR
      IF(SW)499,2053,2053
 2053 CALL SYMBOL(0.,0.,0.21,IRES,90.,24)
      CALL NUMBER(0.,5.3,0.21,QR,90.,4)
      CALL PLOT(5.,0.0,-3)
  145 FORMAT(1H0//1H ,65(1H-)/1H ,'QUALITY OF THE FITTING AFTER CORRECTI
     1ON FOR MONOTONICITY Q=',F6.4/1H ,65(1H-)///1H0,90X,'THATS ALL,SOUK
     2UP'///1H )
      GO TO 499
 4991 IF(SW)2038,2055,2055
 2055 CALL PLOT(0.0,0.0,999)
 2038 END


C     FK IS A PROCEDURE FOR STEP MODIFIED KOLMOGOROW,S FUNCTION
      FUNCTION FK(DIG,N)
      DIF=ABS(DIG)
      IF(DIF-1)207,201,201
  207 IF(N.GT.20)GO TO 205
      DIF=N*DIF
      L=IFIX(DIF)
      IF(L.GE.N)GO TO 201
      FK=(DIF/ FLOAT(N)+1. )**(N-1)
      IF(L.LE.0)GO TO 204
      C=1.
      DO 202 K=1,L
      C=C*(N-K+1)/(FLOAT(K))
  202 FK=FK+C*((K-DIF)/(FLOAT(N)))**K*((DIF+N-K)/(FLOAT(N)))**(N-K-1)
  204 FK=DIF*FK/N
      GO TO 203
  205 FK=EXP(-2*N*DIF**2)
      GO TO 206
  201 FK=1.
  203 FK=1.-FK
      IF(FK)208,206,206
  208 FK=0.
  206 RETURN
      END


      FUNCTION FKC(DIF,NU)
C     FKC IS A PROCEDURE FOR KOLMOGOROW,S FUNCTION,CONTINUOUS INTERPRET.
      FKC=1.
      X=DIF*SQRT(FLOAT(NU))
      IF(X*X-0.04)204,204,203
  203 FF=0.
      FS=2.
  201 FS=-FS
      FF=FF+1.
      DELTA=FS*EXP(-2*(FF**2)*(X**2))
      FKC=FKC+DELTA
      IF(ABS(DELTA)-0.00005)202,201,201
  202 FKC=1.-FKC
  204 RETURN
      END
```

```
      FUNCTION F(M,K,J)
      COMMON P(15,17)
      IF(M-2)01,02,03
   01 F=P(1,J)**(K-1)
      GO TO 04
   02 GO TO(201,202,203,204,205,206,207,208,209,210,211,212,213,214,215)
     1,K
  201 F=1.
      GO TO 04
  202 F=P(1,J)
      GO TO 04
  203 F=P(2,J)
      GO TO 04
  204 F=P(1,J)**2
      GO TO 04
  205 F=P(1,J)*P(2,J)
      GO TO 04
  206 F=P(2,J)**2
      GO TO 04
  207 F=P(1,J)**3
      GO TO 04
  208 F=P(1,J)**2*P(2,J)
      GO TO 04
  209 F=P(1,J)*P(2,J)**2
      GO TO 04
  210 F=P(2,J)**3
      GO TO 04
  211 F=P(1,J)**4
      GO TO 04
  212 F=P(1,J)**3*P(2,J)
      GO TO 04
  213 F=P(1,J)**2*P(2,J)**2
      GO TO 04
  214 F=P(1,J)*P(2,J)**3
      GO TO 04
  215 F=P(2,J)**4
      GO TO 04
   03 IF(M-4)05,06,07
   05 GO TO(301,302,303,304,305,306,307,308,309,310),K
  301 F=1.
      GO TO 04
  302 F=P(1,J)
      GO TO 04
  303 F=P(2,J)
      GO TO 04
  304 F=P(3,J)
      GO TO 04
  305 F=P(1,J)**2
      GO TO 04
  306 F=P(2,J)**2
      GO TO 04
  307 F=P(3,J)**2
      GO TO 04
  308 F=P(1,J)*P(2,J)
      GO TO 04
  309 F=P(1,J)*P(3,J)
      GO TO 04
  310 F=P(2,J)*P(3,J)
      GO TO 04
   06 GO TO(401,402,403,404,405,406,407,408,409,410,411,412,413,414,415)
     1,K
  401 F=1.
      GO TO 04
  402 F=P(1,J)
      GO TO 04
  403 F=P(2,J)
      GO TO 04
  404 F=P(3,J)
      GO TO 04
  405 F=P(4,J)
```

```
      GO TO 04
  406 F=P(1,J)**2
      GO TO 04
  407 F=P(1,J)*P(2,J)
      GO TO 04
  408 F=P(1,J)*P(3,J)
      GO TO 04
  409 F=P(1,J)*P(4,J)
      GO TO 04
  410 F=P(2,J)**2
      GO TO 04
  411 F=P(2,J)*P(3,J)
      GO TO 04
  412 F=P(2,J)*P(4,J)
      GO TO 04
  413 F=P(3,J)**2
      GO TO 04
  414 F=P(3,J)*P(4,J)
      GO TO 04
  415 F=P(4,J)**2
      GO TO 04
   07 IF(K-1)501,501,502
  501 F=1.
      GO TO 04
  502 F=P(K-1,J)
   04 RETURN
      END
```

APPENDIX 2

Computer Program, Method 2

