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STANFORD RSL TECH REPORT #68-3

"NEAREST NEIGHBOR - A NEW NON-PARAMETRIC TEST USED FOR CLASSIFYING SPECTRAL DATA"

by

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Stanford, California

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SCHOOL OF EARTH SCIENCES

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STANFORD RSL TECH REPORT #68-3

"NEAREST NEIGHBOR - A NEW NON-PARAMETRIC TEST USED FOR CLASSIFYING SPECTRAL DATA"

by

Paul Switzer
Wilbur E. Chapman
James J. Nadeau

with subsequent modifications by

John R. Moore

Already Issued

67-1 "Field Infrared Analysis of Terrain - Spectral Correlation Program" Part I

67-2 "Field Infrared Analysis of Terrain - Spectral Correlation Program" Part II and Part III

67-3 "Statistical Analysis of IR Spectra - Stanford Programs Applied to USGS Spectra in Tech Letter #13"

67-4 "Computer Reduction and Analysis of an Infrared Image"

68-1 "Infrared Exploration for Coastal and Shoreline Springs"

68-2 "Re-evaluation of the Normative Minerals of Sonora Pass Rock Standards - Univ. Nev. Reports #7 and #12".

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December 30, 1968

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I. PREFACE AND INTRODUCTION

A. Preface

The ultimate aim of the infrared geological study program in the Remote Sensing Laboratory at Stanford University is the production of geological maps from airborne data. To achieve this end result the spectrometer program was initiated to define the laboratory and field aspects of the infrared spectra of rocks and soil materials. As the spectral periods became shorter with better equipment - decreasing from one every 20 minutes to 6 per second in the airborne operations - the need for more efficient pattern-recognition techniques became paramount in our thinking.

Many programs have been tried to achieve the ideal low unit cost, cleanly definitive method. We progressed from a simple-minded linear cross-correlation technique (CORRCO) which compared the new spectrum and serially ranked the "best-fit" (i.e. high "r" coefficient) spectra from a memory bank obtained from typical rocks. This tabulation sequence was usually correct but had little or no discriminatory power. To enhance this--and to use that portion of the pattern which the human eye seizes upon in optical recognition--we developed a program called PULSE. This transformed the spectrum so that only the peaks and valleys were preserved in the data. The spectrum was replaced by a "histogram"-like bar chart. Unfortunately this was only more successful in a limited way, and the computer had considerable trouble in locating the peaks (by use of 2nd derivatives) in noisy spectra. (See Tech Letters 67-2,67-3)

Stepwise discriminant function programs(BMD07M) from the UCLA BMD group of programs were used successfully (Tech letter 67-3) and have been modified for input and output from airborne data tapes. These "adaptive learning" programs "train" on spectra of the same vintage as are later used in the "unknown" processing stages, but are selected by the geologists (from boresight photography of the ground track of the aircraft).

B. Introduction

Our quest continues. This publication represents the latest development in the series and is in effect a refinement of the BMD07M discriminant program.

Under Paul Switzer's direction this entirely new program was developed from mathematical principles. In the following sections the logic and philosophy of the "nearest neighbor" concept is covered, as it was originally written by Chapman and Nadeau. John Moore has adapted it (principally in the I/O aspects) to make it more useful for our specific data formats, and the illustration included in the Appendix reflects these updating steps.

Copies of the program can be made available at cost upon request.

R.J.P. Lyon

R.J.P. Lyon
Principal Investigator
NASA Contract NAS9-7313

II. PURPOSE

The purpose of this program is to provide a means of performing a non-parametric test that will enable the experimenter to classify unknown data into known categories through comparison with known data.

III. PROCEDURE

The basic procedure for performing this test can be stated very briefly. The distance from the unknown point to each of the known points is calculated. The K closest points or the points which fall within some radius R of the unknown point are then analyzed and their categories noted. The unknown point is then placed in that category which occurs most frequently among the known points under consideration.

IV. GENERAL

Frequently in non-parametric statistical inference the nature of the data and the best test procedure must be determined empirically. An important factor in non-parametric testing is to determine the measure of error associated with the test procedure. In many cases the only way to determine the error is through an empirical study of the procedure against the subject data. With these problems in mind this program was written to provide the experimenter with not only a means of performing a statistical inference test using this test procedure with tried and true constants, but also with a means of testing the various constants and to establish a measure of error.

V. APPLICABILITY OF DATA

Any data of unknown distribution which has associated with it one or more numerical measurements can be tested with this program. The numerical measurements associated with data whose category is known may be considered as the best estimators of the true parameters of the category. The number of numerical measurements (parameters) associated with each known and unknown is called the dimension of the category.

This program requires all categories under consideration to be of the same dimension and each numerical measurement is considered to be in floating point form. The number of dimensions and the number of knowns and unknowns which may be used are dependent only upon the amount of core storage which can be made available to the program. The array declarations may be changed to any desired size provided it is within the core requirements of the equipment.

VI. THE PROGRAM

It was desired to make the program as flexible as possible in order to accommodate varying amounts of data in various dimensions. As a result, a large portion of the program deals with input/output operations and the problem of presenting output in a readable and useful form, in the face of varying amounts of data. An example is the printout of the knowns and unknowns read. When the dimensions exceeded the width of the paper the remaining dimensions are printed on the subsequent pages. However, when the number of knowns or unknowns exceed one page, which would be common, all the knowns (or unknowns) are printed for whatever number of dimensions can fit across a page, then the program returns to printout the remaining dimensions for all the knowns (or unknowns). In this manner it is possible to tear out the sheets, place them alongside one another and have the dimensions for each known (or unknown) read from left to right.

The output on each unknown is identified in the upper left hand corner of the page by X(N) where N is the position it held relative to the other unknowns when read in by the program. The other data on the page is self explanatory with the exception of the columns entitled "cumulative category of unknown" and "Radius Index of Known". The data in the former is calculated in the following manner. The category of the known closest to the unknown is tentatively assigned to the unknown. The categories of the other knowns are checked one at a time in order of distance from the unknown points. In the event two or more categories have occurred with the same frequency then all are printed to reflect the tie. The last item in this column is the

final category assignment for the unknown. The last column entitled "Radius Index of Known" is designed to give the experimenter a means of checking various radii he may be considering. A zero will appear in this column if the known point is between the unknown point and the smallest radius. A one will appear if the known is between the smallest radius and the next smallest radius, etc. If the distance from the known point to unknown point exceeds the largest radius then the number of the largest radius will appear in this column. This number will coincide with the number of radii under consideration.

A summary matrix is provided to indicate the number of correct classifications for a stipulated number of points or for each radius. For example for K=1 the matrix shows how the unknowns were classified by considering only the closest known point. K=2 reflects how they were classified by considering only the two closest known points. The explanation of the summaries for the different radii is similar. The matrix has as its columns the true categories of the "unknowns" and the rows indicate the categories they were assigned as a result of the test.

The last page of each pass (passes will be explained under "Instructions for Use") shows the percentage of correct decisions made. As indicated above each unknown is categorized several times. The percentage of correct categorizations is reflected in this column.

The computation of the distance from the unknown to each known is accomplished through vector and matrix algebra. Before discussing this computation an explanation of the space matrix is in order. If the experimenter has sufficient knowledge of the data he may wish to place more weight on some of the measurements associated with each known than any other. He does this by preparing a space matrix, S, to have these weights reflected in the distance calculation. The space matrix is a square matrix with size equal to the dimension of the categories. If no particular space matrix is desired the program will produce an identity matrix for computational purposes. The first step in the distance calculation is to subtract each measurement of the unknown from the corresponding measurement of the known. This produces

a different vector. This vector is a row vector and the distance, D, is found by solving the equation

$$D = dSd^T$$

where S is the space matrix.

After all the distances have been calculated it is desirable to order them from smallest to largest. However, since it is also necessary to associate each distance with the known point that was used to calculate it, the same order is desired for both the knowns and the distances. To overcome this difficulty a subscripted array of integers 1 to M was produced. The ordering of the distances was then accomplished by moving the corresponding integer to the top of its array each time a smaller distance was found. This subscripted array then becomes the subscript of the distance array for purposes of picking out the smallest distances. For all practical purposes the distances were ordered, but in reality they were still located in memory in the same order as the knowns that were used to calculate them.

VII. INSTRUCTIONS FOR USE

A. General

Until now the treatment of input has been ignored because of the need to discuss it thoroughly in connection with the instructions on how to prepare data, and modify formats and dimensions prior to use.

The first card read is a control card with either a 1, 2, 3, or 4 punched in column one. This number indicates to the program the type of pass to be run. This should not be confused with the number of passes which are made and are printed out at the beginning of each pass. Any number of passes can be made during one computer run, but only four types of passes are available. The first pass must be a type 1 pass. A type 1 pass indicates to the program that all new data and constants are being presented for processing. The second card will contain the following information for the type 1 pass. All values on this card will be integers, and right justified in their fields.

M=Number of knowns	cols.1-5
N=Number of unknowns	cols.6-10
IP=Number of dimensions	cols.11-13
KMIN=Min. No. of distances to be considered	cols.14-16
KRAD=No. of radii employed	cols.17-19
IFDIST=No. of categories	cols.20-22
NAP=Space Matrix indicator	col. 25

For the type 1 pass the space matrix indicator will be a 1 or 2. A 1 tells the program that it is to produce an identity matrix and a 2 indicates that the space matrix is to be read in by the program.

If no radius is to be used cols. 17-19 are to be blank. If cols. 17-19 are not blank the third card will contain the values of the radii. These values will be in floating point form, f8.5, and right justified in the following fields:

Cols. 1-8, 9-16, 17-24, 25-32, 33-40, 41-48, 49-56, 57-64, 65-72, 73-80.

No more than ten radii can be used on any pass.

The fourth and, if needed, the fifth card will contain the identifying symbols of the categories. No more than twenty different categories can be used. These identifying symbols will be in alphanumeric form and right justified in the following fields:

Note: This format applies to both cards 4 and 5.

Cols. 1-4, 7-10, 13-16, 19-22, 25-28, 31-34, 37-40, 43-46, 49-52, 55-58, 61-64, 67-70, 73-76.

The next card to be read will contain the category of the first known. The format for this card is number 37 in the program listing and may be changed to suit the user's needs.

The following cards will contain the numerical measurements. The format for these cards is number 40 in the listing and again this format may be changed to suit the user's needs.* There

---

* Although format 40 can be modified the format must call for exactly 7 data fields otherwise more extensive modifications will become necessary. The format also calls for floating point form.

is no restriction on the number of dimensions or number of knowns and unknowns which can be read other than the restriction of limited core storage.

After the knowns are read the unknowns are read immediately. If the true category of the unknowns is known then the category should be on the card immediately preceding the measurements of each unknown just as it was done for the knowns. If the true category is unknown then a blank card should precede the data for each unknown.

If the space matrix is to be read it will be read after the last unknown. The format for the space matrix is format number 73 in the program listing. This format may also be modified but must maintain 10 data fields on a card floating point form to avoid extensive modifications to the program.

If only the type 1 pass is desired a blank card should be placed after the last card in the space matrix or if no space matrix is to be read, the blank card should be placed after the last card of the unknown data.

If another pass is desired the blank card should be replaced by a control card with either a 1, 2, 3, or 4 in column one. After the first pass there is no restriction on the type of pass which can be made.

A type 2 pass permits the user to change some of the constants he used on the previous pass. It does not allow him to read in additional knowns or unknowns. The card following a type 2 control card has the same format as the format for type 1 pass constants. M and N may be reallocated but the sum of M+N can not exceed the sum of M+N used on the previous pass. This reallocation of M and N only makes sense if the true category of the unknowns is known. IP cannot be changed and must be entered exactly as it was on the previous pass. A new KMIN value may be entered. If no change is desired the same value used on the previous pass must be entered. A new KRAD value may be entered. If the same radii used on the previous pass. NAP may also be changed. However, if the same space matrix is

to be used again col. 25 should be blank. If a new value of KRAD has been entered the new values of the radii will be read next using the same format as before. If a 2 was punched in col. 25 then a new space matrix will be read using the same format as before. After the card(s) containing the constants, the new radii, or space matrix, whichever is applicable, is a blank card or a new control card.

The type 3 pass permits the same changes as the type 2 pass and in addition allows more unknowns to be read. M may be increased to include any or all of the unknowns from the previous pass. N will be the number of new unknowns to be read. Any unknowns from the previous pass which are not included in the knowns will be lost when the new unknowns are read. If new radii are to be used they will read first as in the type 2 pass. Then the new unknowns will be read using the same formats as in the type 1 pass, followed by the new space matrix if desired. Again, either a blank card or a new control card must follow the last card in the type 3 pass data set.

The last type of pass is the type 4. This pass will permit the same changes as the type 2 pass and in addition allows new knowns and unknowns to be added. The card following the type 4 control card has the following format:

All data must be right justified in its field.

NS=number of knowns to be saved,	cols. 1-5
MS=number of knowns to be read,	cols. 7-12
N=number of unknowns to be read,	cols.15-19
KMIN=min. number of points to be considered,	cols.22-24
KRAD=Number of radii employed,	cols.27-29
NAP=Space Matrix indicator	col. 34

NS may include any or all of the knowns and unknowns used on the previous pass. Any knowns or unknowns not included will be lost.

The data which will be read next are the new radii if applicable, the new knowns and unknowns, in that order, and the new space matrix if applicable, followed by a blank card or new control card. All of these will use the same formats as in the type 1 pass.

