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RECOG: PATTERN RECOGNITION ANALYSIS OF GENERALIZED DATA SETS

A USER'S MANUAL

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DISCLAIMER

INTRODUCTION

Pattern recognition is a developing branch of artificial intelligence that has shown great promise in providing a general approach to solutions of a large class of data analysis problems in such diverse areas as medical diagnosis, environmental protection, materials science, production control, and the experimental physical sciences. A general statement of the type of problem that pattern recognition attempts to solve is as follows:

".....Given a set of objects and a list of measurements made on these objects, is it possible to find and/or predict a property of the objects that is not directly measurable but is known to be related via some unknown relationship?....."*

The computer program described in this manual attempts to answer that question for specific data sets. It is perhaps worthwhile to note that the program, called RECOG, not only answers "YES" but sometimes answers "NO". Namely, RECOG operates on data sets in such a way that it is apparent whether or not useful information is contained in the set. A variety of processing techniques are used to look at the data so that the scientist is able to make intelligent decisions about large amounts of data. The problem is roughly parallel to determining the shape of a multivariate function in many-dimensional space, given a number of functional values in the space. The difficulty is that, for the types of problems mentioned above, it is not clear either what the functional form is or what the proper choice of variables ought to be. RECOG's primary task is to help make those choices.

*B. R. Kowalski and C. F. Bender, J. Am. Chem. Soc. 94, 5632 (1972).

DEFINITIONS AND NOMENCLATURE

Consider a collection of NP objects for which NV measurements (or variables) have been tabulated. The tabular description of the information is called a pattern and is denoted by the vector $\underset{\sim}{X}_j$,

$$\underset{\sim}{X}_j = \begin{pmatrix} X_{1j} \\ X_{2j} \\ \cdot \\ \cdot \\ \cdot \\ X_{NVj} \end{pmatrix} \qquad j = 1, \ldots NP \qquad (1)$$

Here X_{ij} is the value of the i^{th} measurement made on the j^{th} object. A pattern space (sometimes called a pattern set or data set) is a collection of these patterns:

$$\underset{\sim}{X} = (\underset{\sim}{X}_1 \; \underset{\sim}{X}_2 \cdots \underset{\sim}{X}_{NP})$$

Of course, it is assumed that the same measurements are made on all the objects. The matrix representation of patterns is used so that the methods of linear algebra can be applied.

A class contains patterns which have some common unmeasurable (either economically or physically) feature. Most pattern recognition problems can be reduced to two-class problems (good actors, bad actors, etc.). A predicted property is a parameter to be predicted from the measurements, usually a continuous function. For cases in which only classes are of interest, the predicted property may be simply the class number.

RECOG VERBS

RECOG analyzes pattern sets by applying various techniques to them. The use of verbs in the input stream allows the program user a great deal of flexibility in the analysis of his data. The format for the verb input is as follows:

INPUT ..... (A10)

Cols	Type	Default	Description
1-10	A	-	VERB (left-justified)

The verbs presently available in RECOG are

Pattern Input

INPUT

Pattern Analysis

CORR
CORRPP

Preprocessing

AUTO
KHPRE
SELECT
SLT

Display

2DPLOT
HISTO
NLM

Supervised Learning

KNEAR
LEAST
MULTCL

Unsupervised Learning

HIER

Utility Routines

END
GIVE
KEEP80
NEW
PRINT

Verbs are described in the sections that follow in such a way that they can be easily added or removed from this manual as RECOG is updated.

PATTERN INPUT

Pattern sets are read by one of three modes: (1) through the normal input stream, or through an alternate (2) formatted or (3) binary file. The last two methods allow manipulation and analysis of input which has been created by other computer programs or which is too large to be easily handled in card form. The only verb included in this section is

INPUT

VERB ..... INPUT

DESCRIPTION .....The parameters and patterns (i.e., the matrix $\underset{\sim}{X}$) for a given pattern set are defined.