```
      PARAMETER PAR1 400
      PARAMETER PAR2=180
      PARAMETER PAR3=6400/PAR1
      PARAMETER PAR4=PAR1+1
      PARAMETER PAR5=PAR2+1
      PARAMETER PAR6=PAR3+1
      PARAMETER PAR7=PAR5+20
      COMMON P(15,17)
      INTEGER SX,SW,SS,GIB,BR, TRA,HIS
      REAL MAX
      DOUBLE PRECISION AD,PBD
      DIMENSION A(801, 8),L(17),C(181,16),B(15,15),BB(15),
     1INF(12),W(PAR6,PAR5),CC(PAR5,PAR6),
     2SS(12,PAR6),SX(12),QQ(PAR6),QQR(PAR6),BUF(3000),
     3PB(2),AQ(PAR3,PAR6),JC(2),WR(PAR6,PAR5),CR(PAR5,PAR6),IFMT(20),
     4AD(PAR3,PAR6),PBD(2),IBCX(1)/6HVALUE /,IBCY(2)/6HPROBAB,6HILITY /,
     5INST(1)/4HNST=/,INU(1)/4HNU= /,IMOM(1)/4HMOM=/,IGIB(1)/4HGIB=/,
     6                 IKOL(1)/4HKOL=/,IRES(4)/6HRESULT,6H AFTER,6H CORRE
     7,6HCTION=/,                   IBXX(2)/6HLOG OF,6H VALUE/,ITR(1)/4HTRA
     8=/
      DATA KK/6H      /,KF/6HFULL  /,KFA/6HTEST  /,IEND/4HSTAR/,BR/ 21/,
     1LIM/PAR1/,IP/1/,    IOUT/3/,QLIM/0.90/,ULIM/0./,NST/500/,NU/PAR5/,
     2SW/2/,XLEN/10./,YLEN/ 5./,MOM/4/,GIB/2/,HIS/0/,KOL/1/,LG/1/,TRA/0/
     3,POW/1./
      READ(1,02)(INF(I),I=1,12)
      WRITE(IOUT,2054)(INF(I),I=1,12)
 2054 FORMAT(1H0///1H ,12A6)
      IF(SW)499,499,2037
 2037 CALL PLOTS(BUF,3000)
      CALL SYMBOL(0.,0.,0.21,INF,90.,72)
      CALL SYMBOL(1.,9.,0.21,INST,0.,4)
      CALL NUMBER(2.05,9.,0.21,FLOAT(NST),0.,-1)
      CALL SYMBOL(1.,8.5,0.21,INU,0.,4)
      CALL NUMBER(2.05,8.5,0.21,FLOAT(NU),0.,-1)
      CALL SYMBOL(1.,8.,0.21,IMOM,0.,4)
      CALL NUMBER(2.05,8.,0.21,FLOAT(MOM),0.,-1)
      CALL SYMBOL(1.,7.5,0.21,IGIB,0.,4)
      CALL NUMBER(2.05,7.5,0.21,FLOAT(GIB),0.,-1)
      CALL SYMBOL(1.,6.5,0.21,IKOL,0.,4)
      CALL NUMBER(2.05,6.5,0.21,FLOAT(KOL),0.,-1)
      CALL SYMBOL(1.,5.5,0.21,ITR,0.,4)
      CALL NUMBER(2.05,5.5,0.21,FLOAT(TRA),0.,-1)
      CALL PLOT(7.,0.0,-3)
C     IP IS A SWITCH.IP=0 COEFFICIENTS G ARE PUNCHED IN FORMAT(1X,E11.6)
C     IP=1 NO PUNCHING
C     HIS IS A SWITCH FOR DRAWING THE DISTRIBUTION CURVE
C     HIS=0 NO PLOT,HIS=1 PLOT OF THE DISTRIB.CURVE IN SPECIAL Y-SCALE
C     BR IS THE LOWEST ORDER OF THE F.SERIES.ALLOWED VALUES 21,41,...,NU
C     TRA IS THE SWITCH FOR BASIC TRANSFORMATION
C     TRA=0 CORRESPONDS TO (LOG(X+1))
C     TRA=1 CORRESPONDS TO (LOG(LOG(X+1)+1))
C     TRA=1 USE FOR VERY SHARP DISTRIBUTIONS WITH A FLAT END
C     LG IS A SWITCH FOR THE X-AXIS IN THE PLOT
C     LG=1 LINEAR SCALE,LG=2 LOGARITHMIC SCALE
C     GIB IS A SWITCH,WHICH INFLUENCES THE GIBB'S PHENOMENA=
C     GIB=1 NO SPECIAL PROCEDURE,GIB=2 LANCZOS SIGMA-COEFFICIENTS,
C     GIB=3 FEJER'S COEFFICIENTS
C     KOL IS A SWITCH FOR KOLMOGOROW CRITERION.KOL=1 CONTINUOUS CRITER.,
C     KOL=2 EXPERIMENTAL STEP DISTRIB.CURVE, FOR RUNNING SUPPPOSED KOL=2
C     SW IS A SWITCH FOR OUTPUT FORM.
C     SW=0 PRINT,SW=1 PRINT AND PLOT,SW=2 PLOT ONLY (ONLY THE MAIN
C     NUMBER OF BLOCKS IN THE PLOT IS 2*P+2,WHERE P IS NUMBER OF GROUPS
C     RESULTS PRINTED).
C     AT ALL EXAMPLES.
C     XLEN IS THE LENGTH OF THE PLOT (X - AXIS)
C     YLEN IS THE HIGH OF THE PLOT (Y - AXIS)
C     READING OF THE CARDS.INPUT CARDS=INFORMATION CARD,FORMAT CARD OF
C     THE FIRST EXAMPLE,HEAD CARD,SAMPLES OF THE GROUP 1,BLANC CARD,
C     HEAD CARD,SAMPLES OF THE GROUP 2,BLANC CARD, ... ,HEAD CARD,
C     SAMPLES OF THE LAST GROUP,''FULL''CARD,HEAD CARD,SAMPLES OF THE
```

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C     UNFINISHED GROUP,''TEST'' CARD,FORMAT CARD OF THE SECOND EXAMPLE,
C     HEAD CARD, ... ,''TEST''CARD OF THE LAST EXAMPLE,''STAR''CARD.
C     ALLOWED MAXIMALLY 17 GROUPS OF SAMPLES (TILL 500 SAMPLES EACH)=
C     16 GIVEN GROUPS, 1 UNFINISHED GROUP
C     INFORMATION CARD CONTAINS THE GENERAL INFORMATION ABOUT THE RUNNIN
C     G (E.G.DATE,NAME,NAME OF THE PROGRAMMER,...).THIS INFORMATION IS
C     PRINTED AND ALSO PLOTTED (IF SW.GT.0)
  499 READ(1,427)(IFMT(I),I=1,20)
      IF(IFMT(1).EQ.IEND)GO TO 4991
C     MAXIMUM L=500,LIMITED BY THE DIMENSION OF A(I,J)
  427 FORMAT(20A4)
C     FORMAT CARD SERVES FOR READING OF THE NAME OF THE SAMPLE (A6)
C     AND OF THE MEASURED VALUE (REAL).
C     NAMES (FULL  ),(      ),(TEST  ),(STAR)  ARE RESERVED FOR
C     ORGANISATION - PURPOSES,SEE ABOVE
C     QLIM IS GIVEN LEVEL FOR KOLMOGOROW,S CRITERIUM
C     FOR RUNNING SUPPOSED Q=0.5
C     ULIM IS THE PRACTICAL UPPER LIMIT FOR THE VALUES A(I,J).
C     IF THIS CHOSEN TOO HIGH,FOURIER,S SERIE CONVERGES VERY SLOWLY.
C     USE THIS VALUE IN THE CASE ONLY THAT YOU SHOULD GUESS A NEW
C     DISTRIBUTION AND THE SAMPLES OF THE NEW GROUP YOU HAVE
C     CONTAINS RELATIVELY HIGH VALUES.
C     NST IS MINIMUM NUMBER OF THE POINTS FOR FOURIER,S SYNTHESIS IN OUT
C     PUT PRINT OR PLOT.THIS VALUE HAS NO INFLUENCE TO THE RESULTS.
C     MAXIMUM NST IS NOT LIMITED,BUT TAKE IN ACCOUNT THAT THE RESULTS
C     ARE EQUIDISTANT FROM THE POINT OF VIEW OF THE FOURIER SYNTHESIS,IT
C     MEANS WITH AN APPROXIMATELY LOGARITHMIC SCALE.IF NST IS TOO SMALL
C     THE RESULTING Q-COEFFICIENTS COULD BE A LITTLE WORSE= THEY CORRES-
C     POND THEN TO THE PURE FOURIER SYNHESIS WITHOUT A CORRECTION FOR
C     MONOTONICITY.
C     NU IS THE NUMBER OF THE MEMBERS OF THE FOURIER,S APPROXIMATION.
C     MAXIMUM NU=181
C     MOM IS A MAXIMUM NUMBER OF THE FIRST CENTRAL MOMENTS,WHICH ARE
C     TESTED AS THE PARAMETERS OF THE DISTRIBUTION.VALUE OF MOM IS
C     AUTOMATICALLY LIMITED ACCORDING TO THE NUMBER OF GROUPS.NORMALLY
C     MOM.GT.3 HAS NO SENSE,BUT IF YOU SUPPOSE THE DISTRIBUTION COULD BE
C     A SUPERPOSITION OF TWO DISTRIBUTIONS(EACH HAVING TWO PARAMETERS),
C     MOM=4 OR GREATER IS NECESSARY A.S.O.
   01 FORMAT(1X,A6,12X,F6.0)
   02 FORMAT(1H0,12A6)
  498 FORMAT(1H1,'ANALYSIS OF THE GENERAL TYPE OF THE DISTRIBUTION'/1H ,
     1'-----------------------------------------------'/1H ,'METHOD 2
     2'/1H0)
      WRITE(IOUT,498)
      N=0
   03 N=N+1
      L(N)=1
      READ(1,02)(SS(I,N),I=1,12)
      WRITE(IOUT,02)(SS(I,N),I=1,12)
   04 LL=L(N)
      READ(1,IFMT)JJ,A(LL,N)
      IF(JJ.EQ.KK)GO TO 03
      IF(JJ.EQ.KFA)GO TO 432
      IF(JJ.EQ.KF)GO TO 431
      IF(L(N).GT.(LIM+1))GO TO 474
      L(N)=L(N)+1
      GO TO 04
  474 WRITE(IOUT,475)
  475 FORMAT(1H ,'TOO MANY SAMPLES IN THIS GROUP,SEE PARAMETER LIM')
      GO TO 477
  431 NY=N
      WRITE(IOUT,434)
  434 FORMAT(1H0,'UNFINISHED DATA='/1H )
      GO TO 03
  432 IF(L(N).EQ.1)GO TO 433
      NX=N
      GO TO 05
  433 NX=N-1
   05 N=NY
      MOM=MIN0(MOM,N-1)
```

```
      DO 713 J=1,NX
  713 L(J)=L(J)-1
      WRITE(IOUT,709)
  709 FORMAT(1H0,'LIST OF THE INPUT DATA'/1H )
  708 FORMAT(1H ,17E9.3)
      DO 707 J=1,LIM
      JJ=0
      DO 706 I=1,NX
      LL=L(I)+1
      IF(J-LL)705,704,704
  704 A(J,I)=-0.1
      GO TO 706
  705 JJ=1
  706 CONTINUE
      IF(JJ.EQ.0)GO TO 703
  707 WRITE(IOUT,708)(A(J,I),I=1,NX)
  703 CONTINUE
C     ORDERING OF THE VALUES A(I,J)
      DO 06 J=1,NX
      LL=L(J)
      DO 06 I=1,LL
      DO 06 IS=1,I
      IF(A(I,J).LT.A(IS,J))GO TO 07
      GO TO 06
   07 AA=A(I,J)
      INN=I-IS
      DO 08 IB=1,INN
   08 A(I+1-IB,J)=A(I-IB,J)
      A(IS,J)=AA
   06 CONTINUE
C     COMPUTING OF THE MOMENTS
C     COMPUTING MAX
      ZMIN=1.E35
      MAX=ULIM
      DO 4009 J=1,NX
      DO 2000 IB=1,MOM
 2000 P(IB,J)=0.
      LL=L(J)
      DO 2035 I=1,LL
 2035 P(1,J)=P(1,J)+A(I,J)
      P(1,J)=P(1,J)/LL
      IF(MOM-2)09,2036,2036
 2036 DO 2001 IB=2,MOM
      DO 10 I=1,LL
   10 P(IB,J)=P(IB,J)+(A(I,J)-P(1,J))**IB
 2001 P(IB,J)=P(IB,J)/LL
   09 MAX=AMAX1(MAX,A(LL,J))
 4009 ZMIN=AMIN1(ZMIN,A(1,J))
      MAX=MAX-ZMIN
      DO 4001 J=1,NX
      LL=L(J)
      DO 4001 I=1,LL
 4001 A(I,J)=A(I,J)-ZMIN
      WRITE(IOUT,420)MOM
  420 FORMAT(1H0,'FIRST ',I2,' CENTRAL MOMENTS'/1H )
      DO 421 J=1,NX
  421 WRITE(IOUT,422)(P(I,J),I=1,MOM)
      SC=1.
      MAX=ALOG(MAX+1.)
      IF(TRA.EQ.1)MAX=ALOG(MAX+1.)
      DO 194 J=1,NX
      LL=L(J)
      DO 194 I=1,LL
      IF(TRA.EQ.1)A(I,J)=ALOG(A(I,J)+1.)
  194 A(I,J)=ALOG(A(I,J)+1.)+MAX/2.
      MAX=2.*MAX
C     TRANSFORMATION TO THE INTERVAL (0,PI)
      DO 13 J=1,NX
      LL=L(J)
      DO 13 I=1,LL
```

```
   13 A(I,J)=A(I,J)*3.1415926/MAX
C     ARRANGE FOR MULTIPLIED STEPS
      DO 413 J=1,NX
      LL=L(J)
      DO 413 I=2,LL
      IF(A(I,J)-A(I-1,J))414,414,413
  414 A(I,J)=A(I-1,J)+0.000001
  413 CONTINUE
      DO 2044 J=1,NX
      DO 2045 IB=1,MOM
 2045 P(IB,J)=0.
      LL=L(J)
      DO 2046 I=1,LL
 2046 P(1,J)=P(1,J)+A(I,J)
      P(1,J)=P(1,J)/LL
      IF(MOM-2)7032,449,449
  449 DO 2044 IB=2,MOM
      X=FLOAT(IB)
      DO 482 I=1,LL
  482 P(IB,J)=P(IB,J)+(A(I,J)-P(1,J))**IB
 2044 P(IB,J)=ABS(P(IB,J)*(X+1.)/LL)**(1./X)*(P(IB,J)/ABS(P(IB,J)))
 7032 WRITE(IOUT,481)MOM
  481 FORMAT(1H0,'FIRST ',I2,' PARAMETERS OF THE DISTRIBUTION - COMPUTED
     1 FROM THE TRANSFORMED VALUES',/1H ,'USED FORMULA-'/1H ,
     2'M1(X)=P1(X)'/1H ,'MK(X)=((K+1)*PK(X))**(1/K) FOR K.GT.2'/1H ,
     3'WHERE PK(X) IS THE K-TH CENTRAL MOMENT AFTER  TRANSFORMATION FROM
     4 T TO X'/1H ,'SEE BELOW')
      DO 450 J=1,NX
  450 WRITE(IOUT,422)(P(I,J),I=1,MOM)
  422 FORMAT(1H ,15E8.3)
      WRITE(IOUT,423)
  423 FORMAT(1H0///1H ,80HPARTIAL RESULTS OBTAINED QUALITY FOR (NUMBER O
     1F MOMENTS/ORDER OF THE POLYNOMIAL)   /1H ,'NUMBERS IN BRACKETS DEN
     2OTE THE ORDERING OF USED MOMENTS FOR POLYNOMIAL APPROXIMATION' /1H
     30,2X)
      WRITE(IOUT,426)
  426 FORMAT(1H ,'ON THE END OF EACH ROW A MINIMUM VALUE')
      NUX=BR-20
      MR=1
      MMR=1
      QR=0.
      NUXR=21
  441 NUX=NUX+20
      IF(NUX-NU)444,443,442
  442 IF(NUX-20-NU)443,446,446
  443 NUX=NU
  444 WRITE(IOUT,445)NUX
  445 FORMAT(1H0,'DEGREE OF THE FOURIER,S SERIES =',I3)
C     FOURIER ANALYSIS ...  C(K,J)
      DO 14 J=1,N
      LL=L(J)
      DO 14 IB=1,NUX
      K=IB-1
      C(K+1,J)=0.
      DO 15 I=1,LL
      C(K+1,J)=C(K+1,J)+SIN(K*A(I,J))
      IF(K)16,16,15
   16 C(K+1,J)=C(K+1,J)+A(I,J)
   15 CONTINUE
      C(K+1,J)=-C(K+1,J)/(LL*3.1415926)
      IF(K)17,17,18
   17 C(K+1,J)=1+C(K+1,J)
      GO TO 14
   18 GO TO(2041,2042,2043),GIB
 2041 C(K+1,J)=2*C(K+1,J)/K
      GO TO 14
 2043 C(K+1,J)=2*C(K+1,J)*(NUX+1-K)/FLOAT(K*(NUX+1))
C     GIBB'S PHENOMENA PUSHED DOWN BY FEJER'S METHOD,SEE CARSLAW=FOURIER
C     SERIES,P.234
      GO TO 14
```

```
      NM=N-2
      DO 20 MM=1,NM
      IF(M-2)21,22,2006
   21 IF(MM-N+2)7001,7001,20
   22 IF(MM-1)20,25,26
   25 IF(N-4)20,7002,7002
   26 IF(MM-3)27,28,29
   27 IF(N-7)20,7003,7003
   28 IF(N-11)20,7004,7004
   29 IF(MM-4)20,30,20
   30 IF(N-16)20,7005,7005
 2006 IF(M-4)23,2004,2005
   23 IF(MM-2)31,33,20
   31 IF(N-5)20,7006,7006
   33 IF(N-11)20,7004,7004
 2004 IF(MM-2)2010,2008,20
 2008 IF(N-16)20,7005,7005
 2005 IF(MM-1)20,2010,20
 2010 IF(N-M-2)20,     7007,7007
 7001 LL=MM+1
      GO TO 24
 7002 LL=3
      GO TO 24
 7003 LL=6
      GO TO 24
 7004 LL=10
      GO TO 24
 7005 LL=15
      GO TO 24
 7006 LL=4
      GO TO 24
 7007 LL=N-M-3
C     REGRESSION
   24 DO 32 IH=1,NUX
      DO 38 I=1,LL
      DO 38 K=I,LL
      B(I,K)=0.
      DO 38 J=1,N
   38 B(I,K)=B(I,K)+F(M,I,J,IH-1)*F(M,K,J,IH-1)*L(J)**POW
      DO 39 I=1,LL
      LLL=I-1
      DO 39 K=1,LLL
   39 B(I,K)=B(K,I)
      DO 47 I=1,LL
      BB(I)=0.
      DO 47 J=1,N
   47 BB(I)=BB(I)+C(IH,J)*F(M,I,J,IH-1)*L(J)**POW
      GO TO 318
  464 DO 465 I=1,LL
      DO 466 J=1,LL
  466 AD(I,J)=DBLE(B(I,J))
  465 AD(I,LL+1)=DBLE(BB(I))
      PBD(1)=4.
      CALL DGJR(AD,17,16,LL,LL+1,$447,JC,PBD)
      DO 467 I=1,LL
  467 W(I,IH)=SNGL(AD(I,LL+1))
      GO TO 32
  447 WRITE(IOUT,448)M,MM
 2042 C(K+1,J)=2*C(K+1,J)*NUX*SIN(K*3.1415926/NUX)/(3.1415926*K*K)
C     GIBB'S PHENOMENA PUSHED DOWN BY ''SIGMA'' COEFFICIENTS
C     SEE LANCZOS=APPLIED MATHEMATICS,P.236
   14 CONTINUE
C     BEGINING OF THE REGRESSION, DEGREE OF THE REGR. POLYNOMIAL
   19 DO 20 M=1,MOM
      GO TO 190
  448 FORMAT(1H ,I2,1H/,I2,2X,'LINEAR SYSTEM FOR REGRESSION HAS NO SOLUT
     1ION EVEN IN DOUBLE PRECISION ARITHMETIC')
  318 PB(1)=4.
      DO 314 I=1,LL
      DO 315 J=1,LL
```

```
  315 AQ(I,J)=B(I,J)
  314 AQ(I,LL+1)=BB(1)
      CALL GJR(AQ,17,16,LL,LL+1,$464,JC,PB)
  316 DO 317 I=1,LL
  317 W(I,IH)=AQ(I,LL+1)
   32 CONTINUE
      FOURIER,S COEFFICIENTS
  408 DO 64 K=1,NUX
      DO 64 I=1,NX
   64 CC(K,I)=0
      IF(M-2)61,62,2020
 2020 IF(M-4)63,2024,2025
      FOURIER COEFFICIENTS AS A RESULT OF REGRESSION,M=1
   61 DO 65 K=1,NUX
      LL=MM+1
      DO 65 I=1,LL
      DO 65 J=1,NX
   65 CC(K,J)=CC(K,J)+W(I,K)*Z(K-1,1,J)**(I-1)
      GO TO 70
C     FOURIER COEFFICIENTS AS A RESULT OF REGRESSION,M=2
   62 DO 66 K=1,NUX
      DO 66 J=1,NX
      S=Z(K-1,1,J)
      T=Z(K-1,2,J)
      CC(K,J)=CC(K,J)+W(1,K)+W(2,K)*S+W(3,K)*T
      IF(MM-2)66,67,67
   67 CC(K,J)=CC(K,J)+W(4,K)*S*S+W(5,K)*S*T+W(6,K)*T*T
      IF(MM-3)66,68,68
   68 CC(K,J)=CC(K,J)+W(7,K)*S**3+W(8,K)*S*S*T+W(9,K)*S*T*T+W(10,K)*T**3
      IF(MM-4)66,69,20
   69 CC(K,J)=CC(K,J)+W(11,K)*S**4+W(12,K)*S**3*T+W(13,K)*S*S*T*T
     1+W(14,K)*S*T**3+W(15,K)*T**4
   66 CONTINUE
      GO TO 70
C     FOURIER COEFFICIENTS AS A RESULT OF REGRESSION,M=3
   63 DO 71 K=1,NUX
      DO 71 J=1,NX
      S=Z(K-1,1,J)
      T=Z(K-1,2,J)
      U=Z(K-1,3,J)
      CC(K,J)=CC(K,J)+W(1,K)+W(2,K)*S+W(3,K)*T+W(4,K)*U
      IF(MM-2)71,72,20
   72 CC(K,J)=CC(K,J)+W(5,K)*S*S+W(6,K)*T*T+W(7,K)*U*U+W(8,K)*S*T
     1+W(9,K)*S*U+W(10,K)*T*U
   71 CONTINUE
      GO TO 70
 2024 DO 2021 K=1,NUX
      DO 2021 J=1,NX
      S=Z(K-1,1,J)
      T=Z(K-1,2,J)
      U=Z(K-1,3,J)
      V=Z(K-1,4,J)