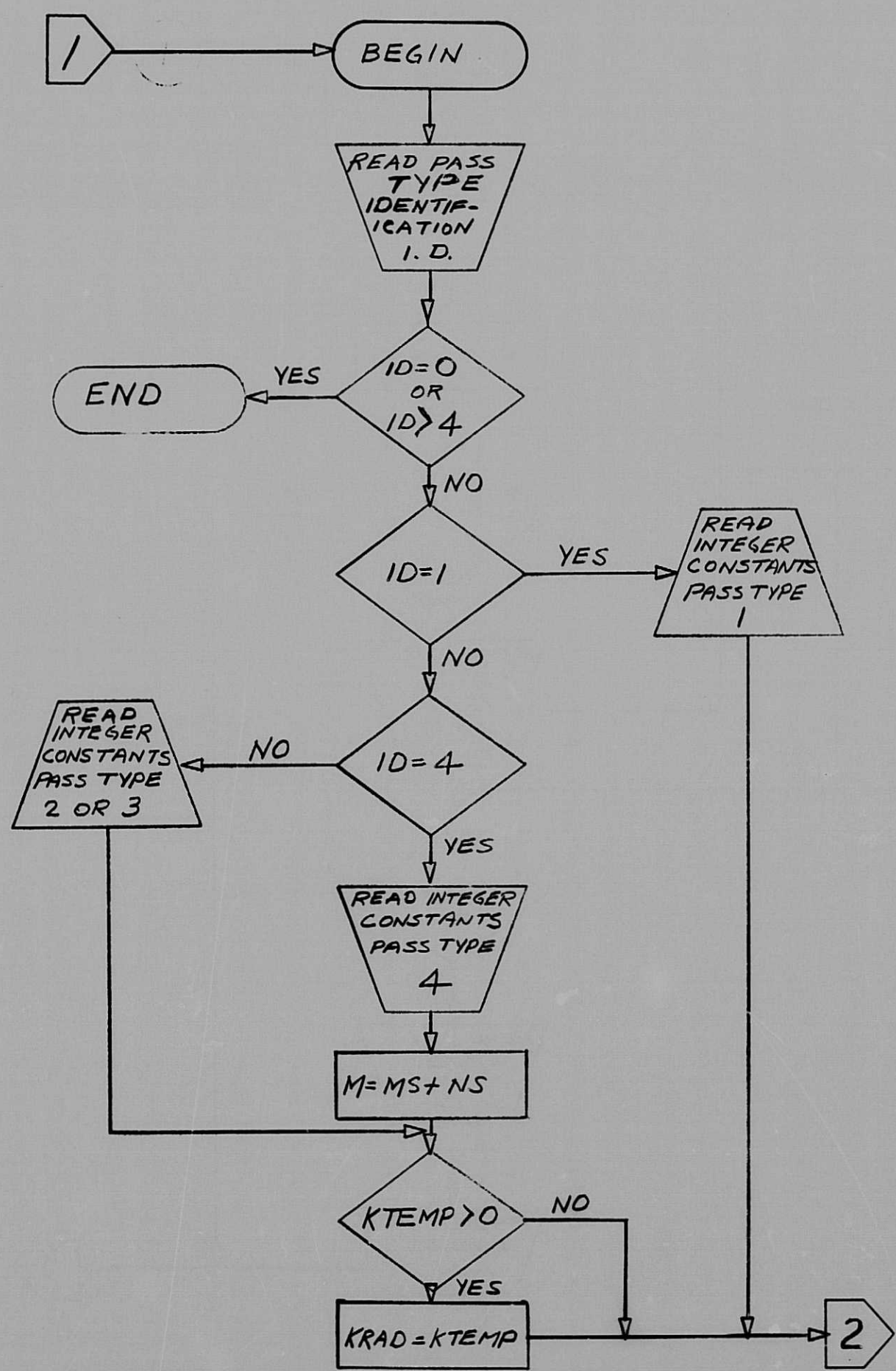
B. Changes in the Dimension Statements

Because of the vast amount of core storage which can be used by arrays, we suggest that the user tailor the array to his own particular needs. The following is to aid in making the desired changes.

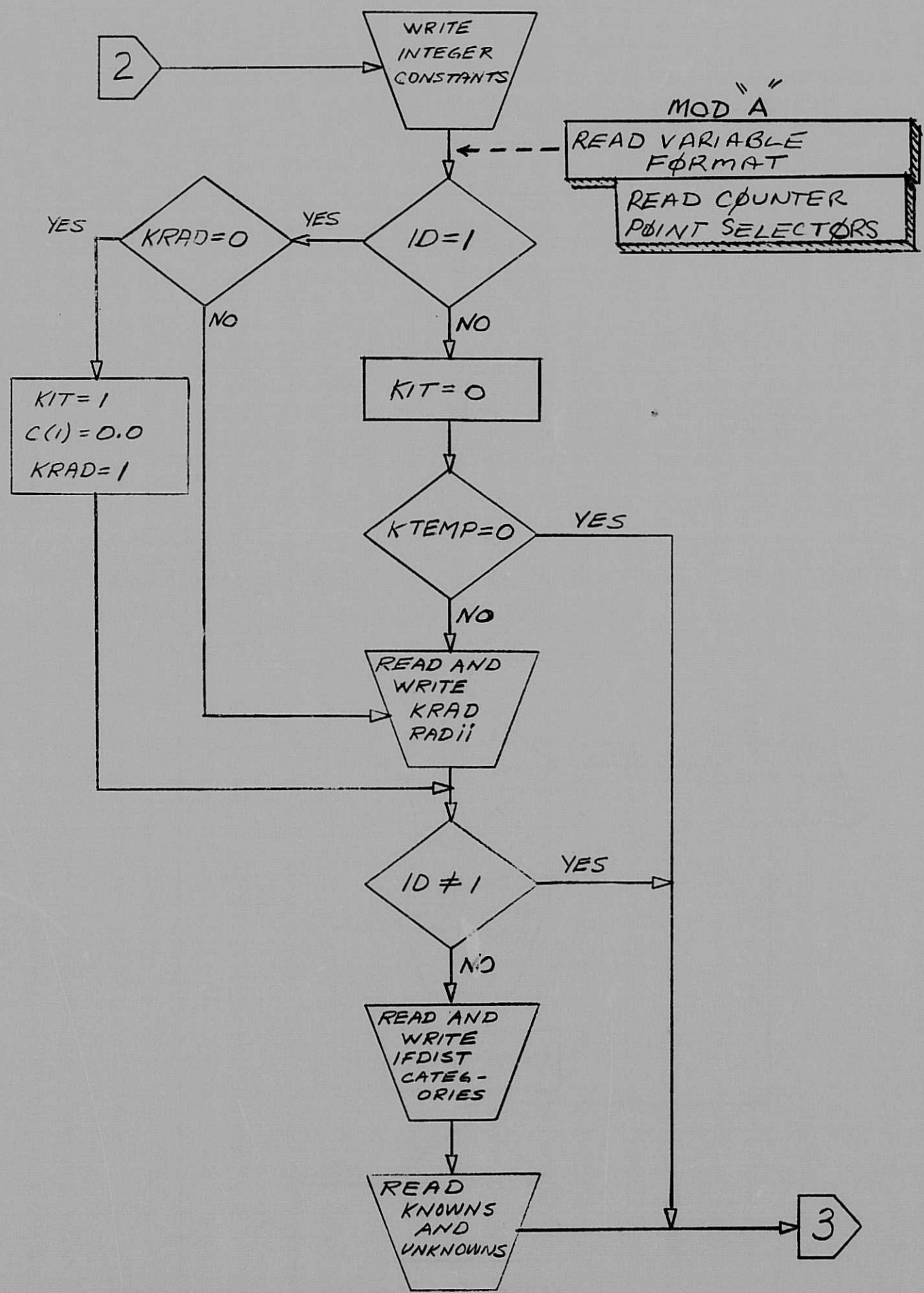
C(10)	--	This array is now at its maximum and should not be changed.
Y(I,J)	--	I is the maximum M+N of any pass. J is the number of dimensions.
S(I,J)	--	I=J= number of dimensions.
ISTD(20)	--	This is now at its maximum and should not be changed.
DIST(I)	--	I is the maximum number of knowns to be used on any pass.
SUM(I)	--	I is the number of dimensions.
DIFF(I)	--	I is the number of dimensions.
NA(I)	--	I is the maximum number of knowns to be used on any pass.
JADD(20)	--	Not to be changed.
NB(20)	--	Not to be changed.
JAB(10, 20, 20)	--	Not to be changed.
MAB(10, 20, 20)	--	Not to be changed.
FAB(I)	--	I is the max N of any pass.
V(I)	--	I is the max (M+N) for any pass.

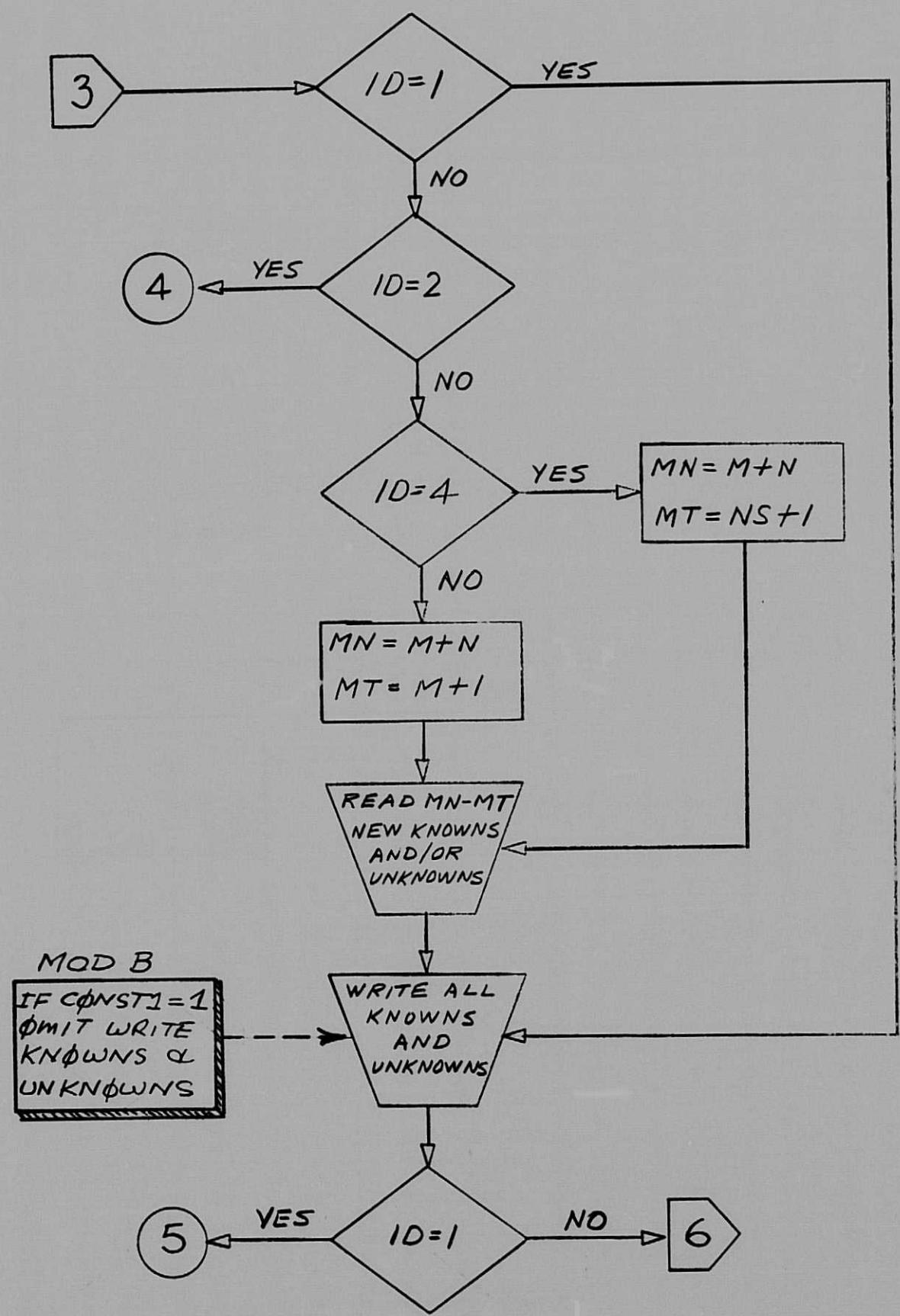
VIII. SUMMARY

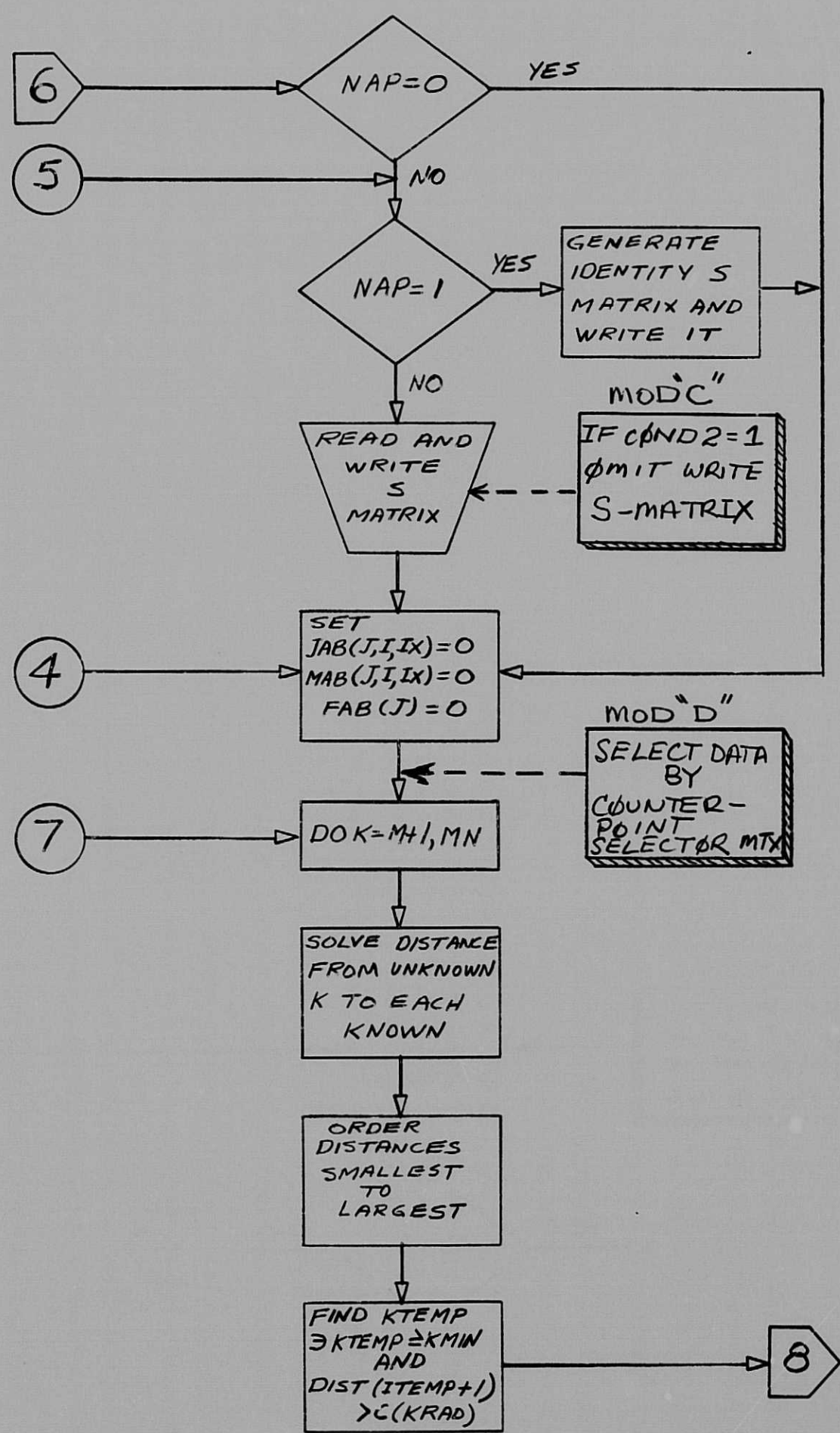
The nature of non-parametric statistical inference usually requires testing with large amounts of data to achieve a respectable degree of accuracy. We feel this program has a wide range of applicability and especially for data with categories of high dimensions. The flexibility which is given to the experimenter in changing and varying his constants and space matrix should aid him considerably, not only in finding the best testing conditions, but also in gaining an insight into the nature of the data itself that may never have come to his attention otherwise.