INPUT .....

PATTERN DEFINITION CARD ..... (A10, 4I5)

Col	Type	Default	Desc.
1-10	A	-	Name of pattern set (must be new and unique)
11-15	I	-	Number of variables per pattern (NV)
16-20	I	-	Number of patterns (NP)
21-25	I	-	Number of classes (NC) (should be at least one)
26-30	I	-	Number of patterns in the training set (NT). If negative, the first NT patterns will constitute the training set; otherwise, the (NP-NT) unknown ordinal pattern numbers will be read in the format (20I3). (on alternate input file if Option 2 is selected -- see below).

INPUT FORMAT CARD ..... (8A10)

Col.	Type	Default	Desc.
1-80	A	-	Format for pattern input in the form (F_1, F_2, ..., B, C, D) where the F_k's are the formats for the pattern values $\underset{\sim}{X}_j$ (must be floating point numbers), B is a floating point format for the predicted property, C is an alphanumeric format for the class name (usually A1-A4), and D is the format (alphanumeric) for the name of the pattern.

If the first three characters on this card are BIN, the patterns will be read off the binary file assigned to Unit 2 (i.e., TAPE2). The unformated read is

READ (2) (X(I,J), I=1, NV), P, CL, NAME

where X is the pattern matrix, P the predicted property, CL the class name, and NAME the pattern name. If the first three characters of the Input Format Card are BCD, then the patterns will be read off the BCD file assigned to Unit 1 (called ALTIN). In this case, the user must read in two

additional formats F1 = (F_1, F_2 ... F_N) and F2 = (B, C, D) as described above. The formatted read from ALTIN is

```
READ (1, F1) (X(I, J), I = 1, NV)
READ (1, F2) P, CL, NAME
```

After the patterns are read in, the (NP-NT) unknown pattern numbers are read in from ALTIN in the format (20I3).

PATTERN ANALYSIS

The subroutines of RECOG described in this section are used to evaluate the usefulness of the measurements. Such analyses should be the first step of a pattern recognition application. Correlations between variables often reveal interesting information on the types of tests performed. Early indications on the applicability of pattern recognition methods may also be inferred at this stage of the analysis. The verbs included in this section are:

CORR

CORRPP

VERB ..... CORR

DESCRIPTION .....The correlation matrix $\underset{\sim}{C}$ is calculated for correlations among all the variables, where

$$C_{ik} = \frac{1}{\sigma_i \sigma_k} \sum_{j=1}^{NP} (X_{ij} - \bar{X}_i)(X_{kj} - \bar{X}_k)$$

$$\sigma_i^2 = \sum_{j=1}^{NP} (X_{ij} - \bar{X}_i)^2$$

$$\bar{X}_i = \frac{1}{NP} \sum_{j=1}^{NP} X_{ij}$$

Non-diagonal elements of $\underset{\sim}{C}$ are ordered on $|C_{ik}|$ and printed, provided their value is ≥ 0.50.

INPUT ..... (A10)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set

VERB ..... CORRPP

DESCRIPTION ..... The correlation coefficients for all variables with the predicted property P are calculated and ordered on absolute value, where

$$C_i = \frac{1}{\sigma_i \sigma_P} \sum_{j=1}^{NP} (X_{ij} - \bar{X}_i)(P_j - \bar{P})$$

$$\sigma_i^2 = \sum_{j=1}^{NP} (X_{ij} - \bar{X}_i)^2$$

$$\sigma_P^2 = \sum_{j=1}^{NP} (P_j - \bar{P})^2$$

$$\bar{X}_i = \frac{1}{NP} \sum_{j=1}^{NP} X_{ij}$$

$$\bar{P} = \frac{1}{NP} \sum_{j=1}^{NP} P_j$$

INPUT ..... (A10)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set

DATA PREPROCESSING

The subroutines described in this section are used to change the representation of the patterns in pattern space. Such changes in representation often make the clustering of like patterns more obvious and classification easier. The verbs described in this section are