      CC(K,J)=CC(K,J)+W(1,K)+W(2,K)*S+W(3,K)*T+W(4,K)*U+W(5,K)*V
      IF(MM-2)2021,2023,2023
 2023 CC(K,J)=CC(K,J)+W(6,K)*S**2+W(7,K)*S*T+W(8,K)*S*U+W(9,K)*S*V+W(10,
     1K)*T**2+W(11,K)*T*U+W(12,K)*T*V+W(13,K)*U**2+W(14,K)*U*V+W(15,K)*
     2V**2
 2021 CONTINUE
      GO TO 70
 2025 DO 2022 K=1,NUX
      DO 2022 J=1,NX
      CC(K,J)=W(1,K)
      DO 2022 I=1,M
 2022 CC(K,J)=CC(K,J)+W(I+1,K)*Z(K-1,I,J)
   70 CONTINUE
C     FOURIER SYNTHESIS
      QM=1.
      DO 73 J=1,N
      WMAX=0.
      LL=L(J)
```

```
      DO 74 I=1,LL
      AA=0.
      DO 75 K=1,NUX
   75 AA=AA+CC(K,J)*COS((K-1)*A(I,J))
      R=FLOAT(I)/LL-AA
      S=AA-FLOAT(I-1)/LL
   74 WMAX=AMAX1(WMAX,R,S)
C     KOLMOGOROW,S TEST
      IF(KOL-1)2049,2049,2047
 2049 QQ(J)=FKC(WMAX,LL)
      GO TO 2048
 2047 QQ(J)=FK(WMAX,LL)
 2048 IF(QQ(J)-QM)85,73,73
   85 QM=QQ(J)
   73 CONTINUE
      WRITE(IOUT,428)M,MM,(QQ(J),J=1,N),QM
  428 FORMAT(1H ,I2,1H/,I2,20(F5.2))
C     ITEM 9
      IF(QM-QR)87,87,86
   86 QR=QM
      DO 300 J=1,N
  300 QQR(J)=QQ(J)
      DO 196 J=1,NX
      DO 196 I=1,NUX
      CR(I,J)=CC(I,J)
  196 WR(J,I)=W(J,I)
      MR=M
      MMR=MM
      NUXR=NUX
   87 IF(QR-QLIM)20,88,88
  190 CONTINUE
   20 CONTINUE
      GO TO 441
C     PRINT,IF THE GIVEN QUALITY HASNT BEEN REACHED
   89 FORMAT(1H1,19HGIVEN QUALITY   Q= ,F6.4,23H  HAS NOT BEEN ACHIEVED/
     11H ,19HTHE BEST RESULT Q= ,F6.4///1H )
  446 WRITE(IOUT,89)QLIM,QR
      NUX=NUX-20
      GO TO 90
C     PRINT OF THE RESULTS
   91 FORMAT(1H0,10HRESULT Q= ,F6.4///1H )
   88 WRITE(IOUT,91)QR
   90 XAXX=0.5*MAX
      IF(TRA)3010,3010,3011
 3011 XAX=(EXP(EXP(XAXX)-1.)-1.)*SC
      GO TO 3012
 3010 XAX=(EXP(XAXX)-1.)*SC
 3012 NUX=NUXR
      WRITE(IOUT,445)NUX
      IF(TRA.EQ.0)WRITE(IOUT,92)XAXX,SC,ZMIN,XAX
      IF(TRA.EQ.1)WRITE(IOUT,3092)XAXX,SC,ZMIN,XAX
   92 FORMAT(1H0,'GENERAL FORM OF THE CUMMULATIVE CURVE='/1H ,'F(Z)=MAX
     1FF(T)  FOR T=(0,Z),F(Z) LESS 1.'/1H ,'WHERE FF(T) IS AN EVEN FOURI
     2ER SUM'/1H ,        42HFF(T)=A(0)+A(1)*COS(X)+A(2)*COS(2*X)...  /1
     3H ,'WHERE X=3.14165926*(ALOG((T-MIN)',
     4                                '/S+1)+MAX/2)/(2*MAX)'/1H ,12HWHERE
     5MAX= ,E11.6,' ,S= ',E11.6,'  IS THE SCALE FACTOR,MIN=',E11.6
     6           /1H ,E11.6,51H   IS THE SUSPECTED MAXIMUM VALUE FOR INP
     7UT VALUES,',(SUSPECTED MINIMUM IS GIVEN BY MIN)'
     8          /1H ,60HIF YOU LIKE TO CHANGE IT,PUT IN THE MAXIMUM AS P
     9ARAMETR ULIM)
 3092 FORMAT(1H0,'GENERAL FORM OF THE CUMMULATIVE CURVE='/1H ,'F(Z)=MAX
     1FF(T)  FOR T=(0,Z),F(Z) LESS 1.'/1H ,'WHERE FF(T) IS AN EVEN FOURI
     2ER SUM'/1H ,        42HFF(T)=A(0)+A(1)*COS(X)+A(2)*COS(2*X)...  /1
     3H ,'WHERE X=3.14165926*(ALOG(ALOG((T-MIN)/S+1)+1)+MAX/2)/(2*MAX)'
     4/1H ,                                                    12HWHERE
     5MAX= ,E11.6,' ,S= ',E11.6,'  IS THE SCALE FACTOR,MIN=',E11.6
     6           /1H ,E11.6,51H   IS THE SUSPECTED MAXIMUM VALUE FOR INP
     7UT VALUES,',(SUSPECTED MINIMUM IS GIVEN BY MIN)'
     8          /1H ,60HIF YOU LIKE TO CHANGE IT,PUT IN THE MAXIMUM AS P
```

```
     9ARAMETR ULIM)
      WRITE(IOUT,96)
   96 FORMAT(1H0,  'POLYNOMIAL APPROXIMATION AFTER THIS TRANSFORMATION'
     1/1H ,'IF MJ(X) DENOTES THE J-TH PARAMETER')
   98 WRITE(IOUT,99)
   99 FORMAT(1H ,  'U=SIN(K*M1(X))/K')
      IF(MR-2)97,101,101
   95 FORMAT(1H ,  'V=SIN(K*M2(X))/(K*M2(X))')
  101 WRITE(IOUT,95)
      IF(MR-3)97,102,102
   94 FORMAT(1H ,      'W=SIN(K*M3(X))/(K*M3(X))')
  102 WRITE(IOUT,94)
      IF(MR-4)97,2026,2026
 2026 WRITE(IOUT,2027)
 2027 FORMAT(1H ,'Z=SIN(K*M4(X))/(K*M4(X))')
      IF(MR-5)97,2028,2028
 2029 FORMAT(1H ,6X,17('.')/1H ,'AND SO ONE,FOR ',I2,' MOMENTS')
 2028 WRITE(IOUT,2029)MR
   93 FORMAT(1H ,'(BE CAREFUL=U RESP. V RESP. W RESP. Z DEPENDS ON THE V
     1ALUE OF K)'/1H0,'GENERAL FORM OF THE POLYNOMIAL=')
   97 WRITE(IOUT,93)
      IF(MR-2)106,107,2030
 2030 IF(MR-4)108,2031,2032
  211 FORMAT(1H , 50HA(K)=G(K,1)+G(K,2)*U+G(K,3)*U**I+...+G(K,19)*U**18)
  106 WRITE(IOUT,211)
      GO TO 105
  110 FORMAT(1H ,104HA(K)=G(K,1)+G(K,2)*U+G(K,3)*V+G(K,4)*U**2+G(K,5)*U*
     1V+G(K,6)*V**2+G(K,7)*U**3+G(K,8)*U**2*V+G(K,9)*U*V**2/1H ,
     2 36HG(K,10)*V**3+G(K,11)*U**4+G(K,12)*U**3*V+G(K,13)*U**2*V**2+G(K
     3,14)*U*V**3+G(K,15)*V**4)
  107 WRITE(IOUT,110)
      GO TO 105
 2031 WRITE(IOUT,2033)
 2033 FORMAT(1H ,'A(K)=G(K,1)+G(K,2)*U+G(K,0)*V+G(K,4)*W+G(K,5)*Z+G(K,6)
     1*U**2+G(K,7)*U*V+G(K,8)*U*W+G(K,9)*U*Z+G(K,10)*V**2+G(K,11)*V*W+G(
     2K,12)*V*Z+G(K,13)*W**2+G(K,14)*W*Z+G(K,15)*Z**2')
      GO TO 105
 2032 WRITE(IOUT,2034)MR,MR,MR
      GO TO 105
 2034 FORMAT(1H ,'A(K)=G(K,1)+G(K,2)*U+G(K,3)*V+ ... +G(K,',I2,')*M',I2,
     1'(X)/S**',I2)
  410 FORMAT(1H ,108HA(K)=G(K,1)+G(K,2)*U+G(K,3)*V+G(K,4)*W+G(K,5)*U**2+
     1G(K,6)*V**2+G(K,7)*W**2+G(K,8)*U*V+G(K,9)*U*W+G(K,10)*V*W)
  108 WRITE(IOUT,410)
  105 NUXX=NUX-1
      WRITE(IOUT,112)MMR,NUXX
  112 FORMAT(1H ,11HUSED ORDER:,I2///1H ,'LIST G(K,J)FOR K=0,...,',I3)
  115 IF(MR-2)117,118,119
  117 LOK=MMR+1
      GO TO 116
  118 IF(MMR-2)120,121,122
  120 LOK=3
      GO TO 116
  121 LOK=6
      GO TO 116
  122 IF(MMR-3)123,123,124
  123 LOK=10
      GO TO 116
  124 LOK=15
      GO TO 116
  119 IF(MMR-2)125,126,126
  125 LOK=4
      GO TO 116
  126 LOK=10
  116 CONTINUE
      DO 127 K=1,LOK
      IF(IP.EQ.1)GO TO 127
      DO 8500 J=1,NUX
 8500 WRITE(2,8501)WR(K,J)
 8501 FORMAT(1X,E11.6)
```

```
 127 WRITE(IOUT,128)(WR(K,J),J=1,NUX)
 128 FORMAT(1H ,20(/1H ,10E11.6))
     QR=1.
     DO 130 K=1,NX
     WRITE(IOUT,129)(SS(J,K),J=1,12),L(K)
 129 FORMAT(1H ////1H ,12A6/1H ,                                  23HNU
    1MBER OF THE SAMPLES: ,I4///1H ,27HVALUE        ORIG.    APPROX./1H )
     I=0
     LL=L(K)
     X=0.
     Y=0.
     YP=0.
     AY=0.
     WMAX=0.
     IF(SW.EQ.0)GO TO 606
     WRITE(IOUT,607)
 607 FORMAT(1H ,'(CURVES ON THE PLOTTER)')
     IF(LG.EQ.1)TIC=(XAX+ZMIN)/XLEN
     IF(LG.EQ.2)TIC=ALOG(XAX+ZMIN)/XLEN
     TAC=1./YLEN
     IF(LG.EQ.1)CALL AXIS(0.,0.,IBCX,-5,XLEN,0.,0.,TIC)
     IF(LG.EQ.2)CALL AXIS(0.,0.,IBXX,-12,XLEN,0.,0.,TIC)
     CALL AXIS(0.,0.,IBCY,11,YLEN,90.,0.,TAC)
     DO 601 J=1,12
 601 SX(J)=SS(J,K)
     X=0.5*XLEN
     Y=0.3*YLEN
     S=XLEN/2.
     S=AMAX1(S,YLEN)
     S=S/3.
     J=IFIX(S)
     BCD=0.07*J
     CALL SYMBOL(X,Y,BCD     ,SX,0.,72)
     X=A(1,K)
     S=EXP(X*MAX/3.1415926-MAX/4.)-1.
     IF(TRA.EQ.1)S=EXP(S)-1.
     IF(LG.EQ.1)S=(S*SC+ZMIN)/TIC
     IF(LG-2)3014,3015,3015
3015 IF(S*SC-1.)3016,3016,3017
3016 S=0.
     GO TO 3014
3017 S=ALOG(S*SC+ZMIN)/TIC
3014 CALL PLOT(S,0,3)
     LLL=LL-1
     DO 602 J=1,LLL
     Y=YLEN*J/FLOAT(LL)
     X=A(J,K)
     S=EXP(X*MAX/3.1415926-MAX/4.)-1.
     IF(TRA.EQ.1)S=EXP(S)-1.
     IF(LG.EQ.1)S=(S*SC+ZMIN)/TIC
     IF(LG-2)3024,3025,3025
3025 IF(S*SC-1.)3026,3026,3027
3026 S=0.
     GO TO 3024
3027 S=ALOG(S*SC+ZMIN)/TIC
3024 CALL PLOT(S,Y,2)
     X=A(J+1,K)
     S=EXP(X*MAX/3.1415926-MAX/4.)-1.
     IF(TRA.EQ.1)S=EXP(S)-1.
     IF(LG.EQ.1)S=(S*SC+ZMIN)/TIC
     IF(LG-2)3034,3035,3035
3035 IF(S*SC-1.)3036,3036,3037
3036 S=0.
     GO TO 3034
3037 S=ALOG(S*SC+ZMIN)/TIC
3034 CALL PLOT(S,Y,2)
 602 CONTINUE
     CALL PLOT(S,YLEN,2)
     CALL PLOT(XLEN,YLEN,2)
     CALL PLOT(0.0,0.0,-3)
```

```
      DO 603 I=1,NST
      X=I*3.1415926/NST
      S=EXP(X*MAX/3.1415926-MAX/4.)-1.
      IF(TRA.EQ.1)S=EXP(S)-1.
      IF(LG.EQ.1)S=(S*SC+ZMIN)/TIC
      IF(LG-2)3044,3045,3045
 3045 IF(SC*S-1.)3046,3046,3047
 3047 S=ALOG(S*SC+ZMIN)/TIC
 3044 IF(S)3046,3046,604
 3046 S=0.
  604 AA=0.
      IF(HIS)3052,3051,3052
 3052 I1=I/200
      I2=MOD(I,200)
      AQ(I1,I2)=0.
      AQ(I1+10,I2)=S
 3051 IF(S-XLEN)609,609,603
  609 DO 605 LH=1,NUX
      IF(HIS.EQ.1)AQ(I1,I2)=AQ(I1,I2)-CR(LH,K)*(LH-1)*SIN((LH-1)*X)*YLEN
  605 AA=AA+CR(LH,K)*COS((LH-1)*X)*YLEN
      IF(HIS*(AA-AY)*(AA-YLEN))3053,3053,3054
 3054 AQ(I1,I2)=0.
 3053 AY=AMAX1(AY,AA)
      AY=AMIN1(AY,YLEN)
      CALL PLOT(S,AY,2)
  603 CONTINUE
      IF(HIS)3056,3055,3056
 3056 AA=0.
      DO 3057 I=1,NST
      I1=I/200
      I2=MOD(I,200)
 3057 AA=AMAX1(AA,AQ(I1,I2))
      IF(AA-1E-30)3055,3055,3058
 3058 AA=YLEN/AA
      CALL PLOT(0.,0.,3)
      DO 3059 I=1,NST
      I1=I/200
      I2=MOD(I,200)
      AQ(I1,I2)=AA*AQ(I1,I2)
      IF(AQ(I1+10,I2)-XLEN)3060,3060,3059
 3060 CALL PLOT(AQ(I1+10,I2),AQ(I1,I2),2)
 3059 CONTINUE
      CALL SYMBOL(0.5*XLEN,0.2*YLEN,BCD,IHI,0.,28)
      BXB=28*BCD
      CALL NUMBER(0.5*XLEN+BXB,0.2*YLEN,BCD,AA,0.,10)
 3055 CALL PLOT(XLEN*1.25,0.0,-3)
      I=0
      X=0.
      Y=0.
      YP=0.
      AY=0.
      WMAX=0.
  606 DO 133 J=1,LL
  134 FORMAT(1H ,E 8.3,2X,F6.4,2X,F6.4)
  135 AA=0.
      DO 136 LH=1,NUX
  136 AA=AA+CR(LH,K)*COS((LH-1)*X)
  193 S=EXP(X*MAX/3.1415926-MAX/4.)-1.
      IF(TRA.EQ.0)S=S*SC
      IF(TRA.EQ.1)S=(EXP(S)-1.)*SC
      S=S+ZMIN
      AY=AMAX1(AY,AA)
      AY=AMIN1(AY,1.)
  440 IF(SW.LT.2)WRITE(IOUT,134)S,Y,AY
      YP=Y
      WMAX=AMAX1(WMAX,Y-AY,AY-YP)
      IF(3.1415926*(I+1)/FLOAT(NST)-A(J,K))137,138,139
  138 I=I+1
      GO TO 139
  137 IF(I-NST)141,140,140
```

```
 141 I=I+1
     AA=0.
     X=3.1415926*1/FLOAT(NST)
     DO 192 LH=1,NUX
 192 AA=AA+CR(LH,K)*COS((LH-1)*X)
     GO TO 193
 139 X=A(J,K)
     Y=Y+1./LL
 133 CONTINUE
 199 AA=0.
     DO 197 LH=1,NUX
 197 AA=AA+CR(LH,K)*COS((LH-1)*X)
     S=EXP(X*MAX/3.1415926-MAX/4.)-1.
     IF(TRA.EQ.0)S=S*SC
     IF(TRA.EQ.1)S=(EXP(S)-1.)*SC
     S=S+ZMIN
     AY=AMAX1(AY,AA)
     AY=AMIN1(AY,1.)
 438 IF(SW.LT.2)WRITE(IOUT,134)S,Y,AY
     YP=Y
     WMAX=AMAX1(WMAX,Y-AY,AY-YP)
     IF(I-NST)198,140,140
 198 I=I+1
     X=I*3.1415926/NST
     GO TO 199
 140 CONTINUE
 608 IF(KOL-1)2052,2052,2050
2052 X=FKC(WMAX,LL)
     GO TO 2051
2050 X=FK(WMAX,LL)
2051 IF(K.LE.N)QR=AMIN1(QR,X)
     IF(K.LE.N)WRITE(IOUT,144)QQR(K),X
     IF(K.GT.N)WRITE(IOUT,4492)X
4492 FORMAT(1H0/1H ,'RESULTING QUALITY Q= ',F6.4)
 144 FORMAT(1H0/1H ,11HQUALITY Q= ,F6.4,'  IN THE FIRST APPROACHING'
    1/1H ,11X,F6.4,'  AFTER CORRECTION FOR MONOTONICITY')
 130 CONTINUE
 477 WRITE(IOUT,145)QR
     IF(SW)499,2053,2053
2053 CALL SYMBOL(0.,0.,0.21,IRES,90.,24)
     CALL NUMBER(0.,5.3,0.21,QR,90.,4)
     CALL PLOT(5.,0.0,-3)
 145 FORMAT(1H0//1H ,65(1H-)/1H ,'QUALITY OF THE FITTING AFTER CORRECTI
    1ON FOR MONOTONICITY Q=',F6.4/1H ,65(1H-)///1H0,90X,'THATS ALL,SOUK
    2UP'///1H )
     GO TO 499
4991 IF(SW)2038,2055,2055
2055 CALL PLOT(0.0,0.0,999)
2038 END

C     FK IS A PROCEDURE FOR STEP MODIFIED KOLMOGOROW,S FUNCTION
      FUNCTION FK(DIG,N)
      DIF=ABS(DIG)
      IF(DIF-1)207,201,201
  207 IF(N.GT.20)GO TO 205
      DIF=N*DIF
      L=IFIX(DIF)
      IF(L.GE.N)GO TO 201
      FK=(DIF/ FLOAT(N)+1. )**(N-1)
      IF(L.LE.0)GO TO 204
      C=1.
      DO 202 K=1,L
      C=C*(N-K+1)/(FLOAT(K))
  202 FK=FK+C*((K-DIF)/(FLOAT(N)))**K*((DIF+N-K)/(FLOAT(N)))**(N-K-1)
  204 FK=DIF*FK/N
      GO TO 203
  205 FK=EXP(-2*N*DIF**2)
      GO TO 206
  201 FK=1.
  203 FK=1.-FK
```

```
      IF(FK)208,206,206
  208 FK=0.
  206 RETURN
      END
```

```
      FUNCTION FKC(DIF,NU)
C     FKC IS A PROCEDURE FOR KOLMOGOROW,S FUNCTION,CONTINUOUS INTERPRET.
      FKC=1.
      X=DIF*SQRT(FLOAT(NU))
      IF(X*X-0.04)204,204,203
  203 FF=0.
      FS=2.
  201 FS=-FS
      FF=FF+1.
      DELTA=FS*EXP(-2*(FF**2)*(X**2))
      FKC=FKC+DELTA
      IF(ABS(DELTA)-0.00005)202,201,201
  202 FKC=1.-FKC
  204 RETURN
      END
```

```
      FUNCTION Z(L,K,J)
      COMMON P(15,17)
      IF(L.EQ.0)Z=P(K,J)
      IF(K.EQ.1.AND.L.GT.0)Z=SIN(L*P(1,J))/L
      IF(K.GT.1.AND.L.GT.0)Z=SIN(L*P(K,J))/(P(K,J)*L)
      RETURN
      END
```

```
      FUNCTION F(M,K,J,L)
      IF(M-2)01,02,03
   01 F=Z(L,1,J)**(K-1)
      GO TO 04
   02 GO TO(201,202,203,204,205,206,207,208,209,210,211,212,213,214,215)
     1,K
  201 F=1.
      GO TO 04
  202 F=Z(L,1,J)
      GO TO 04
  203 F=Z(L,2,J)
      GO TO 04
  204 F=Z(L,1,J)**2
      GO TO 04
  205 F=Z(L,1,J)*Z(L,2,J)
      GO TO 04
  206 F=Z(L,2,J)**2
      GO TO 04
  207 F=Z(L,1,J)**3
      GO TO 04
  208 F=Z(L,1,J)**2*Z(L,2,J)
      GO TO 04
  209 F=Z(L,1,J)*Z(L,2,J)**2
      GO TO 04
  210 F=Z(L,2,J)**3
      GO TO 04
  211 F=Z(L,1,J)**4
      GO TO 04
  212 F=Z(L,1,J)**3*Z(L,2,J)
      GO TO 04
  213 F=Z(L,1,J)**2*Z(L,2,J)**2
```

```
      GO TO 04
  214 F=Z(L,1,J)*Z(L,2,J)**3
      GO TO 04
  215 F=Z(L,2,J)**4
      GO TO 04
   03 IF(M-4)05,06,07
   05 GO TO(301,302,303,304,305,306,307,308,309,310),K
  301 F=1.
      GO TO 04
  302 F=Z(L,1,J)
      GO TO 04
  303 F=Z(L,2,J)
      GO TO 04
  304 F=Z(L,3,J)
      GO TO 04
  305 F=Z(L,1,J)**2
      GO TO 04
  306 F=Z(L,2,J)**2
      GO TO 04
  307 F=Z(L,3,J)**2
      GO TO 04
  308 F=Z(L,1,J)*Z(L,2,J)
      GO TO 04
  309 F=Z(L,1,J)*Z(L,3,J)
      GO TO 04
  310 F=Z(L,2,J)*Z(L,3,J)
      GO TO 04
   06 GO TO(401,402,403,404,405,406,407,408,409,410,411,412,413,414,415)
     1,K
  401 F=1.
      GO TO 04
  402 F=Z(L,1,J)
      GO TO 04
  403 F=Z(L,2,J)
      GO TO 04
  404 F=Z(L,3,J)
      GO TO 04
  405 F=Z(L,4,J)
      GO TO 04
  406 F=Z(L,1,J)**2
      GO TO 04
  407 F=Z(L,1,J)*Z(L,2,J)
      GO TO 04
  408 F=Z(L,1,J)*Z(L,3,J)
      GO TO 04
  409 F=Z(L,1,J)*Z(L,4,J)
      GO TO 04
  410 F=Z(L,2,J)**2
      GO TO 04
  411 F=Z(L,2,J)*Z(L,3,J)
      GO TO 04
  412 F=Z(L,2,J)*Z(L,4,J)
      GO TO 04
  413 F=Z(L,3,J)**2
      GO TO 04
  414 F=Z(L,3,J)*Z(L,4,J)
      GO TO 04
  415 F=Z(L,4,J)**2
      GO TO 04
   07 IF(K-1)501,501, )2
  501 F=1.
      GO TO 04
  502 F=Z(L,K-1,J)
   04 RETURN
      END
```