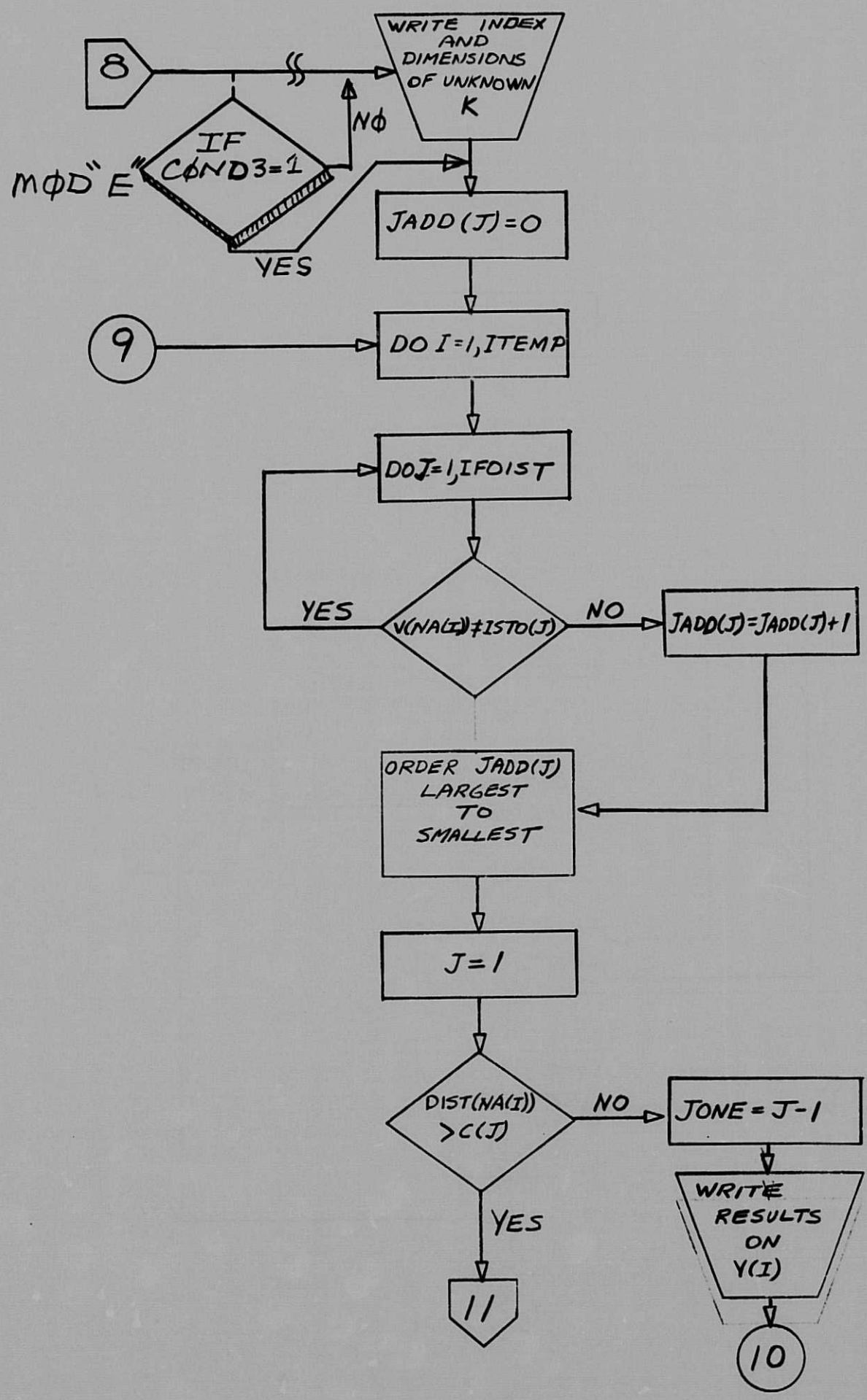


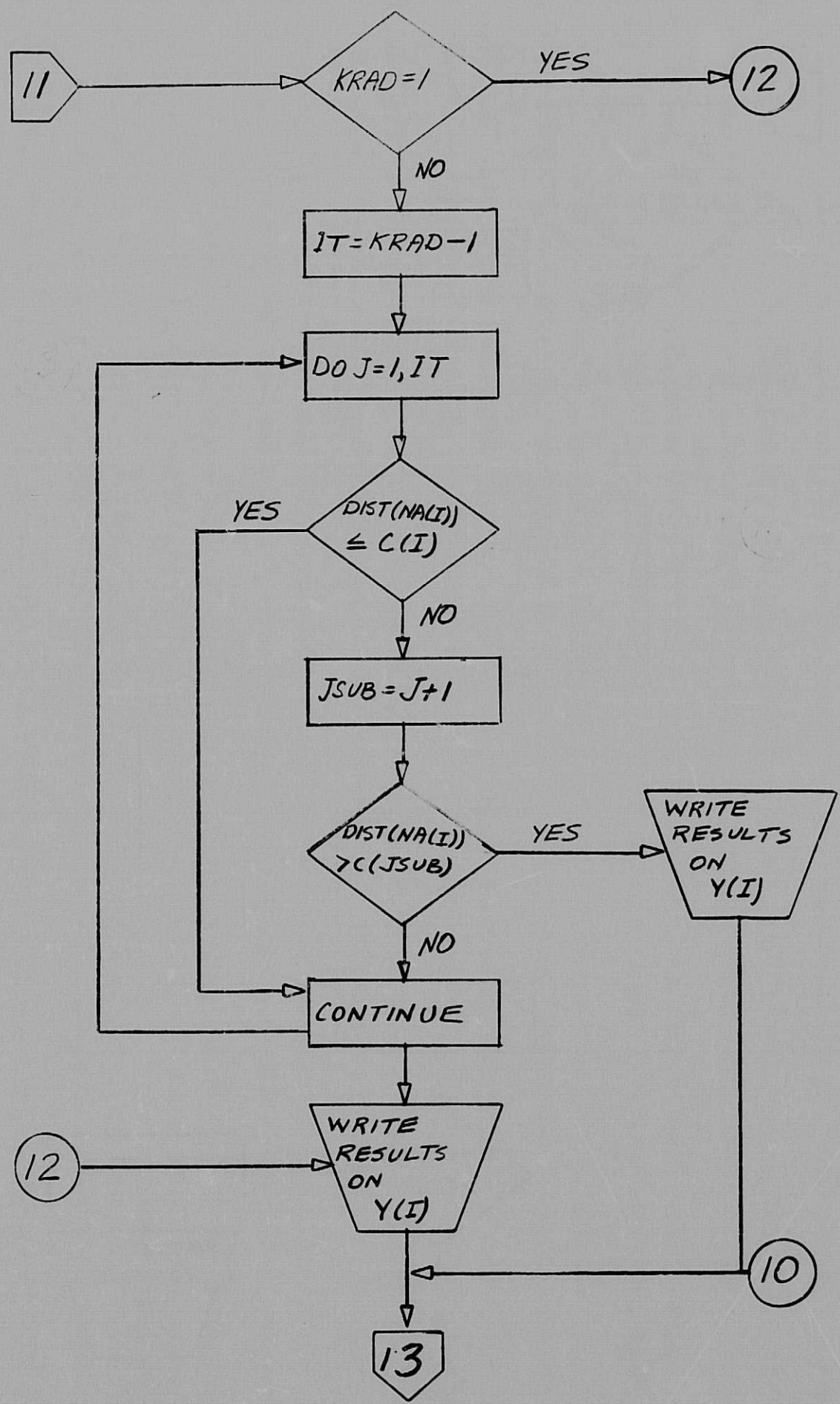
Modifications to original program are shown by flow chart symbols connected to affected areas by dashed lines.

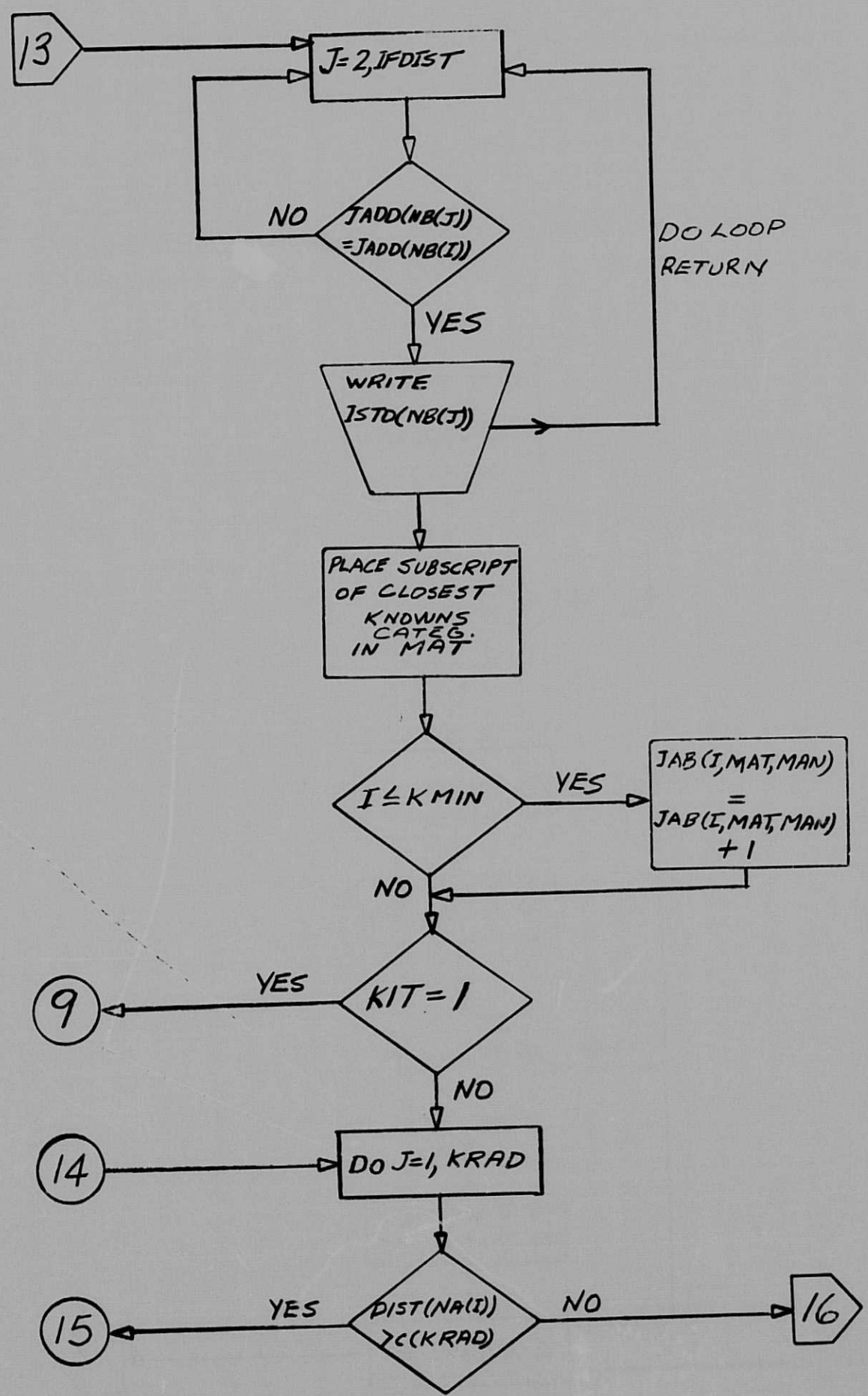

2
WRITE INTEGER CONSTANTS
MOD "A"
READ VARIABLE FØRMAT
READ CØUNTER PØINT SELECTØRS
ID=1
YES
NO
KRAD=0
YES
NO
KIT=1
C(1)=0.0
KRAD=1
KIT=0
KTEMP=0
YES
NO
READ AND WRITE KRAD RADii
ID ≠ 1
YES
NO
READ AND WRITE IFDIST CATEG-ORIES
READ KNOWNS AND UNKNOWNS
3

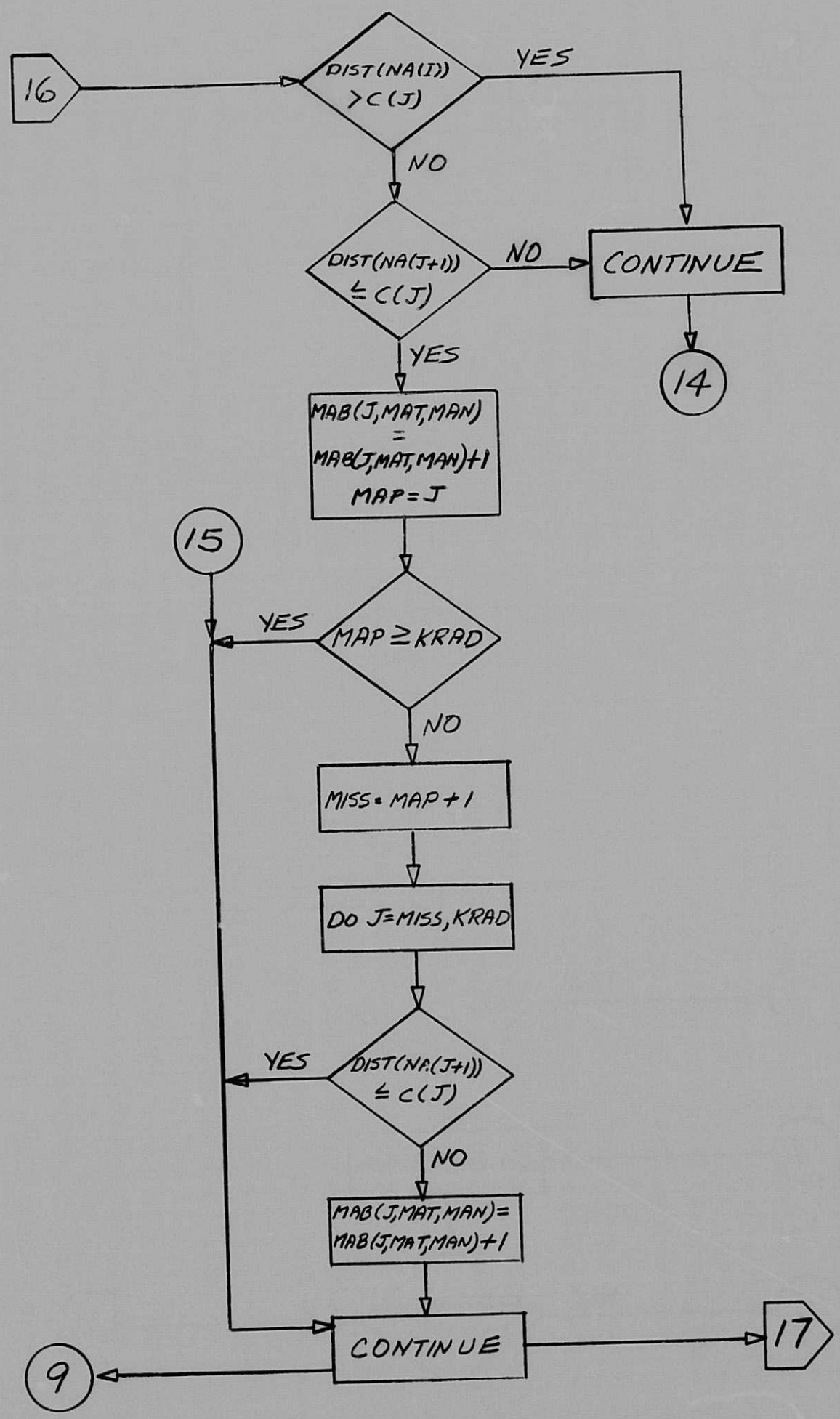

3
ID=1
YES
NO
4
YES
ID=2
NO
ID=4
YES
MN = M+N
MT = NS+1
NO
MN = M+N
MT = M+1
READ MN-MT
NEW KNOWNS
AND/OR
UNKNOWNS
MOD B
IF CØNST1=1
ØMIT WRITE
KNØWNS &
UNKNØWNS
WRITE ALL
KNOWNS
AND
UNKNOWNS
5
YES
ID=1
NO
6