AUTO

KHPRE

SELECT

SLT

VERB ..... AUTO

DESCRIPTION ..... Autoscaling is applied to the variables in order to equally weight each variable. The new variables are defined by

$$Y_{ij} = (X_{ij} - \bar{X}_i) / \sigma_i$$

where

$$\sigma_i^2 = \sum_{j=1}^{NP} (X_{ij} - \bar{X}_i)^2$$

$$\bar{X}_i = \frac{1}{NP} \sum_{j=1}^{NP} X_{ij}$$

The new variables Y_{ij} can also be weighted with class information by setting

$$Y'_{ij} = W_i^{(code)} Y_{ij}$$

There are five weighting codes available. Code 0 sets $W_i^{(0)}=1$ for all i, i.e. $Y'_{ij} = Y_{ij}$. Code 1 defines $W_i^{(1)}$ as the absolute value of the correlation coefficient between the predicted property and variable i (see discussion of CORRPP). Code 2 weights according to the degree of interclass separation

$$W_i^{(2)} = \sum_{j \epsilon C_I,\ I=1,\ ..\ (NC-1)} \ \sum_{k \epsilon C_J,\ J=I+1,\ ...\ NC} (X_{ij} - X_{ik})^2$$

Here the notation means that the first sum is over all patterns in Class I, and the second sum is over all patterns in Class J, where $J > I$. Code 3 defines

$$W_i^{(3)} = \left[\sum_{\substack{j>k \\ j,\, k \in C_I,\ I = 1, \ldots NC}} (X_{ij} - X_{ik})^2 \right]^{-1}$$

i.e., the degree of intraclass clustering. Code 4 does both 2 and 3 simultaneously:

$$W_i^{(4)} = W_i^{(2)} / W_i^{(3)}$$

INPUT..... (2A10, 5X, I5)

Cols.	Type	Default	Desc.
1-10	A	-	Name of input pattern set $\underset{\sim}{X}$
11-20	A	-	Name of output pattern set $\underset{\sim}{Y}$; if this field is blank, the new set will simply replace the old set.
26-30	I	0	Weighting code as described above

VERB ..... KHPRE

DESCRIPTION .... New variables are defined which diagonalize the scatter matrix $\underset{\sim}{S}$, where

$$S_{ik} = \sum_{j=1}^{NP} X_{ij} X_{kj}$$

and

$$\underset{\sim}{Y}_j = \underset{\sim}{X}_j^{+} \underset{\sim}{c}$$

$$\underset{\approx}{Sc} = \underset{\sim}{\lambda} \underset{\sim}{c}$$

This technique is often called the Karhunen-Loève transformation. It can be used to reduce the number of variables by selecting only the first few columns of the transformation matrix of eigenvectors $\underset{\sim}{c}$. These new variables have decreasing variance.

INPUT.....(2A10, I5)

Cols.	Type	Default	Desc.
1-10	A	-	Name of input pattern set
11-20	A	-	Name of output set; if blank, input is replaced.
21-25	I	NV	Number of variables to be retained in the output pattern set. The output pattern set must have a new name if the number of variables is to be changed.

VERB ..... SELECT

DESCRIPTION.....New variables are defined which are ordered on an attribute and may be uncorrelated with one another. At present, only one attribute is available, the absolute value of the correlation coefficient between each variable and the predicted property (see discussion of CORRPP). Note that a training set must exist. The program assumes that the pattern set has been autoscaled.