APPENDIX 3

Input Data for Test Example
consisting of six groups of data

FORTRAN II / IV CODING SHEET

PROJECT NO. ______________ PROGRAMMED BY ______________

PROGRAM NO. ______________ DATE ________ PG ____ OF ______

```
 TEST EXAMPLE
 (1X,A6,21X,F4.0)
 DATA GROUP 1
   1                          15
   2                          20
   3                          25
   4                          20

 DATA GROUP 2
   11                          2
   12                          4
   13                          2

 DATA GROUP 3
   21                        100
   22                         50
   23                        100
   24                         50
```

Company .... Branch ....

FORTRAN II / IV CODING SHEET

PROJECT NO. ______________ PROGRAMMED BY ______________

PROGRAM NO. ______________ DATE ________ PG ____ OF ________

```
C
 DATA GROUP 4
   31                          1
   32                          1
   33                          2
   34                          3

 DATA GROUP 5
   41                          2
   42                         20
   43                         50
   44                        100
   45                        200
FULL
 UNFINISHED GROUP 1
 1  U                         10
 2  U                         25
 3  U                          8
```

Company .... Branch ....

F O R T R A N II / IV C O D I N G S H E E T

PROJECT NO. ______________ PROGRAMMED BY ____________________

PROGRAM NO. ______________ DATE ________ PG ____ OF ________

C / 1	2 3 4 5	6	7 – 72	73 – 80
	TEST			
S	TAR			

Company .... Branch ....

APPENDIX 4

Computer Output for Test Example, Method 1

```
TEST EXAMPLE

ANALYSIS OF THE GENERAL TYPE OF THE DISTRIBUTION
------------------------------------------------
METHOD 1


 DATA GROUP 1
 DATA GROUP 2
 DATA GROUP 3
 DATA GROUP 4
 DATA GROUP 5

UNFINISHED DATA=

 UNFINISHED GROUP 1

LIST OF THE INPUT DATA

   .150+02  .200+01  .100+03  .100+01  .200+01  .100+02
   .200+02  .400+01  .500+02  .100+01  .200+02  .250+02
   .250+02  .200+01  .100+03  .200+01  .500+02  .800+01
   .200+02 -.100+00  .500+02  .300+01  .100+03 -.100+00
  -.100+00 -.100+00 -.100+00 -.100+00  .200+03 -.100+00

FIRST  4 CENTRAL MOMENTS (POSSIBLE PARAMETERS OF THE DISTRIBUTION)

 .200+02 .125+02 .000    .313+03
 .267+01 .889+00 .593+00 .119+01
 .750+02 .625+03 .000    .391+06
 .175+01 .688+00 .281+00 .770+00
 .744+02 .505+04 .289+06 .572+08
 .143+02 .576+02 .293+03 .497+04

PARTIAL RESULTS OBTAINED QUALITY FOR (NUMBER OF MOMENTS/ORDER OF THE POLYNOMIAL)
NUMBERS IN BRACKETS DENOTE THE ORDERING OF USED MOMENTS FOR POLYNOMIAL APPROXIMATION


ON THE END OF EACH ROW A MINIMUM VALUE
```

DEGREE OF THE FOURIER,S SERIES = 21

1/ 1	.05	.76	.49	.39	.88	.05
1/ 2	.73	.48	.53	.83	.93	.48
1/ 3	.72	.60	.78	.90	1.00	.60
2/ 1	.08	.74	.77	.43	1.00	.08
3/ 1	.70	.47	.84	.83	1.00	.47
4/ 1	.70	.47	.84	.83	1.00	.47

DEGREE OF THE FOURIER,S SERIES = 41

1/ 1	.07	.78	.60	.52	.84	.07
1/ 2	.93	.50	.66	.64	.90	.50
1/ 3	.93	.65	.94	.73	1.00	.65
2/ 1	.10	.76	.90	.54	1.00	.10
3/ 1	.94	.49	.96	.64	1.00	.49
4/ 1	.94	.49	.96	.64	1.00	.49

DEGREE OF THE FOURIER,S SERIES = 61

1/ 1	.08	.80	.59	.54	.85	.08
1/ 2	.92	.53	.65	.66	.91	.53
1/ 3	.93	.67	.93	.74	1.00	.67
2/ 1	.12	.79	.89	.55	1.00	.12
3/ 1	.94	.52	.96	.65	1.00	.52
4/ 1	.94	.52	.96	.65	1.00	.52

DEGREE OF THE FOURIER,S SERIES = 81

1/ 1	.09	.81	.59	.54	.85	.09
1/ 2	.93	.53	.65	.66	.90	.53
1/ 3	.93	.67	.93	.74	1.00	.67
2/ 1	.13	.79	.89	.55	1.00	.13
3/ 1	.94	.53	.96	.65	1.00	.53
4/ 1	.94	.53	.96	.65	1.00	.53

