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FORTRAN PROGRAMS FOR ANALYZING COLLABORATIVE TEST DATA

PART II: SCATTER DIAGRAMS

By

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FOREWORD

Man and his environment must be protected from the adverse effects of pesticides, radiation, noise and other forms of pollution, and the unwise management of solid waste. Efforts to protect the environment require a focus that recognizes the interplay between the components of our physical environment--air, water, and land. The National Environment Research Centers provide this multidisciplinary focus through programs engaged in

> studies on the effects of environmental contaminants on man and the biosphere, and

> a search for ways to prevent contamination and to recycle valuable resources.

This work provides a method for understanding the deeper meaning of interlaboratory collaborations. This work also represents one effort to achieve a more complete knowledge of the effectiveness of various analytical methods.

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ABSTRACT

A FORTRAN program for IBM 1130 designed to plot three pairs of data sets in three scatter diagram on one page is described. These data stem from interlaboratory studies of chemical analytical methods.

PREFACE

These program systems for general statistics and plotting of data scatter diagrams are programmed in Fortran 1130. These program systems are designed to be executed on IBM 1130, Version 2, Modification 11, Core Size 16K.

General statistics are obtained on data from interlaboratory method studies through the program, COLST. These statistical approaches are based on a procedure described by Youden (1). In his procedure, a closely related pair of samples, A and B, for example, are analyzed by each of the participating laboratories. The data from all of the participants for each of the samples are subjected to the statistical program, COLST.

The data from each sample pair are plotted, values of A versus values of B. In this particular plot program, SCAT, the data from three pairs of samples are used for making three plots, or diagrams, which are drawn on a single page. This presentation of data provides a vivid display for purposes of comparison.

The general statistics program was adapted from a data summarization program written in Fortran IV (2). This program was adapted to the 1130 Model and expanded to provide for data input in any one of several forms of decimal expression, data screening, and the application of a statistical t-test to expose outliers and to leave a reduced vector of "retained" data. The plotter program, SCAT, utilizes the plotter routines as supplied by IBM.

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REFERENCES

1. Youden, W.J.,Statistical Techniques for Collaborative Tests, AOAC, Washington, D.C.(1967).

2. Larson, K.E.,Ed.,The Summarization of Data, Journal of Quality Technology,1,68(1969).

3. IBM Systems Reference Library, IBM 1130/1800 Plotter Subroutines, Form C26-3755-2, Third Edition, June 1969.

INTRODUCTION

The program, SCAT, was designed to provide for the plotting of paired sets of data. This program treated data from interlaboratory method studies carried out by this agency. For designing the study and for analysis of the data, suggestions of Youden were used (1). The main program for statistics made use of a program listing edited by Larson (2). The main plotting program, SCAT, has made use of plotter subroutines of IBM Systems Reference Library (3).

USE

This program produced a plotter output of three paired sets of data from interlaboratory method studies. In addition, a printed output provided the list of valid data from each data vector, the paired data listing from pairs of data vectors, extreme values of matched data pairs which were not plotted, and list of plotted data pairs. The plotter output consisted of grids with tick marks, two true value lines, one parallel to the abscissa and the other parallel to the ordinate, plotted data points, and a complete set of labels and values marking the ordinate and abscissa scales on the sides and bottoms of the grids.

DESCRIPTION

The main program, SCAT, utilizes 12 subroutines through which data were screened and edited by the removal of statistically rejected data, the pairing of two data vectors, the application of an arbitrary upper limit for plotting, and the plotting of the data. The plotting steps are shown under 'USE'.

The main program used the same input data as the statistics program of PART I utilizing for data screening the subroutine, REALT.

INPUT REQUIREMENTS

Variable	Purpose	Format
D1	Number of user units per tick mark of scale for first grid (grid A)	F10.3
D2	Number of user units per tick mark of scale for second grid (grid B)	F10.3
D3	Number of user units per tick mark of scale for third grid (grid C)	F10.3
TV(I)	Vector of six true values	F10.3
NFOR	Number of data values rejected by the t-test in PART I	I4

FAL(I)	Vector containing laboratory identification numbers of rejected data values	I3
NFN(I)	Vector containing analyst identification numbers of rejected data values. The number of elements in vectors FAL and NFN equals the value of NFOR.	A1
CXY	The arbitrary upper limit of the paired data which is to be plotted	F10.[illegible]
Q	A dummy variable used to pass one card which was used in a previously unrelated program.	A4