Three selection codes are available. Code 1 simply selects variables as ordered on $|C_i|$. For Code 0, the selected variable is "uncorrelated" to the remaining variables by taking linear combinations of the selected variable (i) and each of the remaining variables (k) in question. The particular combination (k′) is determined by requiring the scatter between i and k′ to be zero:

$$\underset{\sim}{k}' = c_i \underset{\sim}{i} + c_k \underset{\sim}{k}$$

$$S_{ik'} = \sum_{j=1}^{NP} X_{ij} X_{k'j} = 0$$

The coefficients c_i and c_k are determined by the condition above and the requirement that $S_{kk'} = 1$. Since the pattern set has been autoscaled, $S_{ii} = S_{kk} = 1$, and the coefficients are uniquely defined. Existing variables are dropped if the scatter $S_{ik} > 0.99$ before uncorrelating. Finally, selection Code 2 uses the Code 1 order of variables for selecting new variables from the original ones.

INPUT ..... (2A10, 2I5)

Cols.	Type	Default	Desc.
1-10	A	-	Name of input pattern set
11-20	A	-	Name of output pattern set; if blank the new set replaces the old set
21-25	I	NV	Number of variables to be retained
26-30	I	0	Selection Code (see above)

VERB ..... SLT

DESCRIPTION ..... New variables are defined which separate one class from each other class. The new variables are generated by the transformation which defines an interclass separation plane. For each pair of classes C_I, C_J, $I > J$, a column vector $\underset{\sim}{Q}^{IJ}$ is defined for the patterns contained in the two classes, where

$$Q_j^{IJ} = +1 \text{ if } \underset{\sim}{X}_j \text{ is in } C_I$$

$$-1 \text{ if } \underset{\sim}{X}_j \text{ is in } C_J$$

The linear transformation $\underset{\sim}{A}^{IJ}$ is found by the least squares solution to

$$\underset{\sim}{X}' \ \underset{\sim}{A}^{IJ} = \underset{\sim}{Q}^{IJ}$$

Here $\underset{\sim}{X}'$ denotes only the pattern space spanned by the members of the classes C_I and C_J. The (NC * (NC-1))/2 transformations $\underset{\sim}{A}^{IJ}$ are then applied to the full pattern set to create the same number of new variables ((NC * (NC-1))/2).

INPUT ..... (2A10)

Cols.	Type	Default	Desc.
1-10	A	-	Name of input pattern set
11-20	A	-	Name of output set; cannot be blank

DISPLAY METHODS

The subroutines described in this section are used to display the NV-dimensional space in two dimensions. Many of these subroutines, if not all of them, require the use of special LLL hardware and software. The verbs included in this section are

2DPLOT
HISTO
NLM

VERB 2DPLOT

DESCRIPTION ..... A two-dimensional representation of the pattern set is defined by the linear transformation (Karhunen-Loève) which diagonalizes the scatter matrix. The two eigenvectors corresponding to the two largest eigenvalues are retained. The "x" and "y" of the plot are thus

$$x_j = \underset{\sim}{c}_1^+ \underset{\sim}{X}_j$$

$$y_j = \underset{\sim}{c}_2^+ \underset{\sim}{X}_j$$

where

$$\underset{\sim}{S}\,\underset{\sim}{c} = \underset{\sim}{\lambda}\,\underset{\sim}{c}$$

and

$$\lambda_1 \geq \lambda_2 \geq \ldots \geq \lambda_{NV}$$

$$S_{ik} = \sum_{j=1}^{NP} X_{ij}\, X_{kj}$$

INPUT ..... (A10)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set

VERB ..... HISTO

DESCRIPTION.....For specified variables or the predicted property, histograms are generated which indicate their distribution within the pattern set. The range of the variable is divided into sub-ranges, and the number of occurrences of each sub-range is plotted.

INPUT.....

PATTERN SET IDENTIFICATION.....(A10)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set

HISTOGRAM SPECIFICATION.....(2I5, A10)

Cols.	Type	Default	Desc.
1-5	I	-	Variable number; - 1 gives predicted property
6-10	I	6	Number of Sub-ranges
11-20	A	Blank	Name of variable for plot label

A blank card is used to terminate HISTO.