DEGREE OF THE FOURIER,S SERIES =101

1/ 1	.09	.80	.59	.54	.85	.09
1/ 2	.94	.53	.66	.65	.90	.53
1/ 3	.94	.67	.93	.73	1.00	.67
2/ 1	.13	.79	.90	.54	1.00	.13
3/ 1	.95	.52	.96	.65	1.00	.52
4/ 1	.95	.52	.96	.65	1.00	.52

```
DEGREE OF THE FOURIER,S SERIES =121
 1/ 1   .09  .80  .59  .54  .85  .09
 1/ 2   .95  .53  .65  .66  .90  .53
 1/ 3   .95  .67  .93  .74 1.00  .67
 2/ 1   .13  .79  .89  .55 1.00  .13
 3/ 1   .96  .52  .96  .65 1.00  .52
 4/ 1   .96  .52  .96  .65 1.00  .52

DEGREE OF THE FOURIER,S SERIES =141
 1/ 1   .09  .80  .59  .54  .85  .09
 1/ 2   .96  .53  .65  .66  .90  .53
 1/ 3   .96  .67  .93  .74 1.00  .67
 2/ 1   .13  .79  .89  .55 1.00  .13
 3/ 1   .96  .52  .96  .65 1.00  .52
 4/ 1   .96  .52  .96  .65 1.00  .52

DEGREE OF THE FOURIER,S SERIES =161
 1/ 1   .09  .80  .59  .54  .84  .09
 1/ 2   .96  .53  .65  .65  .90  .53
 1/ 3   .96  .67  .93  .74 1.00  .67
 2/ 1   .13  .79  .89  .54 1.00  .13
 3/ 1   .96  .52  .96  .65 1.00  .52
 4/ 1   .96  .52  .96  .65 1.00  .52

DEGREE OF THE FOURIER,S SERIES =181
 1/ 1   .09  .81  .59  .54  .85  .09
 1/ 2   .96  .53  .65  .66  .90  .53
 1/ 3   .96  .67  .93  .74 1.00  .67
 2/ 1   .13  .79  .89  .55 1.00  .13
 3/ 1   .96  .52  .96  .65 1.00  .52
 4/ 1   .96  .52  .96  .65 1.00  .52

GIVEN QUALITY   Q=  .8000  HAS NOT BEEN ACHIEVED
THE BEST RESULT Q=  .6740



DEGREE OF THE FOURIER,S SERIES = 81
```

```
GENERAL FORM OF THE CUMMULATIVE CURVE=
F(Z)=MAX FF(T)  FOR T=(0,Z),F(Z) LESS 1.
WHERE FF(T) IS AN EVEN FOURIER SUM
FF(T)=A(0)+A(1)*COS(X)+A(2)*COS(2*X)...  / WHERE X=3.14165926*(ALOG(T/S+1)+MAX/2)/(2*MAX)
WHERE  MAX=  .953249+01 ,S=  .144928-01  IS THE SCALE FACTOR
 .200000+03   IS THE SUSPECTED MAXIMUM VALUE FOR INPUT VALUES,
IF YOU LIKE TO CHANGE IT,PUT IN THE MAXIMUM AS PARAMETR ULIM


POLYNOMIAL APPROXIMATION AFTER THIS TRANSFORMATION FOR:
U=M1(X)/S    ... SCALED FIRST CENTRAL MOMENT


GENERAL FORM OF THE POLYNOMIAL
A(K)=G(K,1)+G(K,2)*U+G(K,3)*U**I+...+G(K,19)*U**18
USED ORDER: 3


LIST G(K,J)FOR K=0,..., 80

 .565522+00-.664991+00-.113226+00 .288715+00 .598340-01-.216644+00 .758158-02 .139060+00-.388910-01-.561741-01
 .120611-01 .196025-01 .281757-01-.360286-01-.275930-01 .520676-01-.425624-02-.316270-01 .184074-01 .347299-03
-.332079-02 .651949-02-.900699-02 .246469-02 .252599-02-.137052-02 .436076-02-.760297-02 .699575-04 .730266-02
-.241017-02-.100118-02-.557004-02 .370469-02 .109919-01-.125842-01-.492706-02 .128461-01-.174388-02-.436570-02
-.151432-02 .277810-03 .806517-02-.418191-02-.774112-02 .688968-02 .291012-02-.338192-02-.157084-02-.120306-02
 .446691-02 .187002-02-.675519-02 .125784-03 .605793-02-.154941-02-.357453-02 .102693-02 .127668-02 .115763-02
-.826864-03-.327836-02 .240483-02 .318922-02-.377829-02-.116355-02 .292325-02-.144223-03-.971672-03-.411227-03
 .229252-03 .116201-02-.656105-03-.833583-03 .735344-03 .226254-03-.274484-03-.126671-03 .466792-04 .134201-03
-.464800-04

-.542413-03 .226112-03 .951633-03-.614518-03-.551385-03 .738684-03 .445433-04-.457101-03 .192307-03 .143321-04
 .555613-05 .135232-03-.299028-03 .810727-04 .279291-03-.268475-03-.220541-04 .159876-03-.987413-04 .448780-04
-.563889-05-.740393-04 .923715-04-.106047-04-.387002-04 .141138-04-.168955-04 .462861-04-.140529-04-.403473-04
 .301564-04-.761533-05 .304720-04-.151709-04-.699497-04 .859962-04 .208613-04-.915819-04 .335994-04 .303055-04
-.127335-04-.157547-05-.337724-04 .328318-04 .291042-04-.546119-04 .879694-05 .289335-04-.193894-04 .529062-05
-.291154-05-.102327-04 .213869-04-.462881-05-.179970-04 .148946-04 .175287-05-.103199-04 .125728-04-.678833-05
-.126264-04 .232684-04-.269286-05-.228625-04 .162591-04 .770160-05-.126129-04 .204203-05 .283811-06 .233141-05
 .327347-05-.817624-05 .162736-05 .583009-05-.349587-05-.136571-05 .911123-06 .749666-06 .199522-06-.933488-06
 .203980-06
```

```
 .362626-06-.152641-06-.633835-06 .416136-06 .352244-06-.489842-06 .461181-08 .263185-06-.146925-06 .691098-07
-.454708-07-.148914-06 .288592-06-.651397-07-.253534-06 .235847-06 .182311-07-.143214-06 .954329-07-.381756-07
-.969562-08 .727489-07-.708434-07-.515999-08 .369884-07-.336066-08 .318982-08-.376035-07 .213744-07 .258774-07
-.291278-07 .153268-07-.267715-07 .671759-08 .619545-07-.701808-07-.199552-07 .781784-07-.286385-07-.279577-07
 .145031-07 .249809-08 .228437-07-.263344-07-.197553-07 .434369-07-.101204-07-.226370-07 .178625-07-.454460-08
 .712299-09 .766907-08-.154974-07 .493143-08 .121471-07-.130932-07 .140621-08 .873318-08-.128241-07 .578520-08
 .121520-07-.193761-07 .111939-08 .187482-07-.126113-07-.597322-08 .962504-08-.208821-08 .557500-09-.170316-08
-.336106-08 .672249-08-.929142-09-.486740-08 .270166-08 .116235-08-.702025-09-.609491-09-.171295-09 .747226-09
-.165138-09

-.516971-10 .220843-10 .899110-10-.599001-10-.486484-10 .694461-10-.290360-11-.349929-10 .218970-10-.138022-10
 .850732-11 .238644-10-.450933-10 .984577-11 .389523-10-.360863-10-.264722-11 .219898-10-.149635-10 .576658-11
 .210378-11-.114123-10 .103664-10 .139149-11-.576182-11 .134324-12-.595676-14 .560651-11-.361776-11-.355982-11
 .453073-11-.266829-11 .408862-11-.776417-12-.946230-11 .104927-10 .310311-11-.118286-10 .433708-11 .430367-11
-.234469-11-.396234-12-.323467-11 .389239-11 .282616-11-.645183-11 .160896-11 .336496-11-.276191-11 .692313-12
-.283788-13-.114868-11 .225763-11-.766577-12-.174782-11 .200690-11-.309950-12-.133285-11 .202484-11-.878100-12
-.188927-11 .292142-11-.138277-12-.280393-11 .187014-11 .870267-12-.141209-11 .334488-12-.118838-12 .247689-12
 .530868-12-.100897-11 .124450-12 .732540-12-.399311-12-.175349-12 .104221-12 .903534-13 .256884-13-.110635-12
 .245119-13

 DATA GROUP 1
NUMBER OF THE SAMPLES:    4

VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


QUALITY Q=  .9339  IN THE FIRST APPROACHING
            .9835  AFTER CORRECTION FOR MONOTONICITY


 DATA GROUP 2
NUMBER OF THE SAMPLES:    3

VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


QUALITY Q=  .6740  IN THE FIRST APPROACHING
            .7243  AFTER CORRECTION FOR MONOTONICITY
```

```
 DATA GROUP 3
NUMBER OF THE SAMPLES:    4


VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


QUALITY Q=  .9255  IN THE FIRST APPROACHING
            .9549  AFTER CORRECTION FOR MONOTONICITY



 DATA GROUP 4
NUMBER OF THE SAMPLES:    4
VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


QUALITY Q=  .7409  IN THE FIRST APPROACHING
            .7409  AFTER CORRECTION FOR MONOTONICITY



 DATA GROUP 5
NUMBER OF THE SAMPLES:    5


VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


QUALITY Q= 1.0000  IN THE FIRST APPROACHING
           1.0000  AFTER CORRECTION FOR MONOTONICITY
```

```
 UNFINISHED GROUP 1
NUMBER OF THE SAMPLES:    3

VALUE       ORIG.   APPROX.

(CURVES ON THE PLOTTER)

RESULTING QUALITY Q=  .1427

----------------------------------------------------------------
QUALITY OF THE FITTING AFTER CORRECTION FOR MONOTONICITY Q= .7243
----------------------------------------------------------------

THATS ALL,SOUKUP

BLOCK 999 HAS BEEN WRITTEN ON TAPE

ESTIMATED PLOT TIME IS      11 MINUTES.
EXECUTION TERMINATED BY FALL-THRU TO END STATEMENT

@ EOF
```

APPENDIX 5

Computer Output for Test Example, Method 2

```
TEST EXAMPLE

ANALYSIS OF THE GENERAL TYPE OF THE DISTRIBUTION
------------------------------------------------
METHOD 2


 DATA GROUP 1
 DATA GROUP 2
 DATA GROUP 3
 DATA GROUP 4
 DATA GROUP 5


UNFINISHED DATA=

 UNFINISHED GROUP 1

LIST OF THE INPUT DATA

   .150+02  .200+01  .100+03  .100+01  .200+01  .100+02
   .200+02  .400+01  .500+02  .100+01  .200+02  .250+02
   .250+02  .200+01  .100+03  .200+01  .500+02  .800+01
   .200+02 -.100+00  .500+02  .300+01  .100+03 -.100+00
  -.100+00 -.100+00 -.100+00 -.100+00  .200+03 -.100+00


FIRST  4 CENTRAL MOMENTS

 .200+02 .125+02 .000    .313+03
 .267+01 .889+00 .593+00 .119+01
 .750+02 .625+03 .000    .391+06
 .175+01 .688+00 .281+00 .770+00
 .744+02 .505+04 .289+06 .572+08
 .143+02 .576+02 .293+03 .497+04
```

```
FIRST  4 PARAMETERS OF THE DISTRIBUTION - COMPUTED FROM THE TRANSFORMED VALUES
USED FORMULA-
M1(X)=P1(X)
MK(X)=((K+1)*PK(X))**(1/K) FOR K.GT.2
WHERE PK(X) IS THE K-TH CENTRAL MOMENT AFTER  TRANSFORMATION FROM T TO X
SEE BELOW
 .167+01 .931-01-.548-01 .958-01
 .106+01 .168+00 .137+00 .160+00
 .205+01 .178+00 .977-03 .154+00
 .918+00 .242+00 .142+00 .225+00
 .182+01 .820+00-.679+00 .870+00
 .154+01 .253+00 .196+00 .242+00
```

```
PARTIAL RESULTS OBTAINED QUALITY FOR (NUMBER OF MOMENTS/ORDER OF THE POLYNOMIAL)
NUMBERS IN BRACKETS DENOTE THE ORDERING OF USED MOMENTS FOR POLYNOMIAL APPROXIMATION


ON THE END OF EACH ROW A MINIMUM VALUE

DEGREE OF THE FOURIER,S SERIES = 21
 1/ 1   .79  .79  .85  .87  .89  .79
 1/ 2   .85  .84  .82  .93  .96  .82
 1/ 3   .83  .57  .91  .90  .98  .57
 2/ 1   .90  .87  .95  .90 1.00  .87
 3/ 1   .93  .88  .94  .94 1.00  .88

DEGREE OF THE FOURIER,S SERIES = 41
 1/ 1   .89  .80  .86  .83  .87  .80
 1/ 2   .95  .87  .83  .92  .96  .83
 1/ 3   .81  .54  .91  .88  .98  .54
 2/ 1   .96  .87  .94  .90 1.00  .87
 3/ 1   .93  .87  .93  .95 1.00  .87

DEGREE OF THE FOURIER,S SERIES = 61
 1/ 1   .90  .79  .85  .80  .86  .79
 1/ 2   .95  .87  .81  .91  .96  .81
 1/ 3   .84  .54  .91  .88  .98  .54
 2/ 1   .96  .88  .94  .90 1.00  .88
 3/ 1   .95  .87  .94  .95 1.00  .87
```

DEGREE OF THE FOURIER,S SERIES = 81

1/ 1	.88	.78	.85	.78	.85	.78
1/ 2	.95	.86	.80	.90	.97	.80
1/ 3	.86	.56	.91	.88	.97	.56
2/ 1	.95	.89	.93	.90	1.00	.89
3/ 1	.96	.87	.94	.95	1.00	.87

DEGREE OF THE FOURIER,S SERIES =101

1/ 1	.87	.77	.85	.78	.84	.77
1/ 2	.95	.85	.79	.90	.97	.79
1/ 3	.86	.57	.91	.88	.97	.57
2/ 1	.95	.89	.93	.91	1.00	.89
3/ 1	.96	.87	.93	.96	1.00	.87

DEGREE OF THE FOURIER,S SERIES =121

1/ 1	.88	.76	.85	.77	.84	.76
1/ 2	.94	.84	.78	.90	.97	.78
1/ 3	.85	.58	.91	.88	.97	.58
2/ 1	.96	.89	.93	.91	1.00	.89
3/ 1	.95	.87	.94	.96	1.00	.87

DEGREE OF THE FOURIER,S SERIES =141

1/ 1	.88	.76	.85	.77	.84	.76
1/ 2	.93	.84	.78	.89	.97	.78
1/ 3	.85	.58	.91	.88	[illegible]	.58
2/ 1	.96	.89	.93	.92	[illegible]	.89
3/ 1	.96	.87	.93	.96	[illegible]	.87

DEGREE OF THE FOURIER,S SERIES =161

1/ 1	.88	.75	.85	.78	.84	.75
1/ 2	.93	.83	.78	.89	.97	.78
1/ 3	.86	.58	.91	.88	.97	.58
2/ 1	.95	.89	.93	.92	1.00	.89
3/ 1	.96	.88	.93	.96	1.00	.88

DEGREE OF THE FOURIER,S SERIES =181

1/ 1	.88	.75	.85	.78	.84	.75
1/ 2	.93	.83	.77	.89	.97	.77
1/ 3	.86	.59	.91	.88	.97	.59
2/ 1	.96	.88	.94	.92	1.00	.88
3/ 1	.96	.88	.93	.96	1.00	.88

```
GIVEN QUALITY   Q=  .9000  HAS NOT BEEN ACHIEVED
THE BEST RESULT Q=  .8915



DEGREE OF THE FOURIER,S SERIES =101

GENERAL FORM OF THE CUMMULATIVE CURVE=
F(Z)=MAX FF(T)  FOR T=(0,Z),F(Z) LESS 1.
WHERE FF(T) IS AN EVEN FOURIER SUM
FF(T)=A(0)+A(1)*COS(X)+A(2)*COS(2*X)...  / WHERE X=3.14165926*(ALOG((T-MIN)/S+1)+MAX/2)/(2*MAX)
WHERE  MAX=  .529832+01 ,S=  .100000+01  IS THE SCALE FACTOR,MIN= .100000+01
 .199000+03   IS THE SUSPECTED MAXIMUM VALUE FOR INPUT VALUES,,(SUSPECTED MINIMUM IS GIVEN BY MIN)
IF YOU LIKE TO CHANGE IT,PUT IN THE MAXIMUM AS PARAMETR ULIM



POLYNOMIAL APPROXIMATION AFTER THIS TRANSFORMATION
IF MJ(X) DENOTES THE J-TH PARAMETER
U=SIN(K*M1(X))/K
V=SIN(K*M2(X))/(K*M2(X))
(BE CAREFUL=U RESP. V RESP. W RESP. Z DEPENDS ON THE VALUE OF K)

GENERAL FORM OF THE POLYNOMIAL=
A(K)=G(K,1)+G(K,2)*U+G(K,3)*V+G(K,4)*U**2+G(K,5)*U*V+G(K,6)*V**2+G(K,7)*U**3+G(K,8)*U**2*V+G(K,9)*U*V**2
G(K,10)*V**3+G(K,11)*U**4+G(K,12)*U**3*V+G(K,13)*U**2*V**2+G(K,14)*U*V**3+G(K,15)*V**4
USED ORDER: 1


LIST G(K,J)FOR K=0,...,100

 .100000+01 .623887+00-.793406-01-.176358+00 .720567-01 .676920-01-.618713-01 .387944-02 .384439-01-.222945-01
-.793039-02 .349996-02 .117194-03-.502398-02 .451292-02 .114596-02 .205818-02-.331872-02 .338026-02-.374304-02
-.723163-02-.151566-02 .487340-02 .236812-02-.167197-02 .483763-02 .148057-02-.122975-01-.403799-02 .642508-02
 .356745-02 .908456-02 .182816-02-.123616-01-.544352-03 .127346-02-.148302-02 .562345-02 .385106-02-.319786-02
 .272788-02-.774245-03-.279409-02 .138526-03 .206235-02-.276979-03-.203082-02-.232191-03 .108178-02 .682756-04
 .991117-03-.145960-02-.419448-03-.286182-02 .437615-03 .388932-02 .689060-02-.326956-03-.282262-02-.386605-02
 .232453-03 .230310-02 .148494-02 .245439-02-.244490-03-.297122-02 .341971-03 .135312-02-.176007-02-.432823-03
 .959904-03-.119911-03-.749265-03-.909466-04 .449039-03-.596536-03-.178097-03-.416771-03-.582478-04 .579877-04
 .452036-03 .340952-03-.100773-02 .525711-04 .124736-02-.635784-03-.156800-04 .986882-03-.835990-03-.107632-03
 .140583-02-.615930-03-.823121-04 .481367-03-.358393-04-.629989-04 .282443-04-.223147-04-.197629-04-.194503-04
 .800860-05
```

```
-.318310+00-.630985+00-.617883+00-.589326+00-.568766+00-.533206+00-.510211+00-.525321+00-.427595+00-.198443+00
-.355596+00 .816386-01-.161121+00-.577159-01-.327421+00 .943390-01 .299984-01-.237513+00 .221630+00 .270292+00
 .594158-01 .233050+00 .265914+00 .199478-01 .664983+00 .217990+00 .216355+00 .904911-01 .366449+00 .332908-01
 .507949+00-.222140+00 .114891-01-.157038+00 .181809+00-.800837-01 .315024+00-.378625-01-.247592+00-.116357+00
 .246443+00-.422443-01 .172458+00 .871851-01-.949668-02 .128078-01-.856989-01 .932533-02-.481803-01 .477161-01
-.107438+00-.193309+00 .967886-01-.954847-01-.918758-01-.173395-02-.493995+00-.174967+00-.144690+00-.128825+00
-.479040-01-.606184-01-.173135+00-.685311-01-.925671-01 .472425-01 .677742-01 .452912-02-.728648-01-.218374-01
 .955236-03-.222747-01-.345462-02-.155849-01-.546215-02-.774619-01-.547782-01 .699807-01-.172899-01-.693210-03
-.145297-01 .263274-01-.903424-01-.523543-01-.120942+00-.785711-02-.381651-01-.230300-01-.716372-01-.223830-01
-.153853+00 .317243-02-.955545-02 .109066-01-.249342-01-.251672-01-.585450-02-.668069-02-.932215-02-.150790-02
-.491840-02

 .243589-07-.629258+00 .821398-01 .188669+00-.812086-01-.819738-01 .758936-01 .332893-02-.554696-01 .191980-01
 .228007-01 .311374-01-.203929-01-.506892-02-.341022-03-.143184-02-.418725-01 .752161-02 .485424-01-.107788-01
-.193918-01 .253391-01 .282060-01-.233021-01-.593838-01 .111411-01 .241019-01 .197620-01-.231861-01-.459839-02
-.181135-01-.425024-01 .120553-01 .457032-01-.423494-01-.682302-01-.957248-01 .516263-01 .465089-01-.670424-01
-.191427-01 .294309-01 .245111-01 .164585-02-.130564-02-.237068-02-.103248-01-.975757-02 .475491-02 .979658-02
 .691230-03-.620214-02-.113818-01-.113593-01-.276494-02 .130555-01 .740839-01-.556394-02-.323049-01-.222406-01
-.174291-02 .113004-01 .109615-01 .187425-01 .630985-02 .124872-01 .130113-01-.114739-01-.471603-01-.225231-01
 .167834-01 .100857-01-.134344-01-.456262-02 .122480-01 .136345-01-.109308-01-.342650-02 .104525-01-.202526-02
-.122912-01-.360906-03 .678255-02-.569147-03-.701276-02 .716772-02 .436593-02-.116555-01 .862632-02 .431935-02
-.197344-01 .181601-03-.430516-03 .136385-02 .276424-02-.929387-04-.141705-02 .310550-02 .595844-03-.169911-02
 .619732-03
```

```
 DATA GROUP 1
NUMBER OF THE SAMPLES:    4
VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)
QUALITY Q=  .9511  IN THE FIRST APPROACHING
            .9511  AFTER CORRECTION FOR MONOTONICITY


 DATA GROUP 2
NUMBER OF THE SAMPLES:    3

VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)
QUALITY  Q=  .8915  IN THE FIRST APPROACHING
             .8915  AFTER CORRECTION FOR MONOTONICITY
```

```
 DATA GROUP 3
NUMBER OF THE SAMPLES:    4


VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


QUALITY Q=  .9315  IN THE FIRST APPROACHING
            .9315  AFTER CORRECTION FOR MONOTONICITY



 DATA GROUP 4
NUMBER OF THE SAMPLES:    4
VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


QUALITY Q=  .9094  IN THE FIRST APPROACHING
            .9094  AFTER CORRECTION FOR MONOTONICITY



 DATA GROUP 5
NUMBER OF THE SAMPLES:    5


VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


QUALITY Q= 1.0000  IN THE FIRST APPROACHING
           1.0000  AFTER CORRECTION FOR MONOTONICITY
```

```
 UNFINISHED GROUP 1
NUMBER OF THE SAMPLES:    3


VALUE        ORIG.   APPROX.

(CURVES ON THE PLOTTER)


RESULTING QUALITY Q=  .9055


--------------------------------------------------------------------
QUALITY OF THE FITTING AFTER CORRECTION FOR MONOTONICITY Q= .8915
--------------------------------------------------------------------

                                                                     THATS ALL,SOUKUP


BLOCK 999 HAS BEEN WRITTEN ON TAPE


ESTIMATED PLOT TIME IS      11 MINUTES.
EXECUTION TERMINATED BY FALL-THRU TO END STATEMENT


@ EOF
```