OUTPUT REQUIREMENTS

The main program, SCAT, produces no output. Output comes from certain subroutines which the main program calls.

```
C         SCAT
      INTEGER AA(120),AAR(120),AB(120),ABR(120),FAL(120),
     1 ANAR(120),ANB(120),ANBR(120),ANA(120)
      DIMENSION NX(120),TA(120),NAR(120),TAR(120),AT(120),
     1 NB(120),TB(120),XC(120),NBR(120),TBR(120),BT(120),YC(120),
     2 NFN(120),X(120),Y(120),XP(120),YP(120),XZ(120),YZ(120),
     3 TV(6)
      IPUT=2
      IOUT=5
      READ(IPUT,4)
      READ(IPUT,3) D1,D2,D3
      READ(IPUT,3) (TV(I),I=1,6)
      CALL TGD4
      CALL TV4(TV,D1,D2,D3)
      DO 10 MAA=1,3
      READ(IPUT,5)
      CALL REALT(AA,NX,TA,ANA,AT,NRA)
      READ(IPUT,5)
      CALL REALT(AB,NB,TB,ANB,BT,NRB)
C
      READ(IPUT,1) NFOR
      READ(IPUT,2)(FAL(I),I=1,NFOR)
      CALL RETN(AA,NX,TA,ANA,NRA,AAR,NAR,TAR,ANAR,NRAR,FAL,NFN,NFOR)
      READ(IPUT,1) NFOR
      READ(IPUT,2)(FAL(I),NFN(I),I=1,NFOR)
      CALL RETN(AB,NB,TB,ANB,NRB,ABR,NBR,ABR,NRBR,FAL,NFN,NFOR)
      CALL PAIR(AAR,NAR,TAR,ANAR,NRAR,ABR,NBR,TBR,ANBR,NRBR,X,Y,L)
      READ(IPUT,3) CXY
      CALL XYTRM(X,Y,CXY,XZ,YZ,L,NA,XC,YC,NC,IOUT)
      GO TO (101,102,103),MAA
101   CALL PRPA4(D1,XZ,YZ,NA,XP,YP)
      GO TO 110
102   CALL PRPB4(D2,XZ,YZ,NA,XP,YP)
      GO TO 110
103   CALL PROPC(D3,XZ,YZ,NA,XP,YP)
110   CALL DPTS(XP,YP,NA)
      READ(IPUT,6) Q
```

```
.0     CONTINUE
       CALL ABCD
.      FORMAT(I4)
2      FORMAT(I3,A1)
3      FORMAT(F10.3)
       FORMAT(//////////)
5      FORMAT(//)
5      FORMAT(A4)
       CALL EXIT
       END
```

SUBROUTINE TGD4

This subroutine plots the grid lines for three scatter plots. IBM plotting routines are found elsewhere.(2) The four cycle loops, DO 10 ..., DO 20 ..., DO 30 ..., are helpful in producing plots of good quality when the ball-point pen is used for plotting.

```
      SUBROUTINE TGD4
      CALL FPLOT(1,0.0,0.0)
      CALL SCALF(0.75,0.75,0.0,0.0)
C         GRID A
      DO 10 MAA=1,4
      CALL FGRID(0,0.0,6.0,1.00,4)
      CALL FGRID(1,4.0,6.0,1.00,4)
      CALL FGRID(2,4.0,10.0,1.00,4)
      CALL FGRID(3,0.0,10.0,1.00,4)
10    CONTINUE
C         GRID B
      CALL SCALF(0.75,0.75,0.0,6.0)
      DO 20 MAA=1,4
      CALL FGRID(0,5.0,6.0,1.00,4)
      CALL FGRID(1,9.0,6.0,1.00,4)
      CALL FGRID(2,9.0,10.0,1.00,4)
      CALL FGRID(3,5.0,10.0,1.00,4)
20    CONTINUE
C         GRID C
      CALL SCALF(0.75,0.75,5.0,6.0)
      DO 30 MAA=1,4
      CALL FGRID(0,0.0,0.0,1.00,4)
      CALL FGRID(1,4.0,0.0,1.00,4)
      CALL FGRID(2,4.0,4.0,1.00,4)
      CALL FGRID(3,0.0,4.0,1.00,4)
30    CONTINUE
      RETURN
      END
```

SUBROUTINE TV4

This subroutine plots the true value lines for the three pairs of samples in the three grids, respectively. No data are returned to the main program by this subroutine.

INPUT REQUIREMENTS

Variable	Purpose
TV(I)	True value vector; six true values, one for each sample.
D1	Number of user units per tick mark of scale for samples 1 & 2
D2	Number of user units per tick mark of scale for samples 3 & 4.
D3	Number of user units per tick mark of scale for samples 5 & 6.

```
      SUBROUTINE TV4
      DIMENSION TV(6)
      AX=TV(1)/D1
      AY=TV(2)/D1
      BX=TV(3)/D2
      BY=TV(4)/D2
      CX=TV(5)/D3
      CY=TV(6)/D3
      AY=AY+6.0
      BX=BX+5.0
      BY=BY+6.0
C         PLOT AX,AY
      DO 40 MAA=1,4
      CALL FPLOT(-2,AX,6.0)
      CALL FPLOT(-1,AX,10.0)
      CALL FPLOT(-2,0.0,AY)
      CALL FPLOT(-1,4.0,AY)
40    CONTINUE
C         PLOT BX,BY
      DO 50 MAA=1,4
      CALL FPLOT(-2,BX,6.0)
      CALL FPLOT(-1,BX,10.0)
      CALL FPLOT(-2,5.0,BY)
      CALL FPLOT(-1,9.0,BY)
50    CONTINUE
C         PLOT CX,CY
      DO 60 MAA=1,4
      CALL FPLOT(-2,CX,0.0)
```

```
      CALL FPLOT(-1,CX,4.0)
      CALL FPLOT(-2,0.0,CY)
      CALL FPLOT(-1,4.0,CY)
60    CONTINUE
      CALL FPLOT(1,0.0,0.0)
      RETURN
      END
```

Note that the DO loops with four cycles are used, with the use of ball point pens, to make a much brighter and even line or character than is made with only one passage of the pen.

SUBROUTINE REALT

The purpose of this subroutine is to screen the raw data as punched. The raw data may consist of censored data or blanks instead of data in valid form for this analysis. The number of data cards may be unknown. A card with numbers other than zero punched in card column 80 follows the data deck. Testing of fields such as censor sign or the absence of a decimal point is accomplished through character comparison. A valid raw data vector is created by this subroutine. This raw data vector is printed followed by count of input data and a count of output data. Subroutine CONV2 is used to convert the validated raw data into a real data vector, T.