VERB..... NLM

DESCRIPTION ..... Non-linear optimization techniques are used to display the NV-dimensional data in two dimensions. The optimization minimizes the function

$$f = \sum_{j>k}^{NP} (d^*_{jk} - d_{jk})^2 (d_{jk})^K$$

where

$$d_{jk} = \left[\sum_{i=1}^{NV} (X_{ij} - X_{ik})^2 \right]^{1/2}$$

and

$$d^*_{jk} = \left[(x_j - x_k)^2 + (y_j - y_k)^2 \right]^{1/2}$$

The current version uses a contra-gradient technique for the minimization.

INPUT ..... (A10, 3I5, F10.0)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set
11-15	I	0	Value of K
16-20	I	250	Number of cycles (N) in iteration (-N gives initial random guess for (x_j, y_j), otherwise the Karhunen-Loève transformation is used
21-25	I	0	Non-zero gives a plot after every cycle; otherwise only a final plot is given
26-36	F	10^{-5}	Δf minimization criterion

SUPERVISED LEARNING

The routines described in this section are used to classify unknown samples by applying rules which were developed using a set of known samples. Verbs included in this section are

KNEAR
LEAST
MULTCL

VERB ..... KNEAR

DESCRIPTION ..... For a given pattern $\underset{\sim}{X}_j$ in the training set the K smallest distances

$$d_{jk} = \sum_{i=1}^{NV} (X_{ij} - X_{ik})^2$$

are calculated and retained, where K=1, 2, ... 7. The pattern is then classified by a majority vote of its nearest neighbors. The "leave-one-out" technique can be used to determine the reliability of the classifiers.

INPUT ..... (A10, I5)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set
11-15	I	0	Zero gives "leave-one-out" statistics

VERB ..... LEAST

DESCRIPTION ..... This routine determines a linear weight vector by a least squares solution to the equation

$$\underset{\sim}{X}^{+} \; \underset{\sim}{W} = \underset{\sim}{P}$$

where $\underset{\sim}{P}$ is the vector of the predicted property. The above is solved by premultiplication by $\underset{\sim}{X}$,

$$(\underset{\sim}{X} \; \underset{\sim}{X}^{+}) \; \underset{\sim}{W} = \underset{\sim}{X} \; \underset{\sim}{P}$$

which can be solved using standard linear equation techniques. The weight vector $\underset{\sim}{W}$ can then be used to predict P_j for unknown patterns.

INPUT ..... (A10, I5, F10.0)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set
11-15	I	0	Zero prints only classifications of unknown patterns, whereas nonzero gives full output
16-25	F	0.	Tolerance (±) for "hit" or "miss" of predicted property

VERB ..... MULTCL

DESCRIPTION ..... For each class, weight vectors are constructed which separate that class from each other class. In this way, (NC*(NC-1)/2) weight vectors are defined. The weight vectors are then applied to the entire pattern space, and the patterns are classified based upon a majority vote. If the classes are linearly separable, a pattern will receive (NC-1) votes for the proper class and a few votes for all the other classes. For non-separable data sets, three answers are possible: (1) a classification in which the number of votes is (NC-1) (the best case); (2) a classification based upon a simple majority; or (3) no classification (tie). Currently, there are two modes of weight vector selection; Mode 1 uses the least square (i.e., SLT) technique, and Mode 2 uses least square followed by a feedback correction technique.