APPENDIX 6

Graphical plot of general distribution function as obtained by Method 1

Figure 1. Method 1, beginning of the plot.

nst=	500
nu=	181
mom=	4
gib=	2
var=	4
kol=	1
scy=	6000.0011
tra=	0

test example

Figure 2. Method 1, group 1.

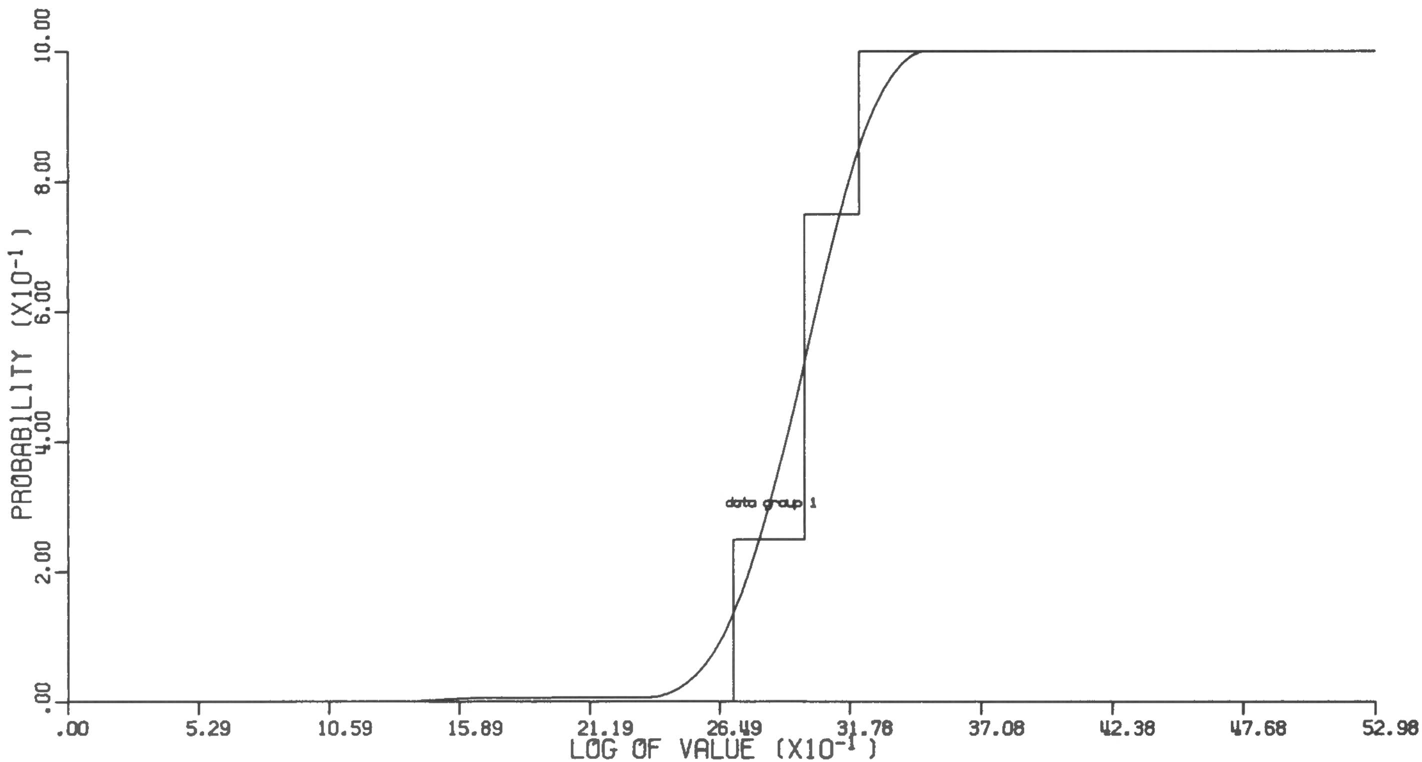


Figure 3. Method 1, group 2.

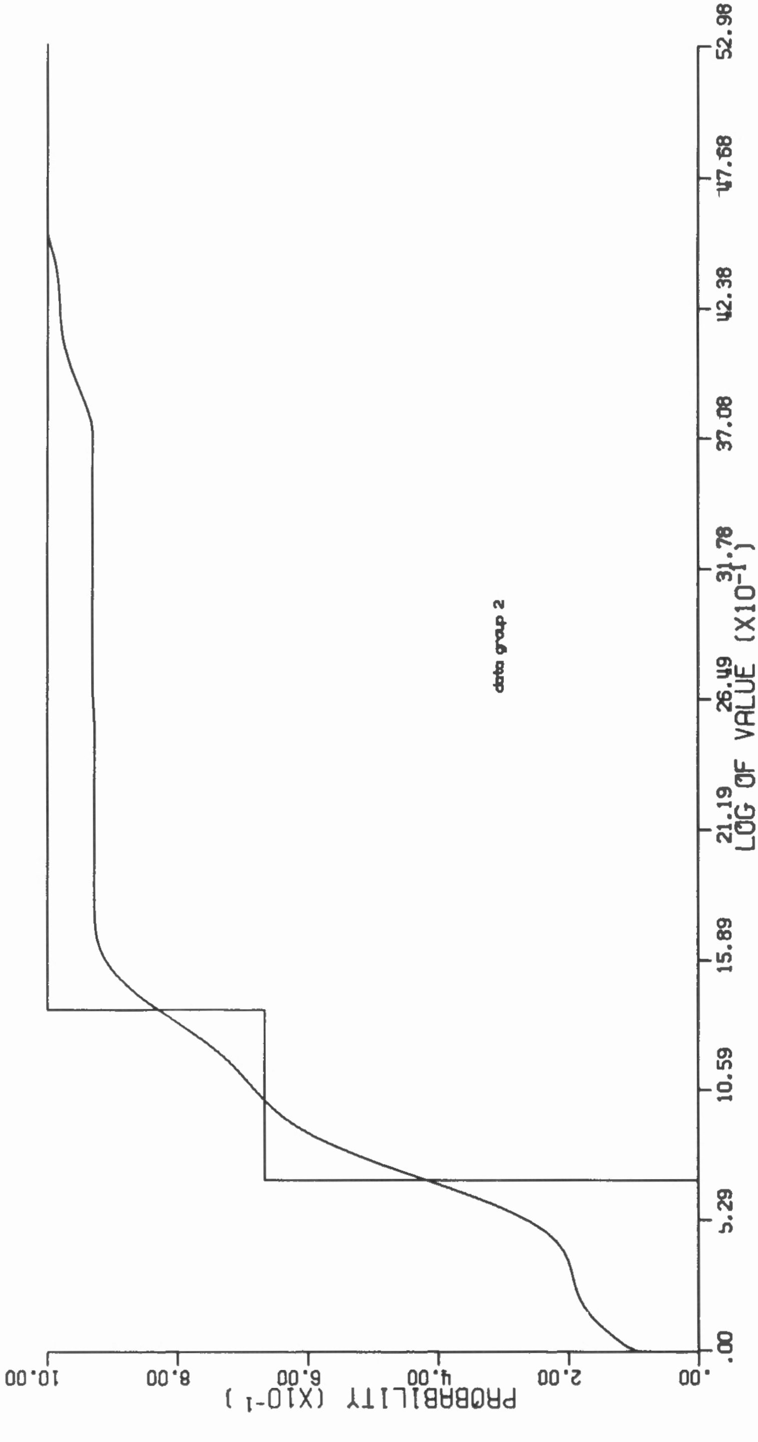


Figure 4. Method 1, group 3.

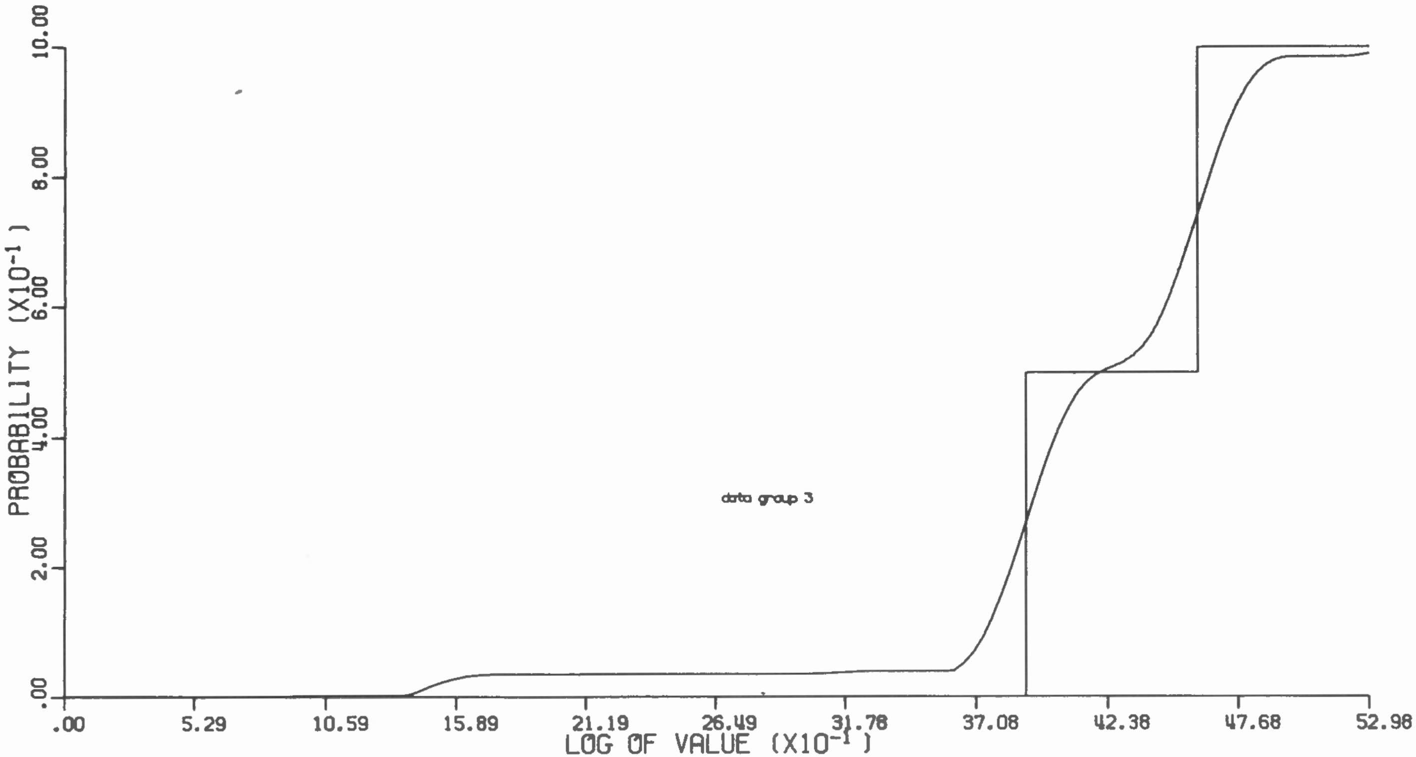


Figure 5. Method 1, group 4.