INPUT REQUIREMENTS

Variable	Purpose	Format
ALAB(I)	Numerical identification of laboratory	I3
NNYL(I)	Numerical identification of analyst	A1
L(I)	Data censor (Greater than or less than)	A1
J(I)	Integer portion of data element	I4
M(I)	Decimal point of data element	A1
K(I)	Decimal portion of data element	I2
AN(I)	Symbol: D = Different method Blank = Official method of test	A1
ST(I)	Unused literal field	A2
KOUNT(I)	Field used for 'stop' card	I2

OUTPUT REQUIREMENTS

Variable	Purpose	Format
AL(I)	Numerical identification of laboratory	I3
NN(I)	Numerical identification of analyst	A1
T(I)	Element of the raw data vector	F10.2
ANA(I)	Method type, all blank	A2

```
      SUBROUTINE REALT(AL,NN,T,ANA,ANB,NR)
      INTEGER AL(120),ALAB(120),AN(120),ANA(120)
      DIMENSION NNYL(120),L(120),J(120),M(120),K(120),ST(120),
     1 NN(120),JJ(120),KK(120),T(120),KOUNT(120),ANB(120)
C         FOR TRACE METAL DATA ANALYSIS...UNKNOWN CARD COUNT.
C         PLACE 9'S CARD AFTER EACH INDIVIDUAL DATA DECK.
      IPUT=2
      IOUT=5
C         INPUT DATA
      I=0
      NR=0
19    I=I+1
      NG=I-1
```

```
      READ(IPUT,1) ALAB(I),NNYL(I),L(I),J(I),M(I),K(I),AN(I),ST(I),
     1 KOUNT(I)
      IF(KOUNT(I)) 10,10,99
10    IF(L(I)-16448) 19,11,19
11    IF(M(I)-16448) 21,19,21
21    IF(AN(I)-16448) 19,20,19
20    NR=NR+1
      AL(NR) = ALAB(I)
      NN(NR) = NNYL(I)
      JJ(NR) = J(I)
      KK(NR) = K(I)
      ANA(NR) = AN(I)
      ANB(NR) = ST(I)
      GO TO 19
C
99    WRITE(IOUT,71)
      DO 40 I=1,NR
      CALL CONV2(JJ,KK,T,NR)
      WRITE(IOUT,31) AL(I),NN(I),T(I),ANA(I)
40    CONTINUE
      WRITE(IOUT,32) NG,NR
C         FORMAT STATEMENTS
1     FORMAT(I3,A1,1X,I4,A1,I2,A1,62X,A2,I2)
31    FORMAT(1H ,I3,A1,5X,F10.2,A1)
32    FORMAT(1H0,5X,'INPUT DATA COUNT = ',I4,' WITH NULL VALUES'/1H ,
     1 5X,'OUTPUT DATA COUNT = ',I4,' CONSOLIDATED REAL DATA'///)
71    FORMAT(1H )
      RETURN
      END
```

SUBROUTINE CONV2

The purpose of this subroutine is to convert a validated input number, entered as an integer variable followed by a literal character (the decimal point) and followed by a second integer number. The data were entered by this format, I4,A1,I2, for the purpose of screening the data. Censored data and missing data were removed from the gross input data vector. This subroutine takes the two integers and converts these to the decimal number.

INPUT REQUIREMENTS

Variable	Purpose
J(I)	Integer to the left of the decimal point
K(I)	Integer to the right of the decimal point

OUTPUT REQUIREMENTS

Variable	Purpose
T(I)	Output valid data vector
N	Number of data elements to be converted

```
      SUBROUTINE CONV2(J,K,T,N)
      DIMENSION J(120),K(120),T(120)
      DO 10 I=1,N
      A = J(I)
      B = (FLOAT(K(I)))/100.
      T(I) = A + B
10    CONTINUE
      RETURN
      END
```

SUBROUTINE RETN

This subroutine isolates the retained data. The raw data are sorted by reading in an integer that represents the number of cards to follow. These cards identify the laboratory identification number and the analyst identification number for each case of rejected data. The retained data vector is returned to the main program.

INPUT REQUIREMENTS

Variable	Purpose
AL(I)	Numerical identification of laboratory
NN(I)	Numerical identification of analyst
T(I)	Data element
ANA(I)	Unused literal vector
NR	Count of input data values
NFOR	Count of rejected data values
FAL(I)	Numerical identification of laboratory, rejected values
NFN(I)	Numerical identification of analyst, rejected values

OUTPUT REQUIREMENTS

Variable	Purpose
RAL(I)	Numerical identification of laboratory, retained values
NCN(I)	Numerical identification of analyst, retained values
RT(I)	Retained data element
ANR(I)	Unused literal vector
L	Count of retained data values

```
      SUBROUTINE RETN(AL,NN,T,ANA,NR,RAL,NCN,RT,ANR,L,FAL,NFN,NFOR)
      INTEGER AL(120),FAL(120),RAL(120)
      DIMENSION NN(120),T(120),RT(120),ANA(120),ANR(120),NCN(120),
     1 NFN(120)
      L=0
      DO 10 I=1,NR
      DO 11 K=1,NFOR
      IF(AL(I)-FAL(K)) 11,13,11
13    IF(NN(I)-NFN(K)) 11,10,11
11    CONTINUE
      L=L+1
      RAL(L)=AL(I)
      NCN(L)=NN(I)
      RT(L)=T(I)
      ANR(L)=ANA(I)
10    CONTINUE
      RETURN
      END
```

SUBROUTINE PAIR

This subroutine compares two vectors of retained data and pairs these data, value-by-value in terms of laboratory number and analyst number. Thus, the paired data set will then consist of a single laboratory number, a single analyst number and two data values, the first from vector one and the second from vector two.