INPUT ..... (A10, 2I5)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set
11-15	I	0	Nonzero gives plot of classifications (2DPLOT)
16-20	I	1	Mode of weight vector selection (see above)

UNSUPERVISED LEARNING

The routines outlined in this section seek to find meaningful clusters of patterns. The only verb included in this section is

HIER

VERB ..... HIER

DESCRIPTION ..... Clusters of patterns are determined based upon one of the three similarity coefficients

1. $S_{jk} = 1 - (d_{jk}/\max(d_{jk}))$

   where

$$d_{jk} = \left[\sum_{i=1}^{NV} (X_{ij} - X_{ik})^2 \right]^{1/2}$$

2. $S_{jk} = (1 + C_{jk})/2$

   where

$$C_{jk} = \frac{1}{\sigma_j \sigma_k} \sum_{i=1}^{NV} (X_{ij} - \bar{X}_j)(X_{ik} - \bar{X}_k)$$

$$\sigma_j^2 = \sum_{i=1}^{NV} (X_{ij} - \bar{X}_j)^2$$

$$\bar{X}_j = \frac{1}{NV} \sum_{i=1}^{NV} X_{ij}$$

3. $S_{jk} = (1 + \underset{\sim}{X}_j^+ \underset{\sim}{X}_k / |\underset{\sim}{X}_j| \, |\underset{\sim}{X}_k|)/2$

Patterns or clusters are connected by maximizing the similarity coefficient S_{jk} with (1) one particular member of a cluster or (2) the average similarity coefficient over the cluster.

INPUT ..... (A10, 4I5, F10.0)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set
11-15	I	1	Similarity code (see above)
16-20	I	0	Connection code (see above); zero gives 1 and 2
21-25	I	0	Minimum number of clusters
26-30	I	0	Non-zero gives plot and analysis after each connection
31-40	F	0.01	Plots and analysis will be given after this specified change in similarity

UTILITY PROGRAMS

The routines outlined in this section are used to control printing, plotting, data set manipulation, etc. Some of them require the use of special LLL hardware and software. The verbs included in this section are

END
GIVE
KEEP80
NEW
PRINT

VERB ..... END

DESCRIPTION ..... This card terminates a RECOG run (no other input cards will be processed).

VERB ..... GIVE

DESCRIPTION ..... This verb sends the printer output files to the RECOG primary output device (currently microfiche).

VERB KEEP80

DESCRIPTION ..... This verb is used to retain a plot file (on disk) under the name HOLDX. Use of this verb allows TMDS viewing or printing of the saved files.

VERB ..... NEW

DESCRIPTION ..... This causes a complete purge of all existing pattern sets and a reinitialization of mass storage allocation. It should be the first verb used in the input stream and may be used to "clean the slate" and begin working on a completely separate data set.

VERB ..... PRINT

DESCRIPTION ..... This verb will cause the writing of an entire pattern set onto the RECOG output file.

INPUT ..... (A10)

Cols.	Type	Default	Desc.
1-10	A	-	Name of pattern set

SUMMARY

RECOG has been written in FORTRAN IV using methods of programming that are relatively machine-independent, yet primarily designed to run on CDC 6000/7000 series computers. The primary input file is called PATIN, and the secondary input files are called TAPE2 (binary) and ALTIN (BCD). The primary output file is called FXRADPBXYZ. The plotting routines, although designed to use LLL's DD80 (CRT) plotting system, are amenable to the more familiar and universally available CALCOMP software. Finally, the bulk of the required mass storage has been shifted to CDC's LCM (slow core or extended core storage). If comparable bulk storage is not available at other locations, it may be necessary to make changes in the program using disk storage so that large pattern sets may be treated.

A sample data deck and output listing are given in the Appendix.

APPENDIX: SAMPLE I/O FOR RECOG

On the following pages, A sample input deck incorporating essentially all of the RECOG verbs is listed along with the printed and plotted output that results. The example used is from B. R. Kowalski, T. F. Schatzki, and F. H. Stross, "Classification of Archaeological Artifacts by Applying Pattern Recognition to Trace Element Data," Journal of Analytical Chemistry 44, 2176 (1972).