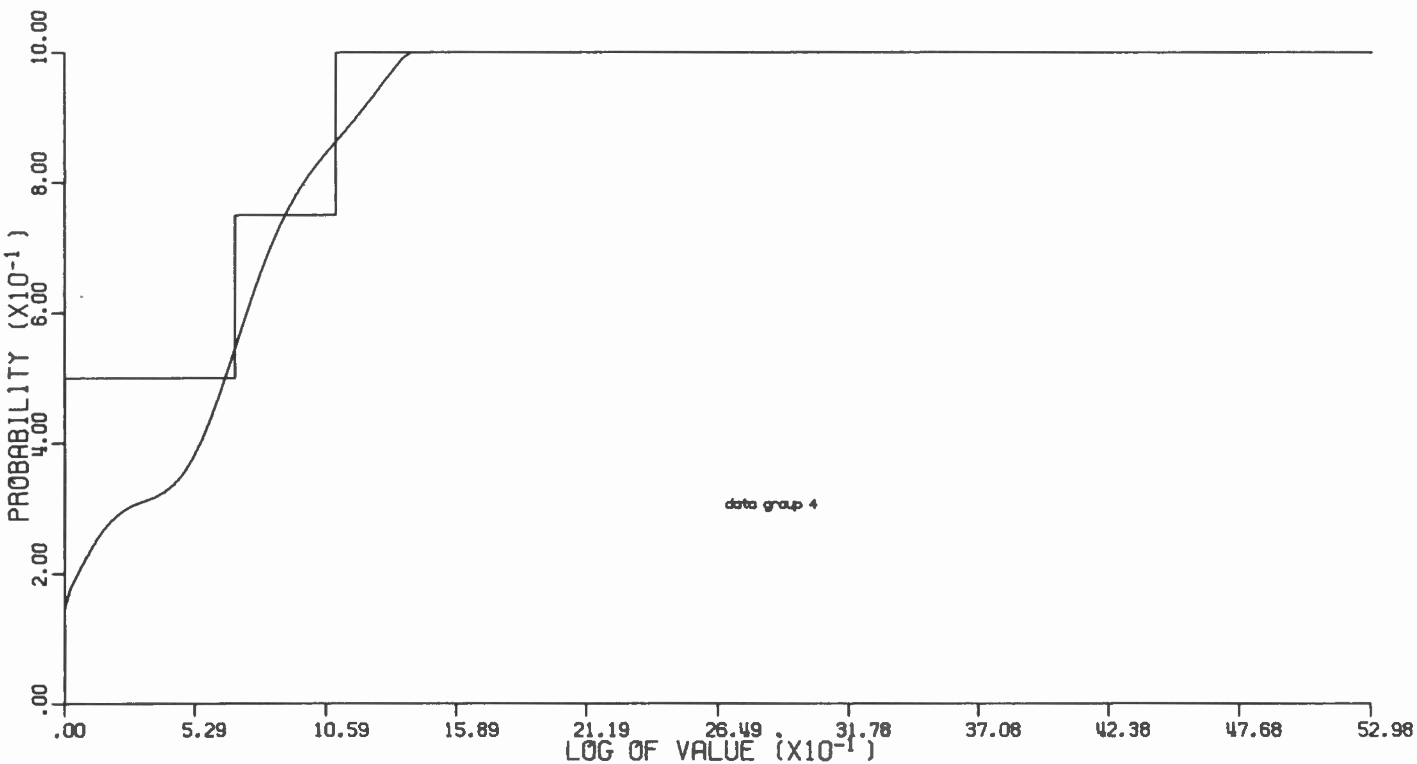


Figure 6. Method 1, group 5.

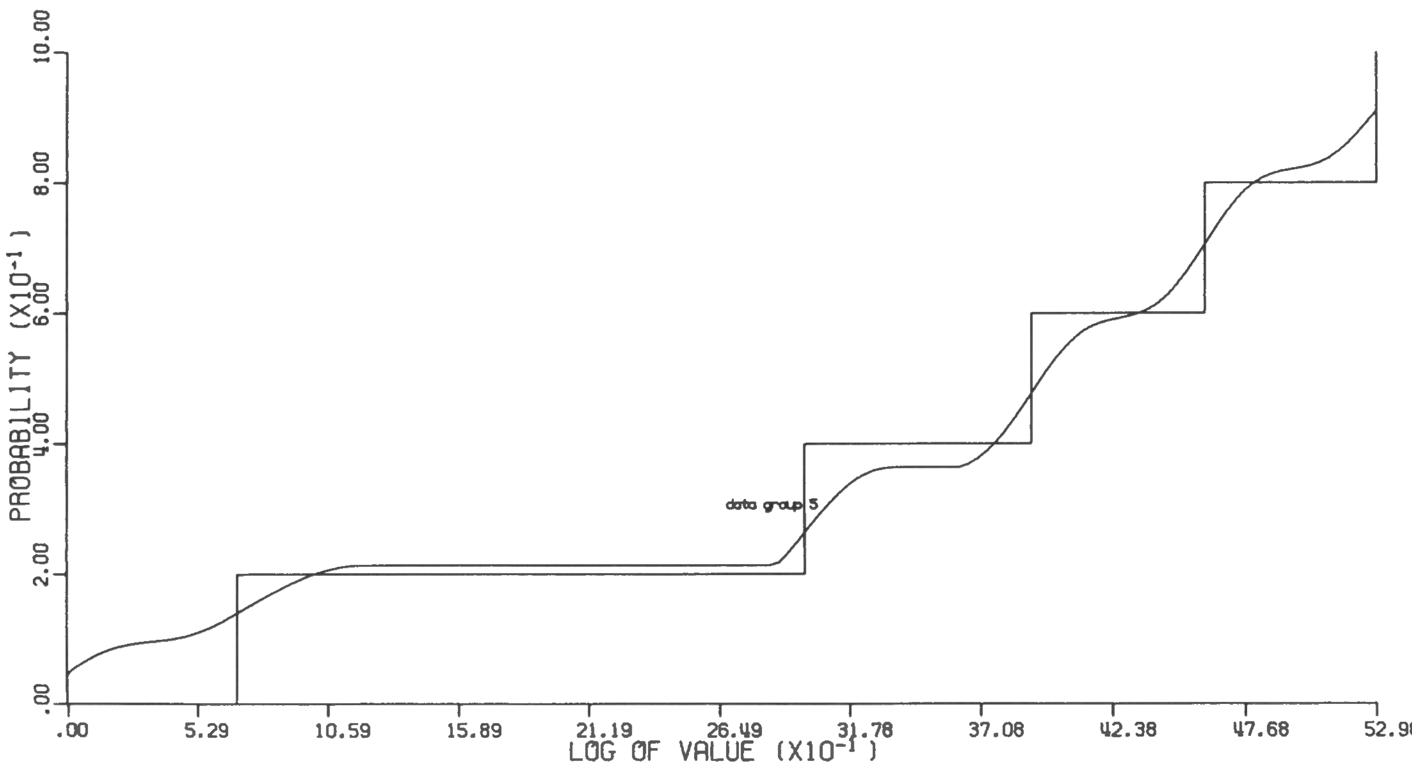
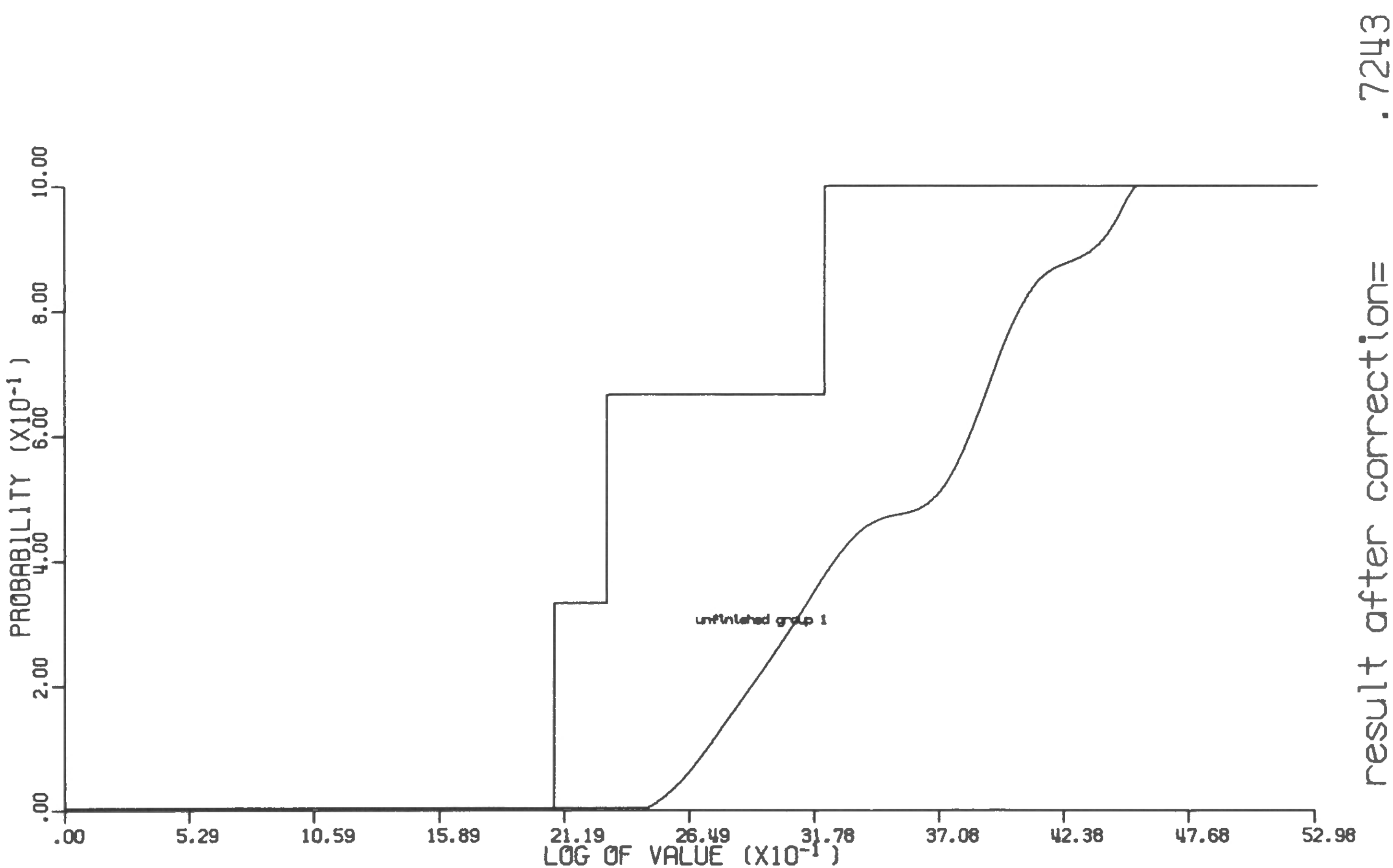


Figure 7. Method 1, "unfinished" group.



APPENDIX 7

Graphical plot of general distribution function as obtained by Method 2

Figure 8. Method 2, beginning of the plot.

test example

nst= 500

nu= 181

mom= 4

gib= 2

kol= 1

tra= 0

Figure 9. Method 2, group 1.

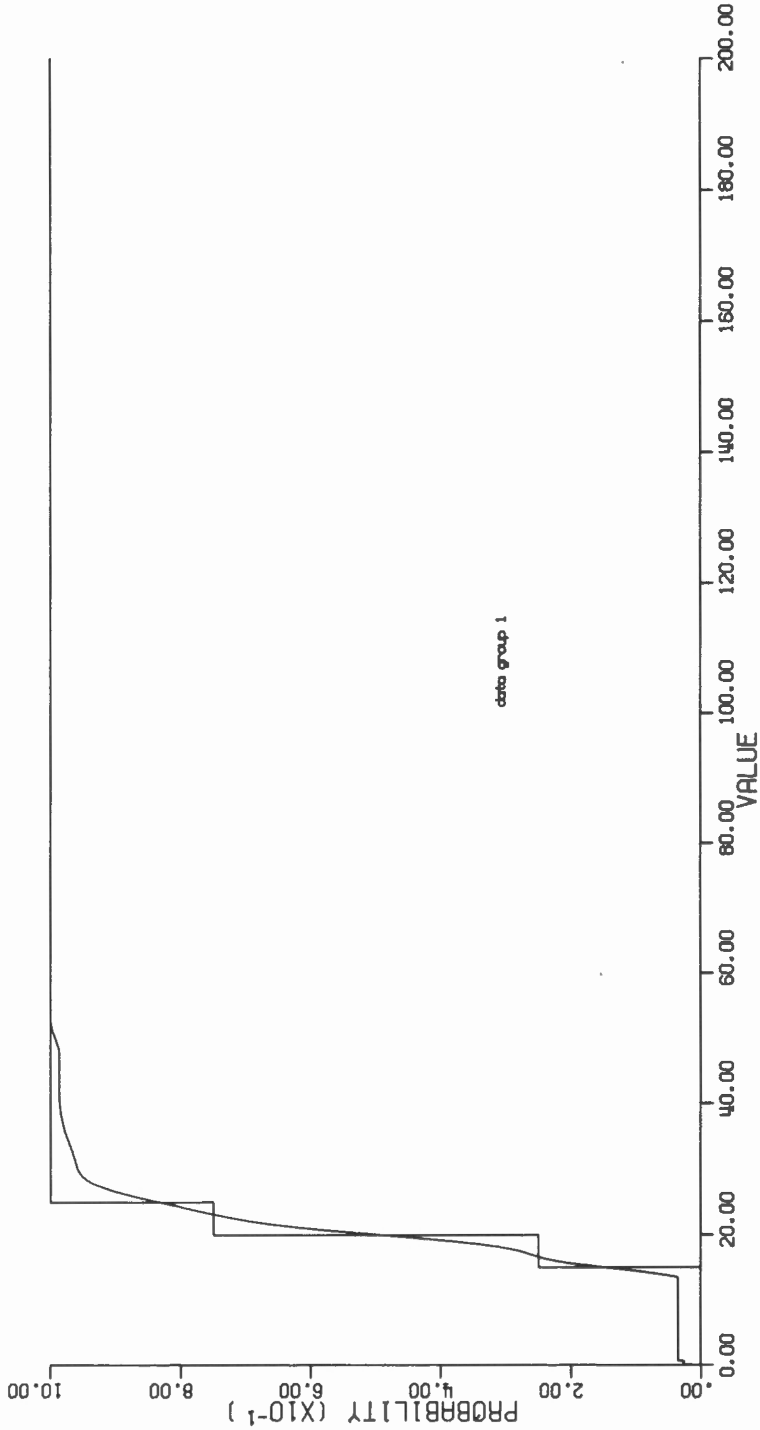


Figure 10. Method 2, group 2.

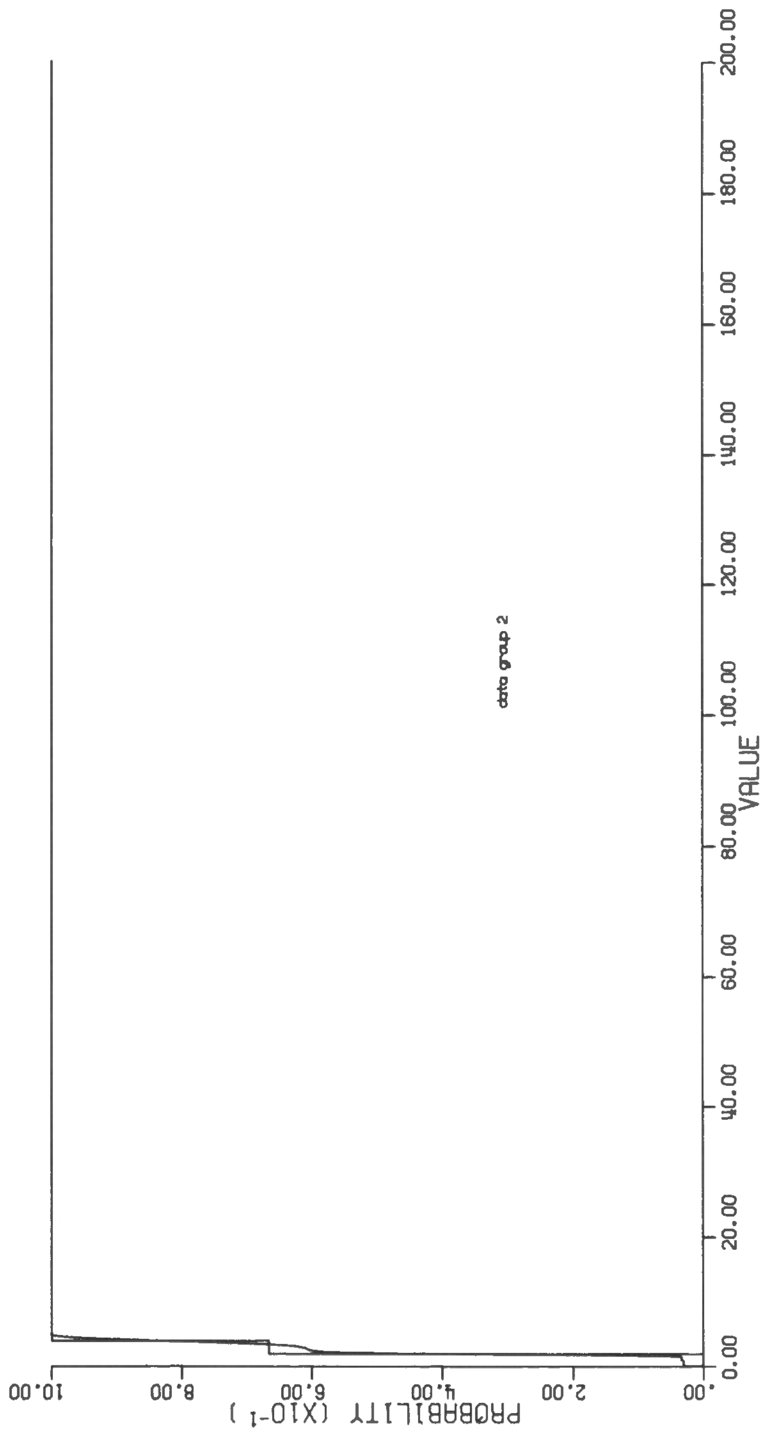


Figure 11. Method 2, group 3.