INPUT REQUIREMENTS

Variable	Purpose
AL(I)	Numerical identification of laboratory, vector one
NN(I)	Numerical identification of analyst, vector one
T(I)	Data element, vector one
NRX	Number of data values, vector one
ANA(I)	Literal vector, vector one
ALY(I)	Numerical identification of laboratory, vector two
NNY(I)	Numerical identification of analyst, vector two
TY(I)	Data element, vector two
NRY	Number of data values, vector two
ANY(I)	Literal vector, vector two

OUTPUT REQUIREMENTS

Variable	Purpose
X(I)	Paired data vector, set one
Y(I)	Paired data vector, set two
L	Number of paired data values

An output listing "Data Retained and Paired With L Elements" is produced.

```
      SUBROUTINE PAIR(AL,NN,T,ANA,NRX,ALY,NNY,TY,ANY,NRY,X,Y,L)
      INTEGER AL(120),ALY(120)
      DIMENSION NN(120),T(120),NNY(120),TY(120),X(120),Y(120),ANA(120),
     1 ANY(120)
      IOUT=5
      L=0
      DO 10 I=1,NRX
      DO 11 K=1,NRY
      IFAL(I)-ALY(K)) 11,12,11
12    IF(NN(I)-NNY(K))11,13,11
13    L=L+1
      X(L)=T(I)
      Y(L)=TY(K)
11    CONTINUE
10    CONTINUE
```

```
      WRITE(IOUT,30)
      WRITE(IOUT,31) L
      WRITE(IOUT,32)(X(I),Y(I),I=1,L)
30    FORMAT(1H1)
31    FORMAT(1H ,'DATA RETAINED AND PAIRED WITH ',I4,' ELEMENTS'///)
32    FORMAT(1H ,2F10.3/)
      RETURN
      END
```

SUBROUTINE XYTRM

This subroutine utilizes an arbitrary upper plotting limit for both vectors, X and Y, in order that data greater than this limit will not be plotted outside the arbitrary grid limits. The paired data not plotted as well as the paired data to be plotted are printed.

INPUT REQUIREMENTS

Variable	Purpose
X(I)	Data vector, set one
Y(I)	Data vector, set two
CXY	Upper limit or cut-off for both X and Y vectors
N	Integer count of data elements in each vector

OUTPUT REQUIREMENTS

Variable	Purpose
XC(I)	Data vector, subset one which exceeds upper limit
YC(I)	Data vector, subset two which exceeds upper limit
XZ(I)	Data vector, subset one less than or equal to upper limit
YZ(I)	Data vector, subset two less than or equal to upper limit
NA	Integer count of data elements to be plotted

```
      SUBROUTINE XYTRM(X,Y,CXY,XZ,YZ,N,NA,XC,YC,NC,IOUT)
      DIMENSION X(120),Y(120),XZ(120),YZ(120),XC(120),YC(120)
      NA=0
      NC=0
      DO 10 I=1,N
      IF(X(I)-CXY) 11,11,9
11    IF(Y(I)-CXY) 12,12,9
9     NC=NC+1
      XC(NC)=X(I)
      YC(NC)=Y(I)
      GO TO 10
12    NA=NA+1
      XZ(NA)=X(I)
      YZ(NA)=Y(I)
10    CONTINUE
      WRITE(IOUT,30)
      WRITE(IOUT,31)
      IF(NC) 55,55,60
60    DO 40 I=1,NC
      WRITE(IOUT,32) XC(I),YC(I)
40    CONTINUE
55    WRITE(IOUT,30)
      WRITE(IOUT,33)
```

```
      DO 50 I=1,NA
      WRITE(IOUT,32) XZ(I),YZ(I)
50    CONTINUE
      WRITE(IOUT,30)
30    FORMAT(1H1)
31    FORMAT(///1H ,'MATCHED DATA PAIRS NOT PLOTTED'//1H ,
     1 15X,'X',9X,'Y'//)
32    FORMAT(1H ,5X,2F10.2)
33    FORMAT(///1H ,'PLOTTED DATA PAIRS'//1H ,
     1 15X,'X',9X,'Y'//)
      RETURN
      END
```

SUBROUTINE PRPA4

The plotted data vectors from samples vary in scale of values from sample to sample. Every element in every vector pair is proportioned to a common scale for plotting purposes. In addition, any necessary coordinate translation is also accomplished.

This subroutine proportions the paired data values which are to be plotted in the first of the three grids, grid A. Grid A is located in the upper left-hand quadrant of the page. The data elements in the X's and Y's are each divided by D1 (see subroutine TV4). In addition, the value, 6.0, the coordinate correction, is added to every value of Y.