I. INPUT LISTING

```
KEEP80
INPUT
RAW DATA      10   75    4  -45
(10F6.0, F3.0,1X,A2,A10)
 1069.  375.   51.  958.  429.   42.  100.   51.   47.  128.  1  1 101K-1A
 1173.  417.   54.  961.  441.   47.  135.   55.   60.  145.  1  1 201K-1B
 1164.  404.   56.  916.  446.   42.  120.   58.   45.  148.  1  1 301K-2
 1030.  373.   59.  920.  487.   38.  128.   53.   58.  138.  1  1 401K-3A
 1077.  373.   55.  888.  455.   38.   97.   51.   54.  145.  1  1 501K-1C
 1080.  403.   53.  919.  442.   41.  133.   60.   45.  155.  1  1 601K-1D
 1020.  360.   59.  883.  473.   43.  119.   40.   50.  134.  1  1 701K-3B
 1050.  396.   56.  924.  482.   48.  140.   74.   71.  157.  1  1 801K-4R
 1100.  373.   53.  910.  477.   51.  137.   61.   58.  152.  1  1 901K-4B
 1186.  257.   10.  940.  431.   40.  121.   20.   53.   73.  2  2 102BL-1
 1210.  276.   10.  966.  430.   44.  117.   20.   44.   73.  2  2 202BL-2
 1205.  291.   10.  975.  420.   43.  115.   25.   58.   73.  2  2 302BL-3
  920.  215.    6.  650.  435.   37.  122.   15.   65.   75.  2  2 402
 1100.  267.   10.  910.  500.   40.  145.   25.   65.   95.  2  2 502BL-6
 1100.  280.   10.  872.  515.   49.  145.   38.   60.   65.  2  2 602BL-7
  860.  182.    7.  722.  418.   33.  115.   20.   55.   53.  2  2 702BL-8
  952.  131.   37.  320.  430.   34.  118.   25.   65.  165.  3  3 103SH-1
  933.  120.   36.  321.  414.   31.  125.   10.   59.  163.  3  3 203SH-15
  999.  129.   38.  343.  446.   34.  121.   15.   52.  161.  3  3 303SH-51
  975.  136.   38.  333.  418.   36.  111.   10.   53.  147.  3  3 403SH-68
  885.  118.   32.  294.  382.   27.   95.   15.   55.  134.  3  3 503SH-2
  928.  127.   37.  337.  455.   30.  109.   15.   47.  151.  3  3 603SH-3
  890.  122.   33.  315.  380.   34.  106.   15.   60.  155.  3  3 703SH-5
  840.  133.   42.  320.  405.   31.  100.   10.   55.  157.  3  3 803SH-13
 1720.  392.   58.  890.  344.   64.   97.   48.   50.  181.  4  4 124ANA-1
 1525.  270.   54.  860.  345.   65.   83.   47.   60.  203.  4  4 224ANA-2
 1565.  374.   54.  813.  295.   59.   88.   42.   49.  187.  4  4 324ANA-3
 1705.  441.   66.  835.  310.   66.   91.   44.   42.  187.  4  4 424ANA-4
 1650.  294.   60.  945.  367.   62.   91.   39.   58.  192.  4  4 524ANA-5
 1630.  314.   54.  934.  340.   67.   95.   33.   38.  220.  4  4 624ANA-6
 1635.  405.   58.  868.  311.   56.   83.   47.   60.  154.  4  4 724ANA-7
 1635.  385.   55.  845.  290.   62.   85.   47.   58.  196.  4  4 824ANA-8
 1480.  310.   54.  850.  320.   66.   71.   27.   47.  184.  4  4 924ANA-9
 1720.  425.   58.  893.  316.   65.   93.   33.   44.  192.  4  41024ANA-10
 1560.  269.   56.  915.  350.   64.   96.   47.   52.  194.  4  41124ANA-11
 1705.  333.   55. 1010.  345.   74.   94.   45.   61.  217.  4  41224ANA-12
 1700.  360.   55.  945.  355.   60.  100.   47.   58.  183.  4  41324ANA-13
 1675.  342.   56.  920.  360.   61.   91.   49.   59.  215.  4  41424ANA-14
 1695.  358.   57.  920.  347.   67.   93.   42.   71.  192.  4  41524ANA-15
 1645.  327.   65.  940.  322.   69.   88.   44.   60.  208.  4  41624ANA-16
 1620.  385.   55.  835.  295.   59.   87.   22.   60.  203.  4  41724ANA-17
 1615.  337.   50.  850.  320.   66.   92.   48.   66.  212.  4  41824ANA-18
 1675.  325.   62.  930.  350.   65.   89.   50.   63.  224.  4  41924ANA-19
 1685.  353.   59.  875.  318.   60.   91.   41.   60.  203.  4  42024ANA-20
 1600.  316.   54.  915.  347.   83.   82.   52.   66.  209.  4  42124ANA-21
  689.  114.    9.  534.  404.   26.  110.   25.   50.   55.  2 Q2 112BLAV7
  863.  183.    8.  826.  452.   34.  121.   15.   58.   70.  2 Q2 212BLAV15
 1100.  390.   55.  920.  460.   45.  120.   57.   58.  142.  1 Q1 111K AVG
 1108.  289.    7.  783.  426.   41.  109.   15.   57.   67.  2 Q2 312BLAV9
 1050.  195.   45.  865.  400.   36.   97.   10.   50.  160.  1 Q1 21129098
  920.  127.   39.  475.  430.   34.   98.    5.   60.  156.  3 Q3 11329099
  900.  115.   37.  310.  440.   34.  108.   30.   60.  175.  3 Q3 21329101A
  920.  138.   41.  350.  450.   34.  110.   20.   62.  157.  3 Q3 313291018
 1010.  357.   65.  900.  455.   42.  112.   65.   55.  145.  1 Q1 311130960
  780.  140.   12.  605.  415.   35.  130.   15.   50.   70.  2 Q2 412131319
  920.  320.   60.  830.  440.   33.  110.   43.   60.  143.  1 Q1 41113138
```