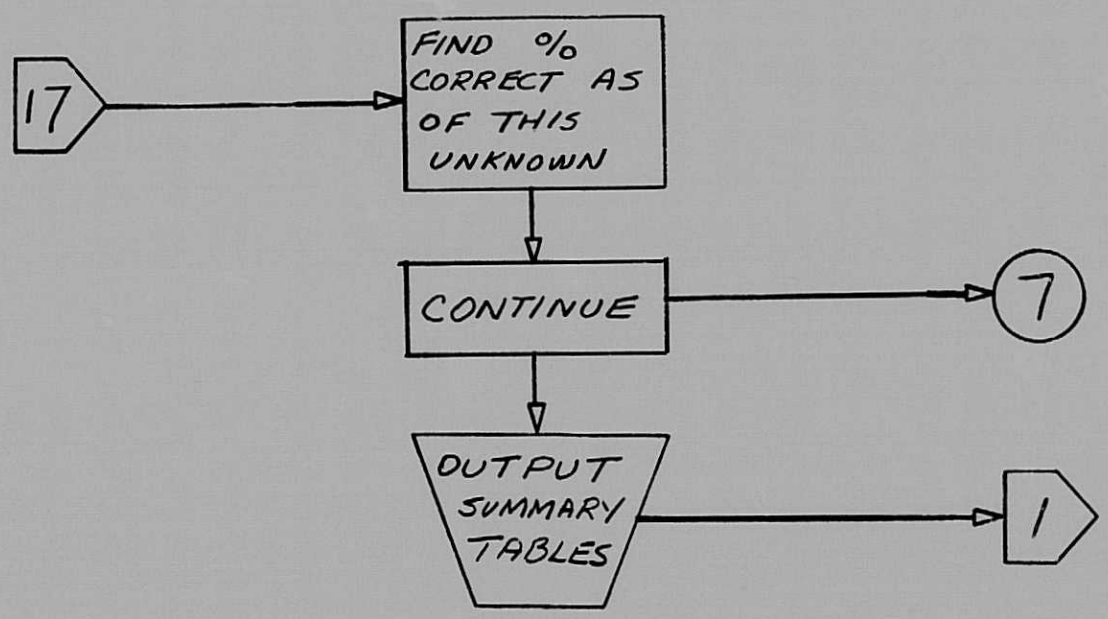

6
5
NAP=0
YES
NO
NAP=1
YES
GENERATE IDENTITY S MATRIX AND WRITE IT
NO
READ AND WRITE S MATRIX
MOD "C"
IF CØND2=1 ØMIT WRITE S-MATRIX
4
SET JAB(J,I,IX)=0 MAB(J,I,IX)=0 FAB(J)=0
MOD "D"
SELECT DATA BY COUNTER-POINT SELECTØR MTX
7
DO K=M+1,MN
SOLVE DISTANCE FROM UNKNOWN K TO EACH KNOWN
ORDER DISTANCES SMALLEST TO LARGEST
FIND KTEMP ∋ KTEMP ≥ KMIN AND DIST (ITEMP+1) > C(KRAD)
8


8
WRITE INDEX AND DIMENSIONS OF UNKNOWN K
IF COND3=1
MOD "E"
NO
YES
JADD(J)=0
9
DO I=1,ITEMP
DO J=1,IFOIST
YES
V(NA(I))≠ISTO(J)
NO
JADD(J)=JADD(J)+1
ORDER JADD(J) LARGEST TO SMALLEST
J=1
DIST(NA(I)) >C(J)
NO
JONE=J-1
YES
WRITE RESULTS ON Y(I)
11
10


11
KRAD=1
YES
12
NO
IT=KRAD-1
DO J=1,IT
YES
DIST(NA(I))
≤ C(I)
NO
JSUB=J+1
DIST(NA(I))
>C(JSUB)
YES
WRITE
RESULTS
ON
Y(I)
NO
CONTINUE
12
WRITE
RESULTS
ON
Y(I)
10
13


13
J=2,IFDIST
NO
JADD(NB(J))
=JADD(NB(I))
YES
DO LOOP
RETURN
WRITE
ISTD(NB(J))
PLACE SUBSCRIPT
OF CLOSEST
KNOWNS
CATEG.
IN MAT
I≤KMIN
YES
JAB(I,MAT,MAN)
=
JAB(I,MAT,MAN)
+1
NO
9
YES
KIT=1
NO
14
DO J=1, KRAD
15
YES
DIST(NA(I))
>C(KRAD)
NO
16


16
DIST(NA(I)) > C(J)
YES
NO
DIST(NA(J+1)) ≤ C(J)
NO
CONTINUE
14
YES
MAB(J,MAT,MAN) = MAB(J,MAT,MAN)+1
MAP=J
15
YES
MAP ≥ KRAD
NO
MISS = MAP+1
DO J=MISS,KRAD
YES
DIST(NA(J+1)) ≤ C(J)
NO
MAB(J,MAT,MAN)= MAB(J,MAT,MAN)+1
CONTINUE
17
9


17
FIND % CORRECT AS OF THIS UNKNOWN
CONTINUE
7
OUTPUT SUMMARY TABLES
1

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

B1

```
$WATFOR
C*******ALL COMMENTS APPLY TO PASS 1 TYPE RUN ONLY
C              CARD 1. TYPE PASS,CARD PUNCH CODE,3 FIELDS OF
C                OUTPUT SUPPRESSOR CODES,NUMBER OF DATA POINTS
C                READ PER CARD OF TRAINING AND TEST SPECTRA,
C                TOTAL NUMBER OF SPECTRAL POINTS
C              CARD 2. FORMAT FOR FIRST DATA INPUT CARD PER CASE
C              CARD 3. FORMAT FOR REMAINING INPUT CARDS IN SAME CASE
C              CARD 4. NUMBER OF TRAINING CASE, NUMBER OF
C                TEST CASES, NUMBER OF POINTS TO BE USED,
C                NO OF DISTANCES,NUMBER OF RADII,NUMBER
C                OF GROUPS, SPACE MATRIX INDICATOR
C              CARDS 5-....MATRIX OF 1'S AND 0'S TO INDICATE
C                WHICH POINTS ARE TO BE USED
C              NEXT CARD. NAMES OF GROUPS
C              DATA CARDS
C*************WARNING*********WARNING*********WARNING**********
C*********************BE CAREFUL ON CONTROL CARDS..FOR EXAMPLE
C*********************FAILURE TO INCLUDE ALL GROUP NAMES WHEREN
C**********************THEY ARE TO BE READ IN FOR IDENTIFICATION
C**********************MAY CAUSE PROGRAM TERMINATION AFTER
C**********************AN EXPENSIVE AMOUNT OF TIME
C   PURPOSE *** TO TEST METHODS OF CLASSIFYING UNKNOWNS BY COMPARISON
C      WITH KNOWNS
      DIMENSION C(10),Y(400,90), S(90,90), ISTD(20), DIST(400),
     2SUM(90), DIFF(90), NA(400), JADD(20), NB(20), JAB(10,20,20),
     3MAB(10,20,20), FAB(400),VP(400,10),ICRT(400),
     1FMT1(20),FMT2(20),ISKI(100)
      INTEGER V(400),GARB(400),SAVE(400),BLANK,COND1,COND2,COND3,
     1SAVDE(400)
      INTEGER*2 ASTER/'**'/
C   KOUNT IS PASS COUNTER
      KOUNT=0
1001  KOUNT=KOUNT+1
      READ(5,1)ID,IQP,COND1,COND2,COND3,NVARC,NPVAR,IDEC
1     FORMAT(5I1,3I2)
      ISUC=0
      READ(5,4000) FMT1
      READ(5,4000) FMT2
4000  FORMAT(20A4)
C   CHECK TYPE PASS
      IF(ID.EQ.0) GO TO 310
      IF(ID.GT.4) GO TO 310
      IF(ID.EQ.1) GO TO 4
      IF(ID.EQ.4) GO TO 2
C   READ PASS TYPE 2 AND 3 CONSTANTS
      READ(5,5)M,N,IP,KMIN,KTEMP,IFDIST,NAP,BLANK
      IF(IP.GT.10) IP=10
      GO TO 3001
C   READ PASS TYPE 4 CONSTANTS
2     READ(5,3)NS,MS,N,KMIN,KTEMP,NAP
3     FORMAT(3(I5,2X),3(I3,2X))
      M=NS+MS
3001  IF(KTEMP.GT.0) KRAD=KTEMP
      GO TO 9
C   READ PASS TYPE 1 CONSTANTS
4     READ(5,5) M,N,IP,KMIN,KRAD,IFDIST,NAP,BLANK
      READ(5,4001)(ISKI(II),II=1,NPVAR)
4001  FORMAT(10I1)
      WRITE(6,6001)(ISKI(II),II=1,NPVAR)
6001  FORMAT(' INPUT SELECTION MATRIX',10(/10I2))
5     FORMAT(2I5,4I3,2X,I1,2X,A2)
9     WRITE(6,10) KOUNT
10    FORMAT(1H1,62H*************************************************
     2**** PASS ,I2,65H ***************************************
     3****************)
      WRITE(6,11)
11    FORMAT(1X,56X,9H*********,//)
      WRITE(6,12)
C   OUTPUT INTEGER CONSTANTS
12    FORMAT(1X,9X,17HINTEGER CONSTANTS)
      WRITE(6,13)
13    FORMAT(1X,9X,17H*****************,/)
      WRITE(6,15)M,N,IP
15    FORMAT(1X,11X,17HNO. OF KNOWNS=M= ,6X,I3,10X,19HNO. OF UNKNOWNS=N=
     2 ,7X,I3,10X,22HNO. OF DIMENSIONS=IP= ,4X,I3,/)
      WRITE(6,20)KMIN,KRAD,IFDIST
20    FORMAT(1X,11X,23HMIN. PTS. TESTED=KMIN= ,I3,10X,26HNO. OF RADII T
     2STED=KRAD= ,I4,10X,26HNO. OF CATEGORIES=IFDIST= ,I3,//)
      IF(ID.NE.1)GO TO 23
      IF(KRAD.NE.0)GO TO 24
      KIT=0
      C(1)=0.00
      KRAD=1
      GO TO 321
C   KTEMP NOT EQUAL TO ZERO IMPLIES NEW TEST RADII
23    KIT=1
      IF(KTEMP.EQ.0) GO TO 441
C   INPUT AND OUTPUT TEST RADII
24    READ(5,25)(C(J),J=1,KRAD)
25    FORMAT(10F8.5)
      WRITE(6,30)KRAD
30    FORMAT(1H0,9X,33HTEST RADII=C(I)  WHERE I=1 UNTIL ,I2)
      WRITE(6,13)
      WRITE(6,31)(J,J=1,KRAD)
31    FORMAT(1X,14X,10(I2,9X),/)
      WRITE(6,32)(C(J),J=1,KRAD)
32    FORMAT(1X,11X,10(F8.5,3X),//)
C   INPUT AND OUTPUT CATEGORY NAMES FOR TYPE 1 PASS
321   IF(ID.NE.1)GO TO 441
      MIP=13
      IF(IFDIST.LE.13)MIP=IFDIST
      READ(5,33)(ISTD(I),I=1,MIP)
33    FORMAT(13(A4,2X))
      IF(IFDIST.LE.13)GO TO 34
      READ(5,33)(ISTD(I),I=14,IFDIST)
34    CONTINUE
      WRITE(6,35)IFDIST
35    FORMAT(1H0,9X,45HDISTRIBUTION SYMBOLS=STD(I)  WHERE I=1 UNTIL ,I2)
      WRITE(6,13)
      WRITE(6,36)(J,ISTD(J),J=1,IFDIST)
36    FORMAT(1X,11X,8(I2,2H) ,A4,6X),//,1X,11X,8(I2,2H) ,A4,6X),//,1X,
     211X,4(I2,2H) ,A4,6X))
C   INPUT CATEGORY AND DIMENSIONS OF KNOWNS AND UNKNOWNS FOR TYPE 1 PASS
      MA=M+N
      DO 44 I=1,MA
      MIP=NVARC
      IF(NPVAR.LE.NVARC)MIP=NPVAR
```