INPUT REQUIREMENTS

Variable	Purpose
D1	Number of user units per tick mark of scale for the first two samples from which data are to be plotted
X(I)	Data vector, set one
Y(I)	Data vector, set two
NA	Integer count of data elements to be plotted

OUTPUT REQUIREMENTS

Variable	Purpose
XP(I)	Data elements which have been proportioned and adjusted, set one
YP(I)	Data elements which have been proportioned and adjusted, set two

```
      SUBROUTINE PRPA4(D1,X,Y,NA,XP,YP)
      DIMENSION X(120),Y(120),XP(120),YP(120)
      DO 10 I=1,NA
      XP(I)=X(I)/D1
      YP(I)=Y(I)/D1
      YP(I)=YP(I)+6.0
10    CONTINUE
      RETURN
      END
```

SUBROUTINE PRPB4

This subroutine proportions the paired data values which are to be plotted in the second of the three grids, grid B. Grid B is located in the upper right-hand quadrant of the page (see Figure 2a). The data elements in the X's and Y's are each divided by D2 (see subroutine TV4). In addition, the value, 6.0, is added to every value of X and the value 5.0 is added to every value of Y.

INPUT REQUIREMENTS

Variable	Purpose
D2	Number of user units per tick mark of scale for samples three and four from which data are to be plotted.
X(I)	Data vector, set one (sample three)
Y(I)	Data vector, set two (sample four)
NA	Integer count of data elements per set to be plotted

OUTPUT REQUIREMENTS

Variable	Purpose
XP(I)	Data elements which have been proportioned and adjusted, set one
YP(I)	Data elements which have been proportioned and adjusted, set two

```
      SUBROUTINE PRPB4(D2,X,Y,NA,XP,YP)
      DIMENSION X(120),Y(120),XP(120),YP(120)
      DO 10 I=1,NA
      XA(I)=X(I)/D2
      YP(I)=Y(I)/D2
      XP(I)=XP(I)+5.0
      YP(I)=YP(I)+6.0
10    CONTINUE
      RETURN
      END
```

SUBROUTINE PROPC

This subroutine proportions the paired data values which are to be plotted in the third of three grids, grid C. Grid C is located in the lower left-hand quadrant of the page (see Figure 2A). The data elements in the X's and Y's are each divided by D3 (see subroutine TV4). No further adjustments to the data values are necessary.

INPUT REQUIREMENTS

Variable	Purpose
D3	Number of user units per tick mark of scale for samples five and six from which data are to be plotted
X(I)	Data vector, set one (sample five)
Y(I)	Data vector, set two (sample six)
NA	Integer count of data elements per set to be plotted

OUTPUT REQUIREMENTS

Variable	Purpose
XP(I)	Data elements which have been proportioned, set one
YP(I)	Data elements which have been proportioned, set two

```
      SUBROUTINE PROPC(D3,X,Y,NA,XP,YP)
      DIMENSION X(120),Y(120),XP(120),YP(120)
      DO 10 I=1,NA
      XP(I)=X(I)/D3
      YP(I)=Y(I)/D3
10    CONTINUE
      RETURN
      END
```

SUBROUTINE DPTS

This subroutine plots the three sets of data points in grid A, grid B and grid C. At this time, a small correction must be made to every data element in order to properly center the plot character, an asterisk.

INPUT REQUIREMENTS

Variable	Purpose
X(I)	Data vector to be plotted
Y(I)	Data vector to be plotted
NA	Integer count of data elements to be plotted per vector

OUTPUT REQUIREMENTS

All output is directed to the plotter.

```
      SUBROUTINE DPTS(X,Y,NA)
      DIMENSION X(120),Y(120),AX(120),AY(120)
      CALL FPLOT(0,0.0,0.0)
      IPUT=2
      IPLT=7
      READ(IPUT,1) MAC
      DO 5 I=1,NA
      AX(I)=X(I)-0.05
      AY(I)=Y(I)-0.05
5     CONTINUE
      DO 20 I=1,NA
      DO 10 MAA=1,4
      CALL FCHAR(AX(I),AY(I),0.1,0.1,0.0)
      WRITE(IPLT,1) MAC
10    CONTINUE
20    CONTINUE
      CALL FPLOT(1,0.0,0.0)
1     FORMAT(A1)
      RETURN
      END
```

SUBROUTINE ABCD

This subroutine prints the labels necessary to the plot. Vectors of labels are inputed as well as the coordinate position of each label. See reference (3) for details regarding the input data for this subroutine.

INPUT REQUIREMENTS

Variable	Purpose
L(I)	Literal vector from seven card input
LBIG	Largest literal vector
LSML	Smallest literal vector
X	Starting location of label in user's units, X-axis
Y	Starting location of label in user's units, Y-axis
H	Height and width of character to be plotted.
A	Theta, the angle, in radians, which the base line of the plotted characters makes with the X-axis

```
      SUBROUTINE ABCD
      DIMENSION L(560),LBIG(41),LSML(20)
      IPUT=2
      IOUT=5
      IPLT=7
      CALL SCALF(0.75,0.75,0.0,0.0)
C         INPUT LITERALS
      READ(IPUT,1)(L(I),I=1,80)
      READ(IPUT,1)(L(I),I=81,160)
      READ(IPUT,1)(L(I),I=161,240)
      READ(IPUT,1)(L(I),I=241,320)
      READ(IPUT,1)(L(I),I=321,400)
      READ(IPUT,1)(L(I),I=401,480)
      READ(IPUT,1)(L(I),I=481,560)
      READ(IPUT,6)(LBIG(I),I=1,49)
      READ(IPUT,7)(LSML(I),I=1,20)
      WRITE(IOUT,99)(L(I),I=1,560)
99    FORMAT(1H (80A1/1H ))
C         READ PARAMETERS AND PLOT LITERALS
      I=81
      J=I+11
      DO 100 LIST=1,40

      READ(IPUT,2) X,Y,H,A
      DO 200 MAA=1,4
      CALL FCHAR(X,Y,H,H,A)
      WRITE(IPLT,92)(L(NET),NET=1,J)
200   CONTINUE
```

```
      I=I+12
      J=I+11
100   CONTINUE
      READ(IPUT,2) X,Y,H,A
      DO 11 MAA=1,4
      CALL FCHAR(X,Y,H,H,A)
      WRITE(IPLT,41)(LBIG(K),K=1,49)
11    CONTINUE
      READ(IPUT,2) X,Y,H,A
      DO 12 MAA=1,4
      CALL FCHAR(X,Y,H,H,A)
      WRITE(IPLT,20)(LSML(K),K=1,20)
12    CONTINUE
C
      WRITE(IOUT,5)
1     FORMAT(80A1)
2     FORMAT(4F10.0)
6     FORMAT(49A1)
7     FORMAT(20A1)
41    FORMAT(49A1)
20    FORMAT(20A1)
5     FORMAT(1H1,'END OF PLOT EXECUTION'////)
92    FORMAT(12A1)
      RETURN
      END
```