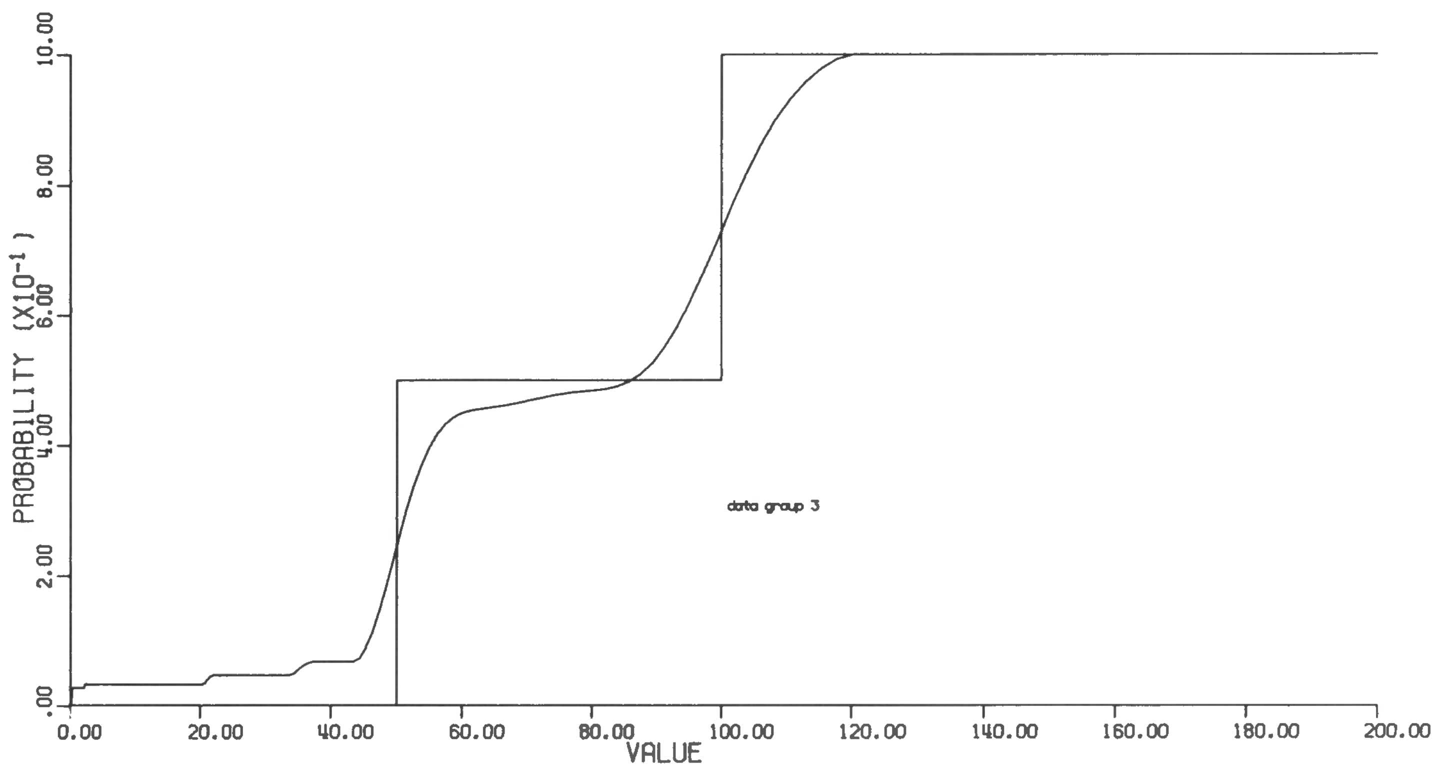


Figure 12. Method 2, group 4.

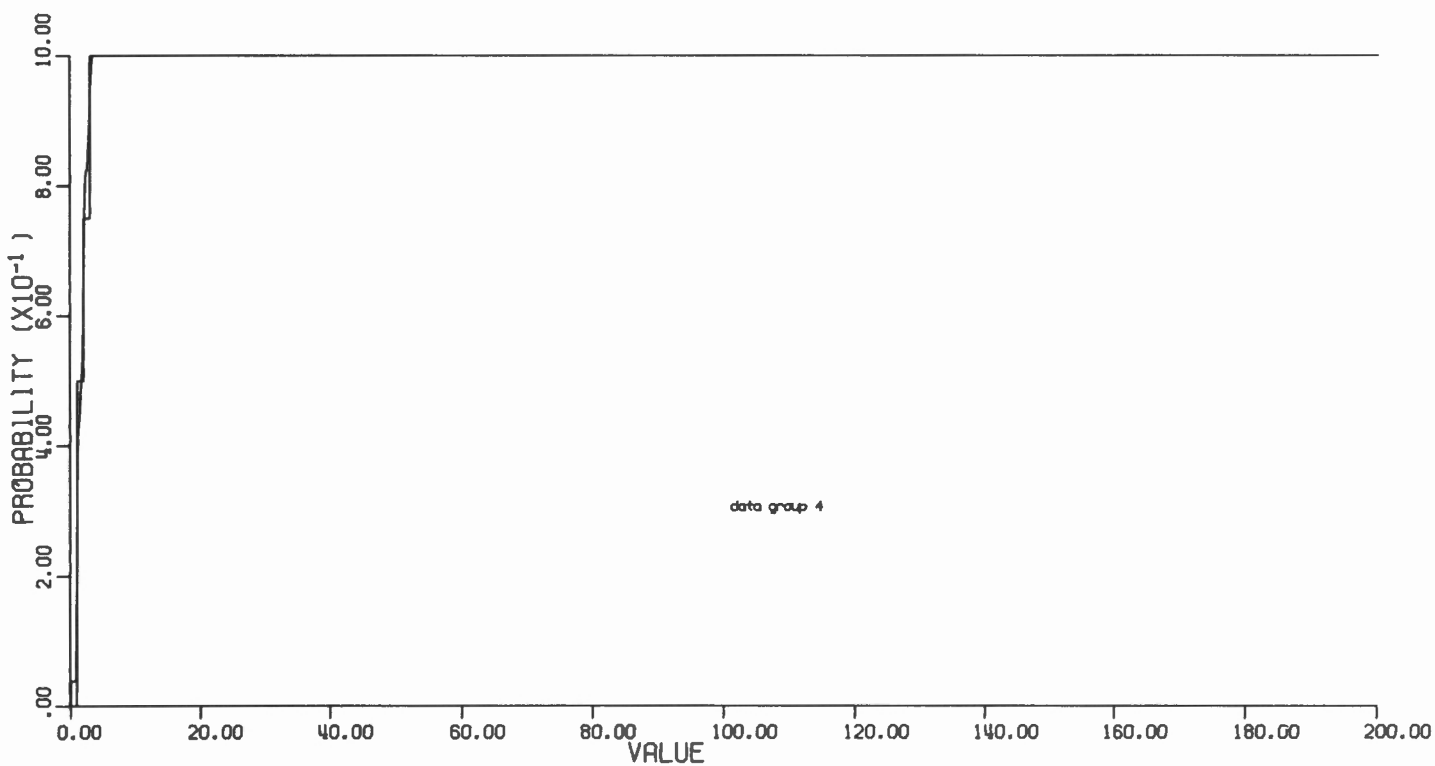
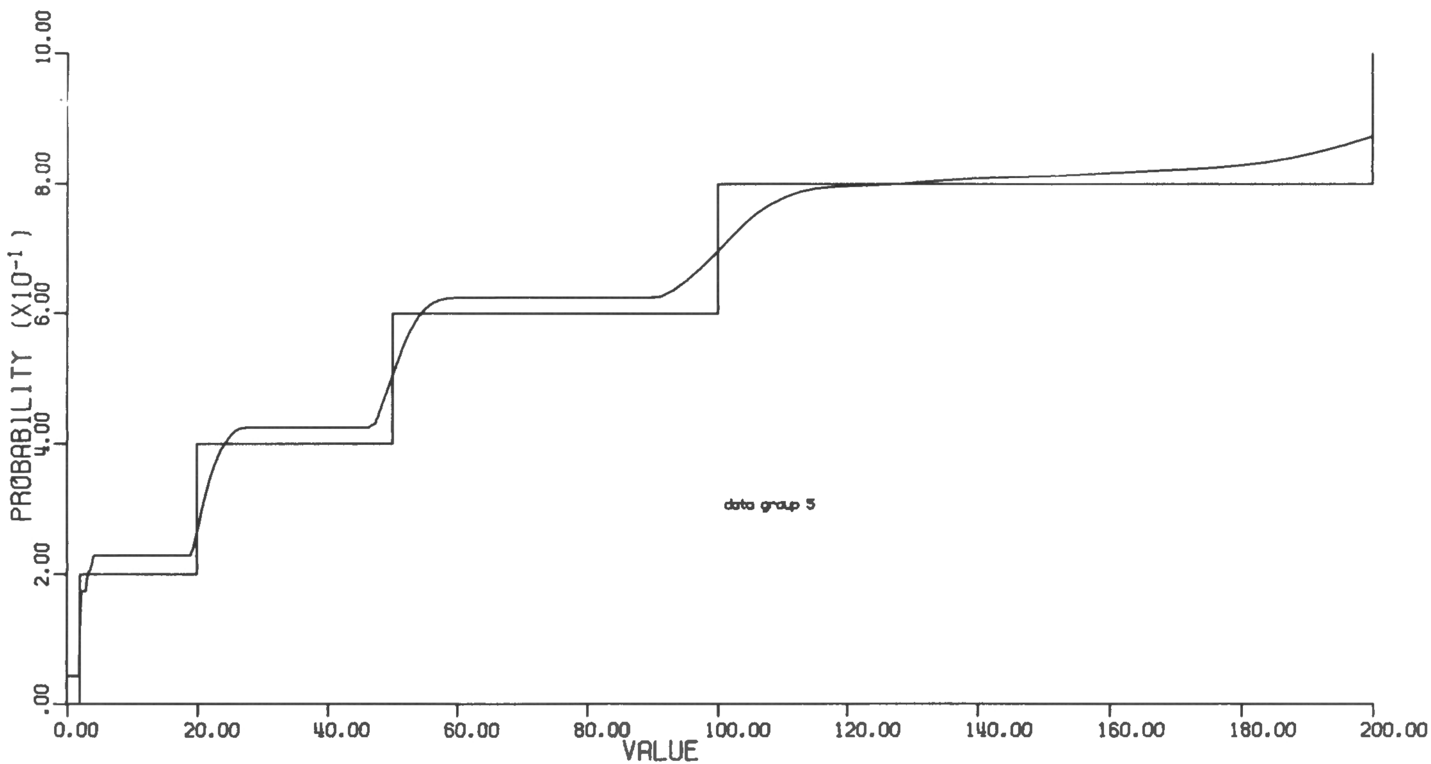


Figure 13. Method 2, group 5.



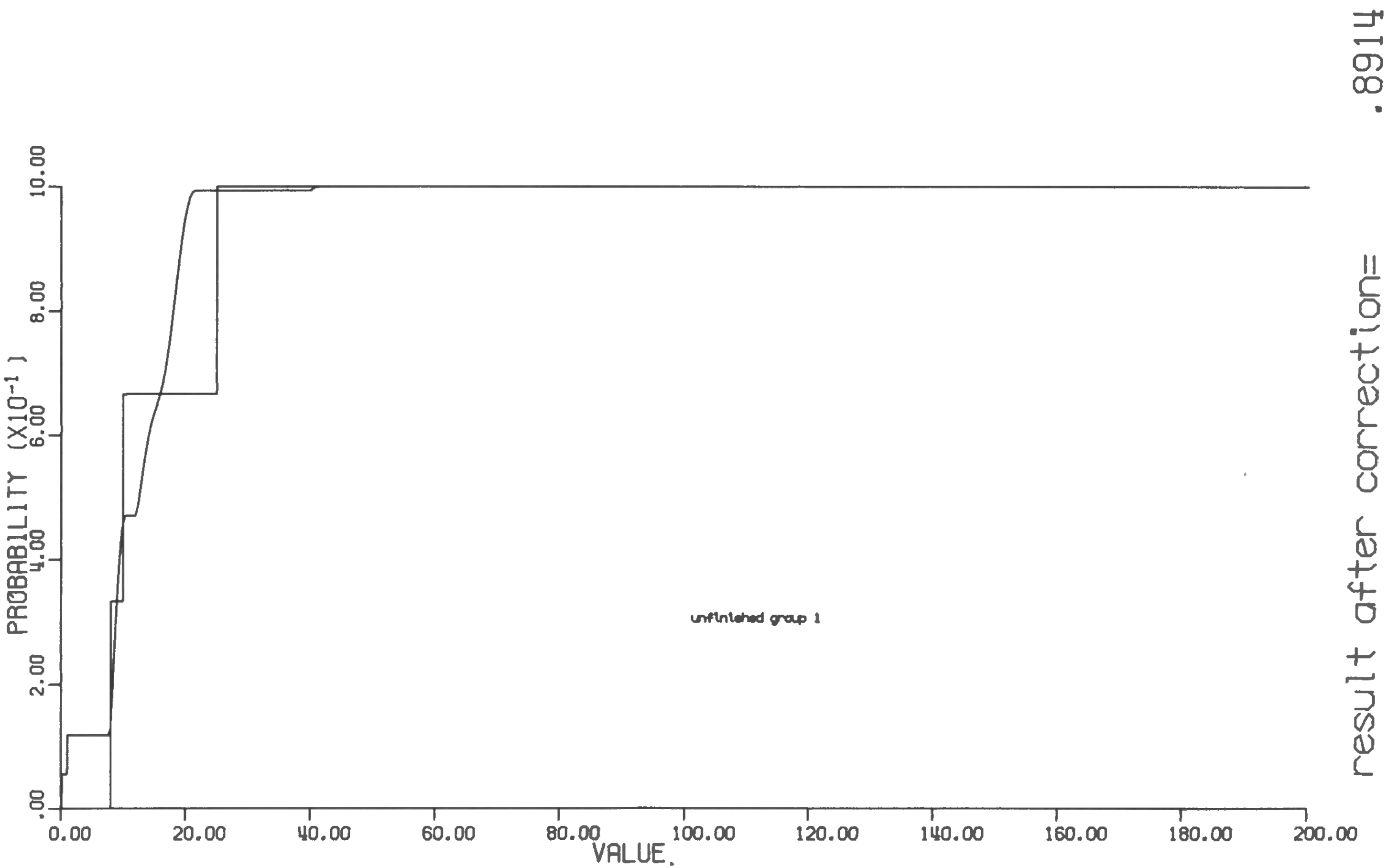


Figure 14. Method 2, "unfinished" group.