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```
      READ(5,FMT1) (VP(I,J),J=1,8), V(I)
      READ(5,FMT2)(Y(I,J),J=1,MIP)
      IF(NPVAR.LE.NVARC) GO TO 44
      DO 43 L=MVARC,LVARC,NVARC
      MIP=L+NVARC-1
      IF(NPVAR.LE.MIP)MIP=NPVAR
      READ(5,FMT2)(Y(I,J),J=L,MIP)
      IF(NPVAR.LE.MIP)GO TO 44
43    CONTINUE
44    CONTINUE
441   IF(IC.EQ.1) GO TO 449
      IF(IC.EQ.2) GO TO 701
      IF(IC.EQ.4) GO TO 448
C   INPUT NEW UNKNOWNS FOR TYPE 3 PASS
449   MN=M+N
      MT=M+1
442   DO 447 I=MT,MN
      MIP=NVARC
      IF(NPVAR.LE.NVARC)MIP=NPVAR
      READ(5,FMT1) V(I)
      READ(5,FMT2)(Y(I,J),J=1,MIP)
      IF(NPVAR.LE.7)GO TO 447
      DO 446 L=MVARC,LVARC,NVARC
      MIP=L+NVARC-1
      IF(NPVAR.LE.MIP)MIP=NPVAR
      READ(5,FMT2)(Y(I,J),J=L,MIP)
      IF(NPVAR.LE.MIP)GO TO 447
446   CONTINUE
447   CONTINUE
      GO TO 449
C   INPUT NEW KNOWNS AND UNKNOWNS FOR TYPE 4 PASS
448   MN=M+N
      MT=NS+1
      GO TO 442
C   OUTPUT THE INPUT OF KNOWNS FOR PASS TYPES 1,3, OR 4.
449   WRITE(6,45)
45    FORMAT(1H1,9X,38HKNOWN'S INDEX, DIMENSIONS AND CATEGORY)
      DO 4004 IT=1,MN
      NCZ=1
      DO 4004 II=1,NPVAR
      IF(ISKI(II).NE.1) GO TO 4004
      Y(IT,NCZ)=Y(IT,II)
      NCZ=NCZ+1
4004  CONTINUE
      NCZ=NCZ-1
      IF(NCZ.NE.IP) WRITE(6,4005)
4005  FORMAT(1H1,' NO. DIMENSIONS WRONG ')
      IP=NCZ
      WRITE(6,13)
      KT=1
      MT=M
      IF(COND1.EQ.1) GO TO 701
46    MP=9
      IF(IP.LE.9)MP=IP
      WRITE(6,50)(J,J=1,MP)
50    FORMAT(1X,11X,12HINDEX   CAT.,7X,9(I2,9X),/)
      DO 53 K=KT,MT
      LM=K
      IF(K.GT.M)LM=K-M
53    WRITE(6,55)LM,V(K),(Y(K,J),J=1,MP)
55    FORMAT(1X,I2X,I3,1X,1H*,1X,A4,3X,1H*,1X,9(F8.5,1X,1H*,1X))
      IF(IP.LE.9)GO TO 69
      DO 60 L=10,LVARC,11
      MP=L+10
      IF(IP.LE.MP)MP=IP
      WRITE(6,56)
56    FORMAT(1H1,8HCONTINUE,//)
      WRITE(6,57)(J,J=L,MP)
57    FORMAT(1X,9X,11(I2,9X),/)
      DO 58 K=KT,MT
      LM=K
      IF(K.GT.M)LM=K-M
58    WRITE(6,59)LM,(Y(K,J),J=L,MP)
59    FORMAT(1X,I3,1X,1H*,1X,11(F8.5,1X,1H*,1X))
      IF(IP.LE.MP)GO TO 69
60    CONTINUE
69    IF(MT.GT.M)GO TO 701
      KT=M+1
      MT=MN
      WRITE(6,70)
C   OUTPUT THE INPUT ON UNKNOWNS FOR PASS TYPES 1,3, OR 4.
70    FORMAT(1H1,9X,36HUNKNOWN'S INDEX, DIMENSIONS AND CATEGORY IF KNOWN
     2-OTHERWISE UNKNWN- )
      WRITE(6,13)
      GO TO 46
701   CONTINUE
      IF(IC.EQ.1) GO TO 71
C   INPUT AND OUTPUT SPACE MATRIX
      IF(NAP.EQ.0) GO TO 59
71    WRITE(6,72)IP,IP
72    FORMAT(1H1,9X,14HSPACE MATRIX--,I2,1X,2HBY,1X,I2)
      WRITE(6,13)
      IF(NAP.EQ.1) GO TO 76
      DO 75 I=1,IP
      DO 74 L=1,LVARC,10
      MIP=L+9
      IF(IP.LE.MIP)MIP=IP
      READ(5,73)(S(I,J),J=L,MIP)
73    FORMAT(10F8.5)
74    IF(IP.LE.MIP)GO TO 75
75    CONTINUE
      GO TO 79
76    DO 78 I=1,IP
      DO 77 J=1,IP
77    S(I,J)=0
78    S(I,I)=1.0
79    MP=9
      IF(COND2.EQ.1) GO TO 97
      IF(IP.LE.9)MP=IP
      WRITE(6,80)(J,J=1,MP)
80    FORMAT(1X,11X,5HINDEX,7X,9(I2,9X))
      WRITE(6,265)
      DO 81 K=1,IP
81    WRITE(6,82)K,(S(K,J),J=1,MP)
82    FORMAT(1X,I2X,I2,6X,9(F8.5,1X,1H*,1X))
      IF(IP.LE.9)GO TO 97
      DO 84 L=10,54,11
      MP=L+10
      IF(IP.LE.MP)MP=IP
      WRITE(6,56)
```

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      WRITE(6,57)(J,J=L,MP)
      WRITE(6,265)
      DO 83 K=1,IF
83    WRITE(6,99)K,(S(K,J),J=L,MP)
      IF(IP.LE.MP)GO TO 97
84    CONTINUE
97    WRITE(6,98)
98    FORMAT(1X,129H*****************************************END INP
     2UT**END INPUT**END INPUT*****************************************
     3************)
C     BEGIN COMPUTATIONS
99    DO 103 I=1,IFDIST
      DO 103 IX=1,IFDIST
      DO 101 J=1,KMIN
101   JAB(J,I,IX)=0
      DO 102 J=1,KRAD
102   MAB(J,I,IX)=0
103   CONTINUE
      DO 104 J=1,N
104   FAB(J)=0
      KKK=M+1
C     MAIN LOOP TAKES ONE UNKNOWN AT A TIME
      DO 245 K=KKK,MA
      ICRT(K)=0
C     FIND DISTANCE FROM UNKNOWN TO ALL KNOWNS
      DO 125 I=1,M
      ITEMP=0
      DIST(I)=0
      DO 105 L=1,IP
105   SUM(L)=0
      DO 110 J=1,IP
110   DIFF(J)=Y(I,J)-Y(K,J)
      DO 120 L=1,IP
      DO 115 J=1,IP
115   SUM(L)=SUM(L)+(DIFF(J)*S(J,L))
120   DIST(I)=DIST(I)+(DIFF(L)*SUM(L))
125   CONTINUE
      DO 130 I=1,M
130   NA(I)=I
      ML=M-1
      DO 140 I=1,ML
      JJJ=I+1
C     ORDER DISTANCE SMALLEST TO LARGEST
      DO 135 J=JJJ,M
      IF(DIST(NA(I)).LE.DIST(NA(J)))GO TO 135
      NAP=NA(I)
      NA(I)=NA(J)
      NA(J)=NAP
135   CONTINUE
      IF(I.LE.KMIN)GO TO 140
      IF(DIST(NA(I)).LE.C(KRAD))GO TO 140
      ITEMP=I-1
      GO TO 145
140   CONTINUE
145   KM=K-M
      SAVC(KM)=0
      SAVDE(KM)=0
      IF(ITEMP.EQ.0)ITEMP=2*KMIN
      MIT=KMIN*2
      IF(ITEMP.GT.MIT)ITEMP=MIT


147   WRITE(6,148)
148   FORMAT(1H1,129H*****************************************************
     2UTPUT**OUTPUT**OUTPUT*****************************************
     3************)
      WRITE(6,149)
149   FORMAT(1X,50X,22H******  ******  ******,//)
C     OUTPUT INDEX AND DIMENSIONS OF UNKNOWN.
      IF(CONT3.EQ.1) GO TO 5004
      WRITE(6,150)KM
150   FORMAT(1X,9X,11HUNKNOWN  X(,I3,1H),22X,15HWITH DIMENSION(S)
      WRITE(6,1002)
      WRITE(6,FMT1)(VP(K,J),J=1,8),V(K)
 1002 FORMAT(1X,'IDENTIFICATION...')
      WRITE(6,13)
5004  CONTINUE
      IF(CONT3.EQ.1) GO TO 5001
      DO 154 J=1,IP,10
      MIT=J+9
      IF(IP.LE.MIT)MIT=IP
      WRITE(6,152)(L,L=J,MIT)
152   FORMAT(/1X,10(I2,9X))
      WRITE(6,153)(Y(K,L),L=J,MIT)
153   FORMAT(1X,10(F8.5,17,1H=,1X))
154   CONTINUE
C     OUTPUT RESULTS FOR PARTICULAR UNKNOWN
      IF(CONT3.EQ.1) GO TO 5001
      WRITE(6,160)
160   FORMAT(1H0,11X,8HINDEX OF,14X,8HCATEGORY,14X,11HDISTANCE TO,14X,19
     2HCUMULATIVE CATEGORY,14X,12HRADIUS INDEX)
      WRITE(6,165)
165   FORMAT(1X,12X,5HKNOWN,16X,9HOF KNOWN,16X,7HUNKNOWN,21X,10HOF UNKN
     2WN,20X,8HOF KNOWN)
5001  CONTINUE
      DO 170 I=1,IFDIST
      JADD(I)=0
170   NB(I)=1
      DO 171 J=1,IFDIST
      IF(V(K).NE.ISTD(J))GO TO 171
      MAN=J
      GO TO 172
171   CONTINUE
172   DO 240 I=1,ITEMP
      DO 175 J=1,IFDIST
      IF(V(NA(I)).NE.ISTD(J))GO TO 175
      JADD(J)=JADD(J)+1
      GO TO 180
175   CONTINUE
180   NEG=IFDIST-1
      DO 185 L=1,NEG
      JJJ=L+1
      DO 185 J=JJJ,IFDIST
      IF(JADD(NB(L)).GE.JADD(NB(J)))GO TO 185
      NBP=NB(L)
      NB(L)=NB(J)
      NB(J)=NBP
185   CONTINUE
      J=1
      IF(DIST(NA(I)).GT.C(J))GO TO 195
      JONE=J-1
      IF(CONT3.EQ.1) GO TO 5002
```

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B4

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      WRITE(6,190)NA(I),V(NA(I)),DIST(NA(I)),ISTD(NB(1)),JONE
190   FORMAT(1X,12X,I4,15X,A4,19X,F8.5,24X,A4,27X,I2)
      GO TO 205
195   IF(KRAD.EQ.1) GO TO 201
      IT=KRAD-1
      IF(COND3.EQ.1) GO TO 5002
      DO 200 J=1,IT
      IF(DIST(NA(I)).LE.C(J))GO TO 200
      JSUB=J+1
      IF(DIST(NA(I)).GT.C(JSUB))GO TO 200
      WRITE(6,190)NA(I),V(NA(I)),DIST(NA(I)),ISTD(NB(1)),J
      GO TO 205
200   CONTINUE
201   WRITE(6,190)NA(I),V(NA(I)),DIST(NA(I)),ISTD(NB(1)),KRAD
5002  GARB(KM)=BLANK
205   DO 210 J=2,IFDIST
      IF(JADD(NB(J)).EQ.JADD(NB(1)).AND.I.EQ.IDEC) GARB(KM)=ASTER
210   IF(JADD(NB(J)).EQ.JADD(NB(1))) WRITE(6,211)ISTD(NB(J))
      IF(I.EQ.IDEC) SAVE(KM)=(JADD(NB(1))*100)/KMIN
      IF(I.EQ.IDEC) SAVDE(KM)=ISTD(NB(1))
211   FORMAT(1X,90X,A4)
      DO 215 J=1,IFDIST
      IF(V(NA(1)).NE.ISTD(J)) GO TO 215
      MAT=J
      GO TO 220
220   IF(I.LE.KMIN) JAB(I,MAT,MAN)=JAB(I,MAT,MAN)+1
215   CONTINUE
C   CUMULATION OF RESULTS FOR SUMMARY
      DO 225 J=1,KRAD
      IF(DIST(NA(I)).GT.C(KRAD))GO TO 240
      IF(DIST(NA(I)).GT.C(J)) GO TO 225
      IF(DIST(NA(I+1)).LE.C(J)) GO TO 240
      MAB(J,MAT,MAN)=MAB(J,MAT,MAN)+1
      MAP=J
      GO TO 230
225   CONTINUE
230   IF(MAP.GE.KRAD)GO TO 240
      MISS=MAP+1
      DO 233 J=MISS,KRAD
      IF(DIST(NA(I+1)).LE.C(J))GO TO 240
233   MAB(J,MAT,MAN)=MAB(J,MAT,MAN)+1
240   CONTINUE
      IF(SAVDE(KM).EQ.V(K))ISUC=ISUC+1
      DO 241 J=1,IFDIST
      FAB(K-M)=JAB(KMIN,J,J)+FAB(K-M)
241   CONTINUE
      FAB(K-M)=(FAB(K-M)/(K-M))*100
245   CONTINUE
C   END MAIN LOOP FOR PARTICULAR UNKNOWN
C   BEGIN SUMMARY OUTPUT
      MOC=M+1
      WRITE(6,511)
      DO 1009 I=MOC,MA
      IZZ=I-M
      WRITE(6,512)(VP(I,J),J=1,8),GARB(I),SAVDE(IZZ),SAVD(IZZ)
      IF(ICP.EQ.1) WRITE(7,512)(VP(I,J),J=1,8),GARB(I),SAVDE(I),SAVD(I)
1009  CONTINUE
511   FORMAT(1H1,34(1H*),'O U T P U T',35(1H*))
512   FORMAT(5A3,3A4,2X,A1,A4,3X,I6)
      DO 275 I=1,KMIN
      WRITE(6,250)
250   FORMAT(1H1,9X,7HSUMMARY)
      WRITE(6,13)
      WRITE(6,255)I
255   FORMAT(1X,11X,3HK= ,I2)
      DO 274 J=1,20,10
      MIP=J+9
      IF(IFDIST.LE.MIP)MIF=IFDIST
      WRITE(6,260)(ISTD(L),L=J,MIP)
260   FORMAT(1H0,22X,10(A4,2X,1H*,2X))
      WRITE(6,265)
265   FORMAT(1X,11X,120H*****************************************************
     2*****************************************************
     3******)
      DO 272 IV=1,IFDIST
272   WRITE(6,273)ISTD(IV),(JAB(I,IV,L),L=J,MIP)
273   FORMAT(1X,13X,A4,2X,1H*,2X,10(I3,6X))
      IF(IFDIST.EQ.MIF)GO TO 275
274   CONTINUE
275   CONTINUE
      IF(KIT.EQ.0)GO TO 2881
      DO 288 I=1,KRAD
      WRITE(6,250)
      WRITE(6,13)
      WRITE(6,284)I,C(I)
284   FORMAT(1X,11X,2HC(,I2,3H)= ,F8.5)
      DO 287 J=1,20,10
      MIP=J+9
      IF(IFDIST.LE.MIP)MIF=IFDIST
      WRITE(6,260)(ISTD(L),L=J,MIP)
      WRITE(6,265)
      DO 285 IV=1,IFDIST
285   WRITE(6,273)ISTD(IV),(MAB(I,IV,L),L=J,MIP)
      IF(IFDIST.EQ.MIP)GO TO 288
287   CONTINUE
288   CONTINUE
2881  WRITE(6,289)
289   FORMAT(1H1,9X,47HUNKNOWN INDEX AND CUMULATIVE PERCENTAGE CORRECT,/
     2/)
      WRITE(6,13)
      WRITE(6,290)
290   FORMAT(1X,11X,5HINDEX,10X,18HPERCENTAGE CORRECT,/)
      DO 295 I=1,K
295   WRITE(6,300)I,FAB(I)
300   FORMAT(1X,10X,I3,17X,F6.2)
C   RETURN TO BEGINNING FOR NEXT PASS
      GO TO 1001
310   STOP
      END