Appendix I shows an outline of the configuration of data cards for the program, SCAT, and for subroutines, REALT and ABCD. The data input is designed to use a data card configuration already in existence. Therefore, cards not used by this program system are just passed through the reader or read with dummy variables.

Section A. indicates the input of 19 cards (10 passed and 9 read). The input data consist of three scale parameter cards and six 'true' values.

Section B. inputs data from three pairs of samples through the subroutine, REALT. Data from each sample is followed by a card having '55' punched in cc-79 and 80. After the preceding card, the first 'REJECTS' card is read. This card bears the number, N, of data points which have been rejected by the t-test. This card is followed by N cards inputing the identification number of the laboratory and analyst. The card punched with the asterisk merely inputs the plotting symbol.

Section C. inputs all labels necessary for plot identification and scale value for all plots.

Figure 1 shows a typical plot as produced by this system.

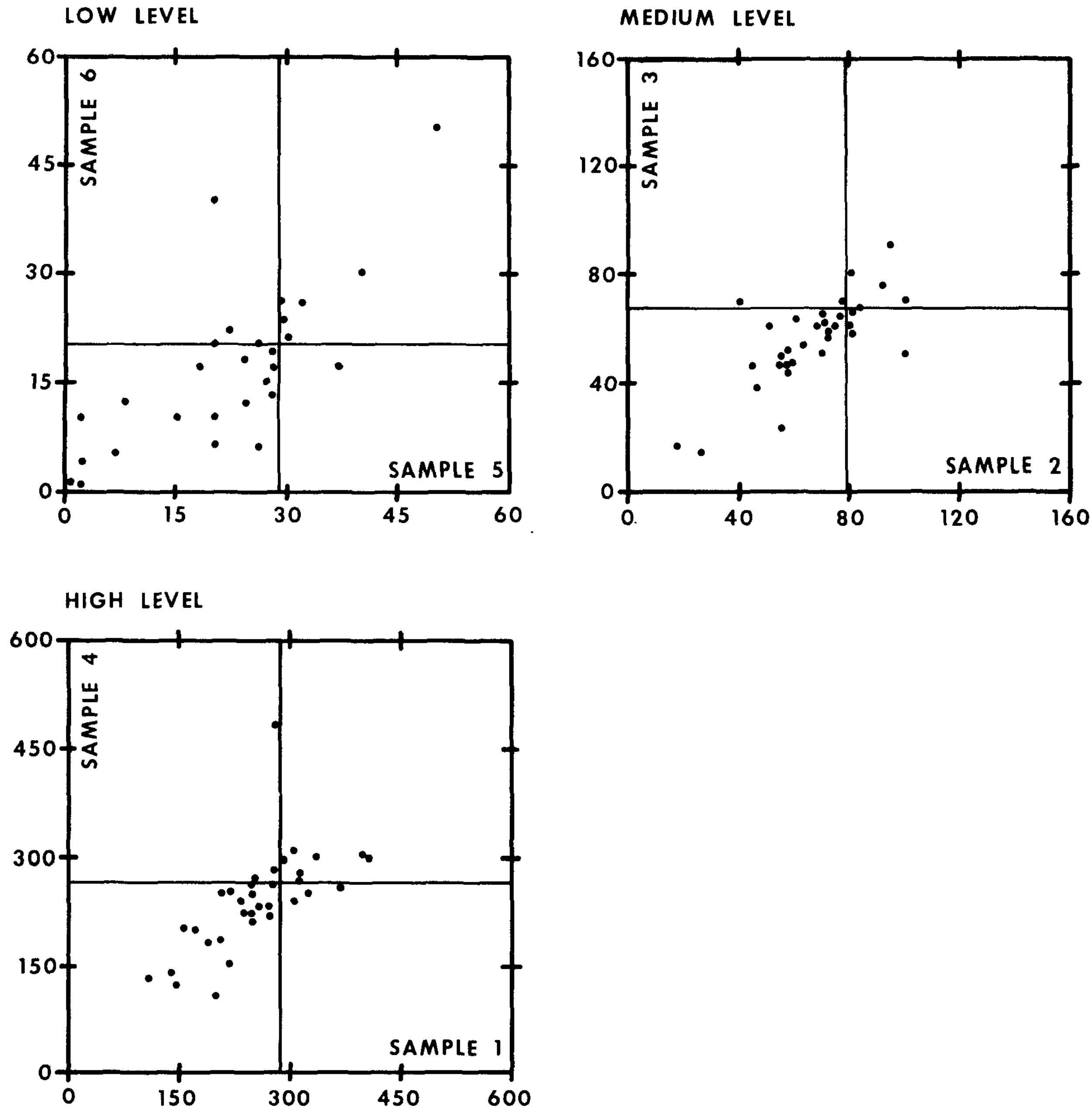

FIGURE 1. Recovery of arsenic from distilled water micrograms per liter

APPENDIX I

CONFIGURATION OF DATA CARDS FOR PROGRAM, SCAT

A. HEADER DATA

(1) Pass 11 literal cards.
(2) Read 3 data cards (D1,D2,D3).
(3) Read 6 data cards (TV(1),...,TV(6)).

B. SIX SAMPLES OF DATA TO BE PLOTTED

Sample one: Data to be plotted.

(1) Pass 3 data cards.
(2) Read CONFIGURATION for subroutine, REALT.

Sample two: Data to be plotted.

(3) Pass 3 data cards.
(4) Read CONFIGURATION for subroutine, REALT.

Samples one & two: Processing of data to be plotted.

Sample one: Control data for subroutine, RETN.

(5) Read 1 data card (NFOR).
(6) Read NFOR data cards (FAL(I),NFN(I)).

Sample two: Control data for subroutine, RETN

(7) Read 1 data card (NFOR).
(8) Read NFOR data cards (FAL(I),NFN(I)).

Samples one & two: Control data for subroutine, XYTRM.

(9) Read 1 data card (CXY).

Dummy read.

(10) Pass 1 data card.

Sample three: Data to be plotted.

(11) Pass 3 data cards.
(12) Read CONFIGURATION for subroutine, REALT.

Sample four: Data to be plotted.

(13) Pass 3 data cards.
(14) Read CONFIGURATION for subroutine, REALT.

Samples three & four: Processing of data to be plotted.

Sample three: Control data for subroutine, RETN.

(15) Read 1 data card (NFOR).
(16) Read NFOR data cards (FAL(I),NFN(I)).

Sample four: Control data for subroutine, RETN.

(17) Read 1 data card (NFOR).
(18) Read NFOR data cards (FAL(I),(NFN(I).

Samples three & four: Control data for subroutine, XYTRM.

(19) Read 1 data card (CXY).

Dummy read.

(20) Pass 1 data card.

Sample five: Data to be plotted.

(21) Pass 3 data cards.
(22) Read CONFIGURATION for subroutine, REALT.

Sample six: Data to be plotted.

(23) Pass 3 data cards.
(24) Read CONFIGURATION for subroutine, REALT.

Samples five & six: Processing of data to be plotted.

Sample five: Control data for subroutine, RETN.

(25) Read 1 data card (NFOR).
(26) Read NFOR data cards (FAL(I),NFN(I)).

Sample six: Control data for subroutine, RETN.

(27) Read 1 data card (NFOR).
(28) Read NFOR cards (FAL(I),NFN(I)).

Dummy read.

(29) Pass 1 data card.

C. LABELS FOR THREE PLOTS

(1) Read CONFIGURATION for subroutine, ABCD.