$DATA
```

APPENDIX C

Pages C1, C2 and C3 show the input data as printed out during execution. Also on C3 is the space matrix (in this case an identity matrix) and a listing of the integer control constants.

Pages C4, C5 and C6 are samples of the output for individual unknowns. Of interest is the category of known column (showing the successive "votes") and the cumulative category of unknown column which shows the resulting decision at each step of the voting process. On page C6, the output for sample 140 shows four sandstone votes and two conglomerate votes with the resulting correct sandstone decision. Sample 142 has three sandstone and three conglomerate votes and the result is an indeterminate answer.

Page C7 consists of the summary output comparing the correct results with the program determined results at each stage of voting.

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KNOWN'S INDEX, DIMENSIONS AND CATEGORY
****

C1

INDEX	CAT.	1	2	3	4	5	6	7	8	9
1	SH	2.19000	1.41020	0.49360	-0.37980	-1.13670	-1.07910	-0.33810	-0.29630	-0.33670
2	SH	2.10780	1.35180	0.40710	-0.32380	-1.21820	-0.97230	-0.45430	-0.23300	-0.06150
3	SH	2.29060	1.38580	0.49600	-0.31810	-1.05840	-1.03570	-0.45660	-0.59240	-0.15610
4	SH	2.13210	1.50550	0.49170	-0.17430	-1.14570	-0.92080	-0.53510	-0.34390	-0.51910
5	SH	2.19450	1.34110	0.38380	-0.47380	-1.17710	-0.83600	-0.25770	-0.39100	-0.25210
6	SH	2.16370	1.36660	0.43420	-0.30950	-1.05910	-0.93730	-0.55850	-0.40630	-0.26110
7	SH	2.42430	1.36550	0.39500	-0.15440	-1.08940	-0.90580	-0.50590	-0.39060	-0.20130
8	SH	1.97990	1.52650	0.57730	-0.49140	-1.09060	-0.90400	-0.52350	-0.39660	-0.14500
9	SH	2.11900	1.38150	0.60290	-0.34740	-1.27290	-1.00100	-0.54920	-0.34600	-0.19360
10	SH	2.33860	1.44040	0.56940	-0.28870	-1.02810	-1.07240	-0.57040	-0.31440	0.04600
11	SH	2.30010	1.21580	0.52260	-0.38730	-1.08030	-0.80560	-0.34640	-0.33380	-0.16900
12	SH	2.26200	1.25950	0.47810	-0.35620	-1.13900	-0.86780	-0.69960	-0.42430	-0.27300
13	SH	2.17250	1.39390	0.50760	-0.24770	-1.26780	-1.02540	-0.44640	-0.36900	-0.20590
14	SH	2.14120	1.40530	0.41410	-0.17480	-1.18520	-1.00950	-0.58120	-0.19400	-0.34370
15	SH	2.58120	1.50960	0.48860	-0.41990	-1.20880	-0.93320	-0.27360	-0.36640	-0.20150
16	SH	2.30050	1.42780	0.61700	-0.23990	-1.31680	-1.12840	-0.52310	-0.34630	-0.18670
17	SH	2.26680	1.32450	0.50250	-0.43550	-1.18430	-0.88010	-0.53460	-0.39080	[illegible]
18	CG	2.24050	1.30120	0.20870	-0.65880	-1.38650	-0.96350	-0.36150	0.13100	0.09030
19	CG	2.13570	1.32030	0.06550	-0.97610	-1.12580	-0.82230	-0.17890	-0.12430	0.63260
20	CG	2.62350	1.10160	0.20210	-1.21650	-1.26820	-0.55590	-0.35420	0.30960	0.78930
21	CG	2.01350	1.04470	0.33400	-0.55150	-1.04780	-1.14510	-0.46600	-0.34700	[illegible]
22	CG	2.30880	1.31570	0.33250	-0.85450	-1.46600	-0.89650	-0.15520	-0.00520	0.28850
23	CG	1.71920	1.32850	0.16640	-0.58910	-1.29870	-0.99770	-0.37960	0.30990	0.35970
24	CG	2.50780	1.30100	0.08640	-0.71150	-0.95640	-0.83400	-0.36980	0.09820	0.58010
25	CG	2.23270	1.47140	0.05950	-0.81060	-1.52380	-0.83570	-0.14120	-0.05970	0.49040
26	CG	2.07850	1.22710	0.45490	-0.61720	-1.15940	-0.98360	-0.25060	0.07390	0.93360
27	CG	2.32060	1.12040	0.44040	-0.57070	-1.16110	-1.12600	-0.13240	[illegible]	0.53230
28	CG	2.30470	1.32960	0.20620	-0.56280	-1.26780	-0.86370	-0.15600	0.12990	0.52980
29	CG	1.79170	1.06390	0.19990	-0.65160	-0.94440	-0.81660	-0.55060	-0.21040	0.58360
30	CG	2.28350	1.22180	0.37150	-0.81890	-1.15900	-0.98270	-0.46430	0.50910	0.04180
31	CG	2.16910	1.05250	0.33090	-0.67090	-1.30690	-1.01320	-0.27990	-0.14370	0.64410
32	CG	2.13710	1.21820	0.37850	-0.68710	-1.07720	-1.13020	[illegible]	0.06680	0.08480
33	CG	2.35540	1.23220	0.15190	-0.85740	-1.14430	-1.01810	[illegible]	0.43670	0.19860
34	CG	2.43010	1.21850	0.41550	-0.83280	-1.07800	-0.67960	-0.17460	0.14830	0.39160
35	CG	2.47110	1.17060	0.06550	-0.91850	-1.15550	-1.03200	-0.38080	0.22470	0.18280
36	CG	2.41560	1.17210	0.31420	-0.60460	-1.07880	-1.04540	-0.15800	0.19620	0.42640
37	CG	2.14420	1.05210	0.20650	-0.74560	-1.29760	-0.99990	-0.01230	0.00150	0.81560
38	CG	2.43320	1.03050	0.02740	-0.79540	-1.04030	-1.04810	-0.44470	0.20370	0.17192
39	CG	2.42380	1.12790	0.21950	-0.75640	-1.14400	-0.71270	-0.45430	-0.08260	0.74430
40	SS	2.99130	0.94640	0.01850	-0.59650	-1.08290	-0.72200	-0.16120	-0.02800	0.39030
41	SS	2.73170	0.94650	-0.03530	-0.58200	-1.06970	-0.84940	-0.37550	-0.07600	0.29320
42	SS	3.12720	0.96520	0.01970	-0.61720	-1.29620	-0.94540	-0.56150	-0.17150	0.23500
43	SS	3.16880	1.00500	0.09310	-0.62020	-1.09270	-0.84140	-0.42300	-0.11460	0.07950
44	SS	2.98590	1.08300	-0.03380	-0.72440	-1.08970	-0.78370	-0.40230	-0.00190	0.29940
45	SS	2.70170	1.16780	-0.14740	-0.75800	-1.12200	-0.90920	-0.23690	-0.12980	0.48300
46	SS	3.27000	1.05730	-0.05500	-0.87660	-1.23250	-0.72390	-0.40750	-0.11290	0.14180
47	SS	3.01040	1.03740	0.03661	-0.61010	-1.15030	-0.96570	-0.52160	-0.00390	0.36070
48	SS	3.13820	1.02570	0.17880	-0.60200	-1.04300	-0.79420	-0.25460	-0.12660	0.27570
49	SS	2.71020	0.85620	-0.00360	-0.61640	-0.99930	-0.77560	-0.22130	0.13840	0.52550
50	SS	2.70940	0.95450	-0.09920	-0.60600	-1.13080	-0.80510	-0.51340	0.07470	0.03760
51	SS	2.84080	1.08620	-0.00220	-0.54180	-1.06740	-0.94530	-0.42030	-0.29510	0.58220
52	SS	3.03190	1.00030	0.05020	-0.54170	-1.01780	-0.83130	-0.37800	-0.03330	0.26793
53	SS	2.93100	1.08690	-0.03280	-0.60880	-1.26670	-0.77100	-0.32620	-0.07910	0.23133
54	SS	2.81470	1.03710	-0.16380	-0.62350	-1.10640	-0.88360	-0.57120	-0.34210	0.30370
55	SS	2.70110	1.17190	0.05090	-0.71980	-1.13720	-0.88190	-0.42310	-0.14630	-0.04840
56	SS	2.65610	1.06390	-0.18110	-0.74870	-1.23700	-0.75350	-0.38970	0.24730	0.08400
57	SS	3.05920	1.09730	0.06030	-0.74800	-0.97820	-0.79190	-0.18190	-0.10770	0.29940
58	SS	2.35870	1.15760	-0.03780	-0.82340	-1.14350	-0.74760	-0.37340	0.12150	0.31630
59	SS	2.77640	1.04640	0.11780	-0.53620	-1.11970	-0.82320	-0.49070	0.03160	0.05510
60	SS	3.07010	1.07700	-0.11950	-0.72230	-1.20300	-0.74520	-0.27970	0.20100	0.43010
61	SS	2.88510	0.85210	-0.06960	-0.70860	-1.25860	-0.84160	-0.25590	0.07350	0.36300
62	SH	2.35840	1.12510	0.56430	0.18360	-0.93270	-1.10430	-0.67680	-0.49960	-0.58250
63	SH	2.68420	1.31320	0.61720	0.19950	-0.89170	-0.96500	-0.06390	-0.71030	-0.73280
64	SH	2.27080	1.38830	0.68420	0.08420	-0.98750	-0.89970	-0.06290	-0.57900	-0.64150
65	SH	2.23030	1.25640	0.68950	0.11240	-0.98390	-0.90770	-0.06980	-0.59600	-0.63850
66	SH	2.67410	1.15310	0.55640	-0.06460	-0.91480	-0.83220	-0.75380	-0.43490	-0.47[illegible]

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

UNKNOWN'S INDEX, DIMENSIONS AND CATEGORY IF KNOWN-OTHERWISE UNKNWN-
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C2

INDEX	CAT.	1	2	3	4	5	6	7	8	9
1	SH	2.30190	1.19590	0.46340	0.20380	-0.93070	-0.97820	-0.75910	-0.66070	-0.32680
2	SH	2.14740	1.24320	0.66420	0.16580	-0.96000	-0.94520	-0.72620	-0.51670	-0.66980
3	SH	2.43760	1.33160	0.58180	-0.16130	-0.97220	-0.92700	-0.64250	-0.58530	-0.38060
4	SH	2.59090	1.23550	0.49560	0.14100	-0.82910	-0.97430	-0.64000	-0.58340	-0.51230
5	SH	2.64940	1.17110	0.48010	0.17620	-0.90340	-1.09440	-0.73960	-0.69690	-0.46620
6	SH	2.45260	1.40170	0.57090	0.04340	-0.86660	-0.94580	-0.77940	-0.72160	-0.77020
7	SH	2.29490	1.31550	0.68360	0.20360	-0.91740	-0.93410	-0.64670	-0.65100	-0.62520
8	SH	2.37250	1.30700	0.63260	0.06330	-0.97530	-0.93170	-0.65730	-0.60210	-0.49320
9	SH	2.33980	1.09120	0.64700	0.12650	-0.79220	-1.10760	-0.67920	-0.75150	-0.43340
10	SH	2.46640	1.12260	0.49640	0.13970	-0.86070	-1.00010	-0.78290	-0.70640	-0.63420
11	SH	2.40560	1.26470	0.63300	0.16540	-0.78410	-0.98080	-0.82840	-0.55360	-0.60930
12	SH	2.05040	1.34040	0.52910	0.14680	-0.87770	-0.92560	-0.56990	-0.53000	-0.63650
13	SH	2.47490	1.29730	0.57440	-0.04660	-0.84190	-1.10340	-0.76680	-0.65680	-0.44470
14	SH	2.50810	1.41520	0.64060	0.17210	-0.96550	-0.95190	-0.72580	-0.42510	-0.79750
15	SH	2.32230	1.22240	0.59400	-0.04400	-0.84180	-0.92030	-0.73750	-0.71710	-0.62770
16	SH	2.49580	1.16850	0.57030	0.02420	-0.92920	-0.82510	-0.79300	-0.60210	-0.39640
17	SH	2.50990	1.38060	0.55050	0.07260	-0.83030	-1.01770	-0.65850	-0.73480	-0.43140
18	SH	2.38740	1.25680	0.64610	0.16560	-0.84420	-1.01660	-0.63250	-0.53700	-0.59850
19	SH	2.56600	1.27010	0.72300	-0.03950	-0.74620	-0.91940	-0.66980	-0.64250	-0.73350
20	SH	2.64500	1.30180	0.62680	0.18720	-0.85570	-0.96530	-0.64200	-0.65960	-0.59275
21	SH	2.65960	1.16700	0.53840	0.11180	-0.82370	-0.90310	-0.74560	-0.54510	-0.61110
22	SH	2.64260	1.27290	0.56850	0.06250	-0.91040	-0.92800	-0.66590	-0.58930	-0.37200
23	SH	2.63650	1.29900	0.50520	0.01420	-0.80060	-0.87700	-0.79410	-0.65580	-0.47150
24	SH	2.71250	1.23340	0.51950	0.00870	-0.95300	-1.06570	-0.66910	-0.38660	-0.71640
25	SH	2.58430	1.19790	0.54320	0.05850	-0.38760	-1.02220	-0.70990	-0.86660	-0.43940
26	SH	2.63140	1.27100	0.63770	0.13580	-0.81120	-0.97570	-0.76430	-0.76110	-0.43100
27	SH	2.17130	1.29650	0.52300	-0.00850	-0.92530	-1.03480	-0.66830	-0.62110	-0.57100
28	SH	2.41790	1.35250	0.61230	0.18280	-0.85090	-0.84160	-0.50490	-0.56673	-0.61300
29	SH	2.15490	1.19880	0.67610	0.14560	-0.92690	-0.94380	-0.74500	-0.78720	-0.49870
30	SH	2.53180	1.14770	0.58530	0.03440	-1.03920	-0.91010	-0.65320	-0.86400	-0.39760
31	SH	2.54800	1.43450	0.65300	0.09110	-0.96110	-0.97770	-0.55590	-0.72490	-0.47970
32	SH	2.46880	1.20020	0.64070	0.26900	-0.98590	-0.94060	-0.76080	-0.52230	-0.49860
33	SH	2.38960	1.32800	0.57030	-0.31510	-1.00340	-1.07980	-0.55850	-0.33183	-0.12080
34	SH	2.14470	1.36040	0.45850	-0.33310	-1.17850	-0.89390	-0.51030	-0.37530	-0.22130
35	SH	2.42560	1.10220	0.68410	-0.09580	-0.98340	-0.94980	-0.66070	-0.60580	-0.39760
36	SH	1.92510	1.24290	0.64460	0.10060	-0.98400	-1.02950	-0.64790	-0.50290	-0.54670
37	SH	2.18230	1.22460	0.65230	0.04630	-0.96570	-1.21080	-0.75230	-0.86060	-0.32310
38	SH	2.17420	1.07490	0.63800	-0.09730	-0.82000	-1.02780	-0.65340	-0.83600	-0.55720
39	SH	2.33790	1.03860	0.64220	0.03080	-0.69870	-1.14400	-0.55570	-0.55930	-0.55300
40	SH	2.06210	1.35650	0.59870	0.08390	-0.77110	-1.14190	-0.62510	-0.60010	-0.15470
41	SH	2.06400	1.19470	0.60610	0.06510	-0.95910	-1.04310	-0.76400	-0.51010	-0.39860
42	SH	2.42580	1.31570	0.72700	0.02430	-1.02330	-1.02591	-0.57930	-0.48023	-0.72320
43	SH	2.39190	1.10090	0.71330	-0.05670	-1.13720	-0.97770	-0.46880	-0.48330	-0.47720
44	SH	2.49360	1.35640	0.54410	-0.09110	-1.06470	-0.82530	-0.56990	-0.43310	-0.50690
45	SH	2.74500	1.29980	0.57360	0.15060	-1.05310	-1.01670	-0.49020	-0.54110	-0.53640
46	SH	2.51980	1.38670	0.62530	0.36030	-0.91870	-1.24610	-0.62520	-0.81380	-0.35100
47	SH	2.44500	1.31030	0.76440	0.24340	-1.24310	-1.00900	-0.05400	-0.32040	-0.76100
48	SH	2.63960	1.14140	0.75440	-0.06960	-0.96670	-1.09510	-0.06540	-0.96950	-0.37460
49	SH	2.44670	1.14000	0.67270	-0.03190	-1.02590	-0.87130	-0.80300	-0.80660	-0.49020
50	SH	2.65140	1.30510	0.56350	0.31970	-1.16230	-0.88670	-0.78900	-0.43270	-0.45573
51	SH	2.32940	1.34380	0.63730	-0.06740	-0.80010	-1.12630	-0.72080	-0.59370	-0.24130
52	SH	2.23220	1.17520	0.59580	0.18130	-0.94220	-1.06180	-0.61480	-0.54831	-0.59150
53	SH	2.15400	1.23060	0.45630	-0.07070	-1.02300	-1.08900	-0.62950	-0.70940	-0.63830
54	SH	2.22270	1.37410	0.50170	0.20800	-0.91890	-0.96570	-0.56370	-0.55180	-0.52010
55	SH	2.40640	1.37160	0.57990	-0.05740	-0.87210	-1.03140	-0.67000	-0.65800	-0.55180
56	SH	2.65450	1.21560	0.74140	0.15120	-0.88950	-0.93830	-0.65080	-0.47420	-0.40700
57	SH	2.42410	1.29450	0.58730	-0.11730	-0.86940	-1.11470	-0.60370	-0.48230	-0.41320
58	SH	2.62520	1.24460	0.66220	0.16270	-0.90920	-0.95900	-0.55620	-0.74160	-0.41470
59	SH	2.31390	1.19700	0.51690	-0.04910	-1.06350	-1.03700	-0.67400	-0.59350	-0.13350
60	SH	2.59450	1.16300	0.49520	-0.09020	-0.87820	-1.07380	-0.86050	-0.56350	-0.56030
61	CG	2.44670	1.03980	-0.10610	-0.08750	-1.27400	-0.87560	-0.86060	0.46650	0.47700
62	CG	2.06000	0.98680	-0.06590	-1.28950	-1.13320	-0.49900	0.23500	0.24080	0.52460
63	CG	2.55050	1.01430	-0.04050	-0.92110	-1.27040	-0.72270	-0.07310	0.58830	0.50350
64	CG	2.11240	1.29660	-0.00870	-0.93810	-1.30720	-0.83300	-0.14810	0.14790	0.59410
65	CC	2.08840	1.03780	-0.21060	-1.16590	-1.28550	-0.61130	-0.04590	0.12930	0.29220
66	CG	2.16180	1.19890	0.07960	-0.96060	-1.28220	-0.91500	-0.13550	0.13460	0.59800
67	CC	1.78590	1.09680	0.03140	-1.05990	-1.07010	-0.74280	0.06240	0.49860	0.70465
68	CG	1.83620	1.26090	0.09530	-1.06750	-1.07260	-0.78490	0.00820	0.55860	0.64930
69	CG	2.45900	1.13440	-0.06150	-1.16080	-1.27770	-0.87790	0.05710	0.74700	0.55560
70	CG	2.20290	1.05550	0.20730	-1.02610	-1.38630	-0.62200	-0.31650	0.15610	0.43960
71	CG	2.20360	1.16180	-0.12300	-1.10460	-1.03590	-0.82820	-0.18670	0.31420	0.55540
72	CG	2.19290	1.27650	0.06780	-0.89450	-1.40110	-0.73810	-0.07840	0.03210	0.53020
73	CG	2.19520	1.09070	-0.08230	-1.16100	-1.43030	-0.80900	0.07200	0.04027	0.45960
74	CG	1.85920	1.27570	-0.15360	-0.88730	-1.25160	-0.69571	-0.00350	0.32978	0.14230
75	CG	2.06790	1.33250	-0.15530	-1.05190	-1.13990	-0.77200	-0.18820	-0.09680	0.75550
76	CG	2.14[illegible]	1.08250	0.07560	-1.22460	-1.26080	-0.58350	-0.10020	0.1465[illegible]	0.14650
77	CG	2.23600	1.23560	-0.01660	-0.84950	-1.32640	-0.61980	-0.05040	0.15260	0.67000
78	CG	2.06700	1.07010	-0.13210	-1.13560	-1.17860	-0.78780	0.05840	0.16430	0.73350
79	CG	2.06250	1.30810	0.23780	-1.08790	-1.25310	-0.94880	0.04050	0.32140	0.73310
80	CG	1.83710	1.19070	0.25550	-1.09180	-1.28100	-0.88080	-0.01090	0.45130	0.64550
81	CG	1.92280	1.19830	0.20540	-1.12000	-1.41040	-0.85710	-0.02210	0.44720	0.4252[illegible]
82	CG	1.92360	1.37380	0.15610	-1.26300	-1.24670	-0.77700	-0.11300	0.47770	0.55760
83	CG	1.75140	1.22530	0.27780	-1.21080	-1.22470	-0.83120	0.11200	0.24660	0.31310
84	CG	1.83490	1.31470	0.22310	-1.07920	-1.30900	-0.94090	0.00390	0.45610	0.28920
85	CG	2.09140	1.23080	0.16510	-1.03950	-1.28150	-0.92990	-0.03780	0.45700	0.59860
86	CG	1.68270	1.36820	0.19670	-1.04170	-1.43110	-0.90580	0.16050	0.23620	0.54530
87	CG	1.72930	1.36540	0.23650	-1.28390	-1.24640	-0.81920	-0.03320	0.23320	0.37520
88	CG	1.75930	1.40910	0.22430	-1.11560	-1.40070	-0.85970	-0.05010	0.24550	0.37400
89	CG	1.67200	1.40120	0.36160	-1.20800	-1.22000	-0.84290	0.03550	0.23920	0.54350
90	CG	1.79480	1.29440	0.29840	-1.19950	-1.18740	-0.92710	-0.10750	0.27780	0.62600