APPENDIX II

SCHEMATIC CONFIGURATION OF DATA DECK

```
QUALITY ASSURANCE & LABORATORY EVALUATION BRANCH, MDQARL ....
EPA METHOD STUDY 7, TRACE METALS                            .
     ANALYSES FOR ARSENIC IN WATER                          .
     ALL DATA, EPA & NON-EPA LABORATORIES                   .
     UNACCEPTABLE DATA, EPA & NON-EPA LABORATORIES          .
     ACCEPTABLE DATA, EPA & NON-EPA LABORATORIES            ... A1
     STATISTICS ON DATA, EPA & NON-EPA LABORATORIES         .
     RECOVERY OF INCREMENT FROM DISTILLED WATER             .
            (blank card)                                    .
            (blank card)                                    .
     MATCHED & PAIRED DATA, EPA & NON-EPA LABORATORIES ......

       15.    ...............................................
       40.                                                  ... A2
      150.    ...............................................

       29.    ...............................................
       20.                                                  .
       80.                                                  .
       67.                                                  ... A3
      292.                                                  .
      266.    ...............................................

                                    2   .....................
      29.0                                                  ... B1
AMPUL 5 INCREMENT = 29 UG/LITER ARSENIC .....................

1011    32.     AS05D    ....................................
1021    30.   DMAS05D                                       .
1031     8.0    AS05D                                       .
1061    18.     AS05D                                       .
  .       .       .                                         .
  .       .       .                                         .
  .       .       .                                         .
1901    24.     AS05D                                       ... B2
  .       .       .                                         .
  .       .       .                                         .
  .       .       .                                         .
5031    26.   DMAS05D                                       .
5041   000.23   AS05D    ....................................

                                       55 (in cc-79,80)

                                    2   .....................
      20.0                                                  ... B3
AMPUL 6 INCREMENT = 20 UG/LITER ARSENIC .....................
```

```
1011     26.     AS06D  ....................................
  .        .       .                                        .
  .        .       .                                        .
4401             AS06D                                      ... B4
  .        .       .                                        .
  .        .       .                                        .
5041    000.0    AS06D  ....................................

                                              55 (in cc-79,80)

0001        REJECTS    AS05D  ............................... B5

1000        REJECTS    AS05D  ............................... B6

0001        REJECTS    AS06D  ............................... B7

4702        REJECTS    AS06D  ............................... B8

       60.  ................................................. B9

*  ......................................................... X

0506  ....................................................... B10

                                     2  ......................
      80.0                                                  ... B11
AMPUL 2 INCREMENT = 80 UG/LITER ARSENIC  .....................

1011     78.     AS02D  ....................................
  .        .       .                                        .
  .        .       .                                        .
4801             AS02D                                      ... B12
  .        .       .                                        .
  .        .       .                                        .
5041     63.     AS02D  ....................................

                                          55 (in cc-79,80)

                                     2  ......................
      67.0                                                  ... B13
AMPUL 3 INCREMENT = 67 UG/LITER ARSENIC  .....................

1011     70.     AS03D  ....................................
  .        .       .                                        .
  .        .       .                                        .
4411     68.   DMAS03D                                      ... B14
  .        .       .                                        .
  .        .       .                                        .
5041     53.     AS03D  ....................................

                                              55 (in cc-79,80)

0003         REJECTS    AS02D  .............................. B15
```

```
1371        REJECTS   AS02D  ................................
3291        REJECTS   AS02D                                 ... B16
4641        REJECTS   AS02D  ................................

0004        REJECTS   AS03D  ................................
1131        REJECTS   AS03D                                 .
1371        REJECTS   AS03D                                 .
3291        REJECTS   AS03D                                 ... B18
4641        REJECTS   AS03D  ................................

      160.  ................................................ B19

*           ................................................ X

0203  .......................................................... B20

                              2  .......................
     292.0                                                  ... B21
AMPUL 1 INCREMENT = 292 UG/LITER ARSENIC  .................

1011    405.   AS01D  ........................................
  .        .      .                                         .
  .        .      .                                         .
  .        .      .                                         .
4371   1000.0DMAS01D                                        ... B22
  .        .      .                                         .
  .        .      .                                         .
  .        .      .                                         .
5041    271.   AS01D  ........................................

                              2  .......................
     266.                                                   ... B23
AMPUL 4 INCREMENT = UG/LITER ARSENIC  ......................

1011    295.   AS04D  ........................................
  .        .      .                                         .
  .        .      .                                         .
  .        .      .                                         .
4441    199.   AS04D                                        ... B24
  .        .      .                                         .
  .        .      .                                         .
  .        .      .                                         .
5041    229.   AS04D  ........................................

0003        REJECTS  AS01D  ................................... B25

2911        REJECTS  AS01D  ..................................
1102        REJECTS  AS01D                                  ...  B26
1371        REJECTS  AS01D  ..................................

0003        REJECTS  AS04D  ..................................
```

```
2911        REJECTS   AS04D  ...................................
1371        REJECTS   AS04D                                      ... B28
4641        REJECTS   AS04D  ...................................

       600.  ......................................................... B29

*  ................................................................... X

0104  ................................................................ B30

FIGURE 1      LOW LEVEL  MEDIUM LEVELHIGH LEVEL   SAMPLE 1  ..
SAMPLE 2      SAMPLE 3   SAMPLE 4     SAMPLE 5    SAMPLE 6    .
0             15         30           45          60          .
0             15         30           45          60          .
0             40         80           120         160         .
0             40         80           120         160         .
0             150        300          450         600         .
0             150        300          450         600         .
RECOVERY OF ARSENIC FROM DISTILLED WATER                      .
MICROGRAMS PER LITER                                          .
     3.33     12.06        0.2     0.                         .
     0.0      12.67         .1     0.                         .
     5.0      10.67         .1     0.                         .
     0.0       4.67         .1     0.                         .
     2.67      0.18         .1     0.                         .
     7.67      6.13         .1     0.                         .
     5.20      8.67         .1     1.57079                    .
     0.2       2.67         .1     1.57079                    .
     2.67      6.13         .1     0.                         .
     0.2       8.67         .1     1.57079                    .
     -.08      5.73         .1     0.                         .
     0.84      5.73         .1     0.                         .
     1.84      5.73         .1     0.                         .
     2.84      5.73         .1     0.                         .
     3.84      5.73         .1     0.                         .
     -.26      6.00         .1     0.                         .
     -.40      7.00         .1     0.                         .
     -.40      8.00         .1     0.                         ... C1
     -.40      9.00         .1     0.                         .
     -.40     10.00         .1     0.                         .
     4.92      5.73         .1     0.                         .
     5.84      5.73         .1     0.                         .
     6.84      5.73         .1     0.                         .
     7.79      5.73         .1     0.                         .
     8.79      5.73         .1     0.                         .
     4.74      6.00         .1     0.                         .
     4.60      7.00         .1     0.                         .
     4.60      8.00         .1     0.                         .
     4.46      9.00         .1     0.                         .
     4.46     10.00         .1     0.                         .
     -.08     -0.22         .1     0.                         .
     0.79     -0.22         .1     0.                         .
     1.79     -0.22         .1     0.                         .
```

2.79	-0.22	.1	0.	.	
3.79	-0.22	.1	0.	.	
-.26	0.00	.1	0.	.	
-.53	1.00	.1	0.	.	
-.53	2.00	.1	0.	.	
-.53	3.00	.1	0.	...	C1 (Ctd)
-.53	4.00	.1	0.	.	
1.87	11.67	.1	0.	.	
3.33	11.40	.1	0.	.	

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(Please read Instructions on the reverse before completing)

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16. ABSTRACT

A FORTRAN program for IBM 1130 designed to plot three pairs of data sets in three scatter diagrams on one page is described. These data stem from interlaboratory studies of chemical analytical methods.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
FORTRAN, Data, Scatter diagrams	Programs, Collaborative test	9B

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