91	CG	1.93180	1.17070	0.31710	-1.03290	-1.22100	-0.87660	0.05240	0.49150	0.62430
92	CG	1.78010	1.24120	0.10100	-1.04680	-1.41270	-0.93730	-0.06110	0.57200	0.64650
93	CG	1.65390	1.32540	0.35080	-1.31860	-1.42260	-1.00570	-0.05650	0.39780	0.74420
94	CG	2.04360	1.25150	0.16540	-0.97570	-1.21570	-0.85970	-0.10700	0.11780	0.45360
95	CG	2.00470	1.32240	0.35650	-1.24400	-1.40460	-1.01770	-0.06320	0.23210	0.83190
96	CG	1.68300	1.17510	0.20040	-0.95440	-1.27360	-1.01910	-0.11230	0.34050	0.31470
97	CG	1.93230	1.20980	0.31900	-1.04600	-1.32540	-1.00930	-0.07980	0.26980	0.37370
98	CG	2.14150	1.15710	0.21330	-1.17270	-1.28900	-0.74030	0.06570	0.47900	0.53900
99	CG	1.62247	1.16180	0.36140	-1.22550	-1.35910	-1.01280	-0.06050	0.13810	0.63930
100	CG	1.89210	1.14170	0.21700	-1.20440	-1.24390	-0.90650	0.00870	0.22850	0.44510
101	CG	1.84430	1.32180	0.23440	-1.07150	-1.10150	-0.73080	-0.02800	0.42080	0.70580
102	CG	1.84300	1.13980	0.36550	-1.17530	-1.24270	-0.77240	-0.01530	0.42560	0.63200
103	CG	1.85350	1.44130	0.21110	-1.24850	-1.26470	-1.03320	0.17300	0.19810	0.60280
104	CG	1.90320	1.39560	0.12970	-0.95640	-1.27150	-0.90560	0.02710	0.44910	0.55380
105	CG	1.99640	1.29470	0.34830	-1.06550	-1.41790	-1.00750	-0.03780	0.39700	0.42010
106	CG	2.40690	1.16510	-0.03170	-1.10590	-1.10740	-0.80940	-0.00590	0.64430	0.50540
107	CG	1.78800	1.29910	-0.09970	-0.95710	-1.19620	-0.66260	-0.03950	0.18560	0.53730
108	CG	1.98850	1.18280	-0.04440	-0.94390	-1.43540	-0.79460	-0.04960	0.53530	0.73550
109	CG	2.20500	1.17350	0.06140	-0.90480	-1.18290	-0.75900	-0.14520	0.40020	0.63110
110	CG	2.22340	1.38060	-0.13580	-0.93290	-1.24380	-0.81860	-0.09620	0.08820	0.48750
111	CG	2.12580	1.26730	-0.08950	-1.12890	-1.25000	-0.85600	-0.37620	0.55130	0.36280
112	CG	1.61660	1.09250	-0.00750	-1.02070	-1.31470	-0.89120	0.07020	0.21640	0.87770
113	CG	2.01430	1.23570	0.04330	-1.14080	-1.35410	-1.02580	-0.09320	0.12310	0.45530
114	CG	1.89370	0.99640	0.05490	-1.13190	-1.04960	-0.82570	-0.01060	0.48150	0.49060
115	CG	1.94750	1.09110	-0.09580	-1.23710	-1.21370	-0.64060	-0.26380	0.15550	0.45070

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

C3

116 * CG	* 1.75010 *	1.33240 *	0.05810 *	-1.02570 *	-1.12790 *	-0.93580 *	-0.08070 *	0.39270 *	0.66020 *
117 * CG	* 1.78710 *	1.16210 *	0.06180 *	-1.02300 *	-1.09160 *	-0.86250 *	-0.29050 *	0.35790 *	0.47010 *
118 * CG	* 2.11570 *	1.28750 *	-0.02650 *	-0.85630 *	-1.17400 *	-0.98120 *	-0.00800 *	0.18630 *	0.65966 *
119 * CG	* 2.00770 *	1.26470 *	0.10670 *	-1.00800 *	-1.14110 *	-0.70920 *	-0.12710 *	0.06950 *	0.40390 *
120 * CG	* 2.06310 *	1.16940 *	0.01480 *	-1.13650 *	-1.44340 *	-0.82480 *	0.06210 *	0.39810 *	0.57140 *
121 * CG	* 2.37010 *	1.36090 *	0.01790 *	-1.01820 *	-1.11850 *	-0.76670 *	0.05830 *	0.22750 *	0.59580 *
122 * CG	* 2.15760 *	1.17980 *	-0.07650 *	-0.85130 *	-1.41430 *	-0.83800 *	-0.18320 *	0.18570 *	0.27460 *
123 * CG	* 2.07850 *	1.20850 *	-0.10600 *	-0.92630 *	-1.34270 *	-0.87500 *	0.00280 *	-0.13390 *	0.77340 *
124 * SS	* 3.11590 *	1.05500 *	0.05460 *	-0.67300 *	-1.34570 *	-0.79310 *	-0.27150 *	-0.29720 *	0.38400 *
125 * SS	* 2.91770 *	1.03900 *	0.11410 *	-0.68440 *	-1.08710 *	-0.87550 *	-0.32950 *	-0.00870 *	0.28890 *
126 * SS	* 2.69070 *	0.95010 *	0.18040 *	-0.56810 *	-1.14350 *	-0.96350 *	-0.24320 *	-0.01900 *	0.33750 *
127 * SS	* 3.02590 *	1.12100 *	-0.09090 *	-0.74870 *	-0.99470 *	-0.78720 *	-0.52770 *	0.20880 *	0.13010 *
128 * SS	* 2.87590 *	1.13420 *	-0.07220 *	-0.77290 *	-1.12980 *	-0.88850 *	-0.26550 *	-0.05570 *	0.47320 *
129 * SS	* 2.79550 *	0.92450 *	0.03580 *	-0.57580 *	-1.04640 *	-0.84310 *	-0.59220 *	-0.23150 *	0.20470 *
130 * SS	* 2.96610 *	1.18550 *	0.07680 *	-0.65590 *	-1.14540 *	-0.87660 *	-0.47880 *	-0.14710 *	0.23680 *
131 * SS	* 2.77330 *	1.04970 *	-0.00130 *	-0.59290 *	-1.23240 *	-0.95480 *	-0.61930 *	-0.11370 *	0.31430 *
132 * SS	* 2.96490 *	1.09220 *	0.00850 *	-0.67890 *	-1.06480 *	-0.81590 *	-0.37570 *	-0.02770 *	0.23420 *
133 * SS	* 2.76250 *	1.00240 *	-0.09700 *	-0.75420 *	-1.07050 *	-0.93250 *	-0.40110 *	0.02710 *	0.01140 *
134 * SS	* 2.80070 *	1.12870 *	-0.04160 *	-0.63350 *	-1.06160 *	-0.74560 *	-0.28910 *	-0.08510 *	0.24430 *
135 * SS	* 2.62950 *	0.90710 *	0.06950 *	-0.76990 *	-1.04740 *	-0.76480 *	-0.46710 *	0.06780 *	0.25280 *
136 * SS	* 2.53120 *	0.98430 *	-0.00080 *	-0.68260 *	-1.23250 *	-0.71860 *	-0.37250 *	0.07630 *	0.31790 *
137 * SS	* 2.87640 *	1.19910 *	-0.14030 *	-0.73190 *	-1.18730 *	-0.86970 *	-0.47300 *	-0.12520 *	0.49460 *
138 * SS	* 3.10200 *	1.03590 *	-0.02450 *	-0.60800 *	-1.25460 *	-0.90380 *	-0.50820 *	-0.10100 *	0.22640 *
139 * SS	* 2.78300 *	1.03960 *	0.10950 *	-0.49800 *	-1.11700 *	-0.76800 *	-0.26750 *	-0.14080 *	0.19180 *
140 * SS	* 2.55560 *	1.10970 *	0.03220 *	-0.65850 *	-1.09510 *	-0.96230 *	-0.38950 *	-0.01600 *	0.17160 *
141 * SS	* 2.98970 *	1.09180 *	0.02540 *	-0.60030 *	-1.19220 *	-0.85120 *	-0.51380 *	-0.01160 *	0.09780 *
142 * SS	* 2.39620 *	1.00980 *	-0.04430 *	-0.60150 *	-1.20570 *	-1.03450 *	-0.26080 *	0.10850 *	0.49790 *
143 * SS	* 2.89040 *	1.02760 *	-0.24590 *	-0.64620 *	-1.26430 *	-0.72220 *	-0.23820 *	-0.04150 *	0.35710 *
144 * SS	* 2.84910 *	1.00800 *	-0.02000 *	-0.66780 *	-1.07700 *	-0.82810 *	-0.35500 *	0.03110 *	0.40110 *
145 * SS	* 2.66680 *	1.05630 *	-0.14460 *	-0.58570 *	-1.17210 *	-0.85990 *	-0.35900 *	-0.26680 *	0.12300 *
146 * SS	* 2.82260 *	0.94610 *	-0.01520 *	-0.70650 *	-1.10160 *	-0.89750 *	-0.42200 *	0.01770 *	0.32550 *
147 * SS	* 3.01080 *	0.96960 *	-0.15440 *	-0.63900 *	-1.18550 *	-0.80660 *	-0.46810 *	-0.10230 *	0.26200 *
148 * SS	* 2.96090 *	0.97450 *	0.03[illegible] *	-0.75850 *	-1.01190 *	-0.91870 *	-0.38940 *	0.19630 *	0.22350 *
149 * SS	* 2.70820 *	0.99770 *	-0.13[illegible] *	-0.50470 *	-1.09890 *	-0.82550 *	-0.36670 *	-0.43160 *	0.17450 *
150 * SS	* 3.05360 *	0.95070 *	0.02880 *	-0.51530 *	-1.09780 *	-0.86580 *	-0.43850 *	-0.33450 *	0.11210 *
151 * SS	* 2.92410 *	0.97780 *	-0.14220 *	-0.77100 *	-1.21730 *	-0.75770 *	-0.37260 *	0.11630 *	0.30[illegible] *
152 * SS	* 2.81950 *	1.16450 *	0.00340 *	-0.54820 *	-1.11470 *	-0.94840 *	-0.42540 *	-0.09870 *	0.22760 *
153 * SS	* 2.55160 *	0.92610 *	-0.02590 *	-0.65280 *	-1.25130 *	-0.78700 *	-0.49780 *	-0.05260 *	0.38590 *
154 * SS	* 2.83940 *	1.11450 *	-0.05080 *	-0.63010 *	-1.20130 *	-0.78040 *	-0.34460 *	-0.06890 *	0.11770 *
155 * SS	* 2.73300 *	1.03650 *	-0.00950 *	-0.57110 *	-1.07930 *	-0.92820 *	-0.50300 *	0.00380 *	0.36530 *
156 * SS	* 2.74770 *	1.11750 *	0.00310 *	-0.63600 *	-1.23130 *	-0.78060 *	-0.54600 *	-0.09420 *	0.18310 *
157 * SS	* 3.14950 *	1.14140 *	-0.05680 *	-0.60400 *	-1.34530 *	-0.91860 *	-0.36640 *	-0.16720 *	0.31140 *
158 * SS	* 2.68000 *	0.92340 *	0.00300 *	-0.46720 *	-1.10540 *	-0.86180 *	-0.53440 *	-0.23190 *	-0.00100 *
159 * SS	* 2.73020 *	1.01860 *	0.02110 *	-0.67500 *	-0.91900 *	-0.93370 *	-0.56980 *	-0.05420 *	0.58290 *
160 * SS	* 3.08460 *	0.77420 *	-0.13760 *	-0.79440 *	-1.13590 *	-0.82710 *	-0.47740 *	-0.07220 *	0.33300 *
161 * SS	* 2.90380 *	1.08130 *	0.07680 *	-0.55160 *	-1.16520 *	-0.81550 *	-0.46590 *	-0.21950 *	0.16420 *
162 * SS	* 3.12540 *	0.96250 *	-0.09750 *	-0.41620 *	-1.18230 *	-0.79760 *	-0.38060 *	0.00160 *	0.35320 *
163 * SS	* 2.97470 *	1.00900 *	-0.04310 *	-0.53170 *	-1.13760 *	-0.86560 *	-0.66500 *	-0.18970 *	0.19300 *
164 * SS	* 3.07460 *	1.00370 *	-0.01620 *	-0.45880 *	-1.12050 *	-1.03130 *	-0.36970 *	-0.27990 *	0.25130 *
165 * SS	* 2.88880 *	0.96350 *	0.05190 *	-0.80950 *	-1.35360 *	-0.79820 *	-0.57900 *	0.11980 *	0.08750 *
166 * SS	* 3.05680 *	1.03900 *	-0.03050 *	-0.68340 *	-1.16550 *	-0.79360 *	-0.44720 *	0.10360 *	0.30470 *
167 * SS	* 3.08580 *	1.03930 *	0.14160 *	-0.52320 *	-1.15960 *	-0.76960 *	-0.46630 *	-0.01260 *	0.25550 *
168 * SS	* 2.96910 *	0.98090 *	-0.09790 *	-0.46960 *	-0.94720 *	-0.78750 *	-0.56235 *	-0.40470 *	0.31340 *
169 * SS	* 3.14330 *	0.87070 *	-0.05430 *	-0.41860 *	-1.19450 *	-0.79400 *	-0.47830 *	-0.20660 *	0.07450 *
170 * SS	* 3.03500 *	0.96140 *	0.02530 *	-0.49540 *	-1.06410 *	-0.83940 *	-0.51240 *	-0.20710 *	0.23150 *
171 * SS	* 2.94530 *	1.01150 *	0.07720 *	-0.58960 *	-1.06550 *	-0.72970 *	-0.52920 *	0.03740 *	0.32710 *
172 * SS	* 3.05460 *	1.05890 *	-0.18520 *	-0.51160 *	-1.02880 *	-0.73080 *	-0.25980 *	-0.04010 *	0.03780 *
173 * SS	* 3.06400 *	1.09240 *	-0.02860 *	-0.52720 *	-1.05680 *	-0.77800 *	-0.46070 *	-0.09160 *	0.19650 *
174 * SS	* 3.18760 *	1.00070 *	0.01310 *	-0.53590 *	-1.05270 *	-0.96530 *	-0.45910 *	-0.20010 *	0.03920 *
175 * SS	* 2.82450 *	1.08170 *	0.16090 *	-0.51770 *	-1.05750 *	-0.76600 *	-0.37750 *	-0.19840 *	0.06530 *
176 * SS	* 3.13410 *	0.95940 *	-0.02200 *	-0.56810 *	-1.13190 *	-0.86360 *	-0.34000 *	-0.17460 *	0.[illegible] *
177 * SS	* 3.08740 *	1.03100 *	0.02420 *	-0.61190 *	-0.94600 *	-0.69120 *	-0.39530 *	-0.19000 *	0.03450 *
178 * SS	* 3.09440 *	1.08700 *	0.22710 *	-0.52390 *	-1.04390 *	-0.86520 *	-0.42080 *	-0.03870 *	0.30[illegible] *
179 * SS	* 2.56730 *	1.00340 *	-0.05980 *	-0.45320 *	-1.01560 *	-0.78650 *	-0.49740 *	-0.17830 *	0.17450 *

SPACE MATRIX-- 9 BY 9
****

INDEX	1	2	3	4	5	6	7	8	9
1	1.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *
2	0.00000 *	1.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *
3	0.00000 *	0.00000 *	1.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *
4	0.00000 *	0.00000 *	0.00000 *	1.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *
5	0.00000 *	0.00000 *	0.00000 *	0.00000 *	1.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *
6	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	1.00000 *	0.00000 *	0.00000 *	0.00000 *
7	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	1.00000 *	0.00000 *	0.00000 *
8	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	1.00000 *	0.00000 *
9	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	0.00000 *	1.00000 *

**********END INPUT**END INPUT**END INPUT**********

********** PASS 1 **********
****

INTEGER CONSTANTS
****

NO. OF KNOWNS=M= 66 NO. OF UNKNOWNS=N= 179 NO. OF DIMENSIONS=IP= 9

MIN. PTS. TESTED=KMIN= 6 NO. OF RADII TESTED=KRAD= 0 NO. OF CATEGORIES=IFDIST= 3

DISTRIBUTION SYMBOLS=STD(I) WHERE I=1 UNTIL 3
****

1) SH 2) SS 3) CG

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

C4

**********OUTPUT**OUTPUT**OUTPUT**********
****** ****** ******

UNKNOWN X(1) WITH DIMENSIONS
IDENTIFICATION...
16 SH7801 SH
****

1	2	3	4	5	6	7	8	9
2.30190 *	1.19990 *	0.48340 *	0.20380 *	-0.93070 *	-0.97820 *	-0.79910 *	-0.66070 *	-0.32680 *

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
62	SH	0.14083	SH	1
65	SH	0.16802	SH	1
64	SH	0.22939	SH	1
66	SH	0.31299	SH	1
63	SH	0.36409	SH	1
7	SH	0.38363	SH	1

**********OUTPUT**OUTPUT**OUTPUT**********
****** ****** ******

UNKNOWN X(2) WITH DIMENSIONS
IDENTIFICATION...
16 SH7801 SH
****

1	2	3	4	5	6	7	8	9
2.14740 *	1.24320 *	0.66420 *	0.16580 *	-0.96000 *	-0.94520 *	-0.72620 *	-0.51670 *	-0.66980 *

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
65	SH	0.02612	SH	1
64	SH	0.06216	SH	1
62	SH	0.10589	SH	1
4	SH	0.33967	SH	1
63	SH	0.34696	SH	1
66	SH	0.41379	SH	1

**********OUTPUT**OUTPUT**OUTPUT**********
****** ****** ******

UNKNOWN X(3) WITH DIMENSIONS
IDENTIFICATION...
16 SH7801 SH
****

1	2	3	4	5	6	7	8	9
2.43760 *	1.33160 *	0.58180 *	-0.16130 *	-0.97220 *	-0.92700 *	-0.64250 *	-0.58530 *	-0.38360 *

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
7	SH	0.13917	SH	1
12	SH	0.15751	SH	1
3	SH	0.16142	SH	1
66	SH	0.16472	SH	1
6	SH	0.17605	SH	1
64	SH	0.17783	SH	1

**********OUTPUT**OUTPUT**OUTPUT**********
****** ****** ******

UNKNOWN X(4) WITH DIMENSIONS
IDENTIFICATION...
16 SH7801 SH
****

1	2	3	4	5	6	7	8	9
2.39090 *	1.23550 *	0.49560 *	0.14130 *	-0.82910 *	-0.97430 *	-0.81800 *	-0.58340 *	-0.51230 *

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
66	SH	0.11116	SH	1
63	SH	0.12537	SH	1
62	SH	0.13458	SH	1
64	SH	0.22097	SH	1
65	SH	0.23056	SH	1
7	SH	0.44578	SH	1

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

C5

**********OUTPUT**OUTPUT**OUTPUT**********
****** ****** ******

UNKNOWN X(120) WITH DIMENSIONS
IDENTIFICATION...
22 CC0804 CG
****

1	2	3	4	5	6	7	8	9
2.06310 *	1.16940 *	0.01480 *	-0.13050 *	-1.44340 *	-0.02480 *	0.00210 *	0.39810 *	0.57140 *

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
33	CG	0.45669	CG	1
19	CG	0.46664	CG	1
25	CG	0.47144	CG	1
37	CG	0.47894	CG	1
22	CG	0.51593	CG	1
28	CG	0.58037	CG	1

**********OUTPUT**OUTPUT**OUTPUT**********
****** ****** ******

UNKNOWN X(119) WITH DIMENSIONS
IDENTIFICATION...
22 CC0804 CG
****

1	2	3	4	5	6	7	8	9
2.00770 *	1.26470 *	0.10670 *	-1.00800 *	-1.14110 *	-0.70920 *	-0.12710 *	0.06950 *	0.40390 *

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
19	CG	0.12764	CG	1
25	CG	0.32138	CG	1
34	CG	0.32413	CG	1
22	CG	0.32664	CG	1
28	CG	0.36070	CG	1
33	CG	0.42418	CG	1

**********OUTPUT**OUTPUT**OUTPUT**********
****** ****** ******

UNKNOWN X(121) WITH DIMENSIONS
IDENTIFICATION...
22 CC0804 CG
****

1	2	3	4	5	6	7	8	9
2.37010 *	1.36050 *	0.01790 *	-1.01820 *	-1.11850 *	-0.76670 *	0.05830 *	0.22750 *	0.58680 *

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
19	CG	0.24592	CG	1
34	CG	0.28512	CG	1
33	CG	0.33189	CG	1
28	CG	0.33790	CG	1
24	CG	0.35214	CG	1
25	CG	0.37652	CG	1

**********OUTPUT**OUTPUT**OUTPUT**********
****** ****** ******

UNKNOWN X(122) WITH DIMENSIONS
IDENTIFICATION...
22 CC0804 CG
****

1	2	3	4	5	6	7	8	9
2.15760 *	1.17950 *	-0.07650 *	-0.85130 *	-1.41430 *	-0.83800 *	-0.18320 *	0.18570 *	0.27460 *

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
18	CG	0.22542	CG	1
25	CG	0.23137	CG	1
22	CG	0.23476	CG	1
34	CG	0.27775	CG	1
33	CG	0.28440	CG	1
28	CG	0.29841	CG	1

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

C6

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*****************************************OUTPUT**OUTPUT**OUTPUT*****************************************
                                          ******  ******  ******

        UNKNOWN  X(139)                    WITH DIMENSIONS
IDENTIFICATION...
     23    SS23                 SS
        *****************

 1          2          3          4          5          6          7          8          9
 2.78300 *  1.03960 *  0.10950 * -0.49800 * -1.11700 * -0.76800 * -0.26750 * -0.14080 *  0.19180 *
```

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
41	SS	0.07420	SS	1
53	SS	0.08790	SS	1
55	SS	0.10290	SS	1
52	SS	0.11146	SS	1
40	SS	0.13676	SS	1
48	SS	0.15545	SS	1

```
*****************************************OUTPUT**OUTPUT**OUTPUT*****************************************
                                          ******  ******  ******

        UNKNOWN  X(140)                    WITH DIMENSIONS
IDENTIFICATION...
     23    SS23                 SS
        *****************

 1          2          3          4          5          6          7          8          9
 2.59560 *  1.10970 *  0.03220 * -0.65850 * -1.09510 * -0.96230 * -0.38950 * -0.01600 *  0.17160 *
```

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
41	SS	0.08751	SS	1
55	SS	0.09385	SS	1
59	SS	0.10501	SS	1
50	SS	0.12432	SS	1
35	CG	0.15483	SS	1
38	CG	0.19207	SS	1

```
*****************************************OUTPUT**OUTPUT**OUTPUT*****************************************
                                          ******  ******  ******

        UNKNOWN  X(141)                    WITH DIMENSIONS
IDENTIFICATION...
     23    SS23                 SS
        *****************

 1          2          3          4          5          6          7          8          9
 2.58571 *  1.09180 *  0.02540 * -0.60030 * -1.19220 * -0.85120 * -0.50380 * -0.01160 *  0.09780 *
```

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
44	SS	0.05927	SS	1
59	SS	0.07011	SS	1
43	SS	0.07255	SS	1
53	SS	0.07283	SS	1
47	SS	0.08797	SS	1
52	SS	0.09080	SS	1

```
*****************************************OUTPUT**OUTPUT**OUTPUT*****************************************
                                          ******  ******  ******

        UNKNOWN  X(142)                    WITH DIMENSIONS
IDENTIFICATION...
     23    SS23                 SS
        *****************

 1          2          3          4          5          6          7          8          9
 2.39620 *  1.00980 * -0.04430 * -0.60150 * -1.20570 * -1.03450 * -0.26080 *  0.10850 *  0.49790 *
```

INDEX OF KNOWN	CATEGORY OF KNOWN	DISTANCE TO UNKNOWN	CUMULATIVE CATEGORY OF UNKNOWN	RADIUS INDEX OF KNOWN
36	CG	0.19484	CG	1
28	CG	0.22068	CG	1
45	SS	0.23377	CG	1
49	SS	0.23704	CG	1
			SS	
24	CG	0.24753	CG	1
41	SS	0.25884	CG	1
			SS	

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR.

C7

SUMMARY
****

K= 1

	SH	SS	CG
SH	60	0	0
SS	0	55	0
CG	0	1	63

SUMMARY
****

K= 2

	SH	SS	CG
SH	60	0	0
SS	0	55	0
CG	0	1	63

SUMMARY
****

K= 3

	SH	SS	CG
SH	60	0	0
SS	0	55	0
CG	0	1	63

SUMMARY
****

K= 4

	SH	SS	CG
SH	60	0	0
SS	0	55	0
CG	0	1	63

SUMMARY
****

K= 5

	SH	SS	CG
SH	60	0	0
SS	0	55	0
CG	0	1	63

SUMMARY
****

K= 6

	SH	SS	CG
SH	60	0	0
SS	0	55	0
CG	0	1	63