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  680.   ....   10.   460.   400.    31.   127.    15.    57.    87.   2 Q2 5121
  775.   110.   35.   327.   337.    34.    93.    15.    65.   132.   3 Q3 41369534
 1000.   194.   58.   965.   460.    42.   125.    30.    60.   145.   1 Q1 51169535
  935.   131.   38.   360.   420.    37.   105.    10.    85.   150.   3 Q3 51369536
  850.   119.   37.   272.   384.    32.   117.    15.    50.   160.   3 Q3 6135HII70
 1000.   135.   35.   335.   385.    32.   100.    15.    50.   135.   3 Q3 7135HV18
  930.   131.   32.   342.   385.    28.   100.    10.    55.   140.   3 Q3 8135HIL10
  880.   156.   36.   279.   388.    37.   103.    15.    53.   143.   3 Q3 9135HIL13
  960.   137.   35.   315.   390.    34.   110.    10.    60.   167.   3 Q310135HII18
  870.   133.   40.   310.   390.    36.   115.    15.    65.   160.   3 Q311135HV12
  819.   131.   38.   435.   392.    35.   108.    15.    54.   150.   3 Q312135HV24
  932.   147.   37.   318.   393.    32.   122.    28.    56.   174.   3 Q313135HII54
  970.   140.   40.   338.   394.    36.   118.    15.    61.   160.   3 Q314135HIIK5
 1000.   146.   41.   360.   394.    33.   125.    15.    48.   170.   3 Q315135HIL15
  970.   133.   40.   310.   390.    36.   115.    15.    65.   160.   3 Q316135HV12
  930.   140.   36.   335.   395.    33.   100.    10.    65.   170.   3 Q317135HI10
  960.   138.   35.   323.   395.    52.   103.    10.    55.   145.   3 Q318135HI13
  950.   142.   38.   405.   400.    37.   122.    15.    60.   155.   3 Q319135HV14
  918.   133.   35.   317.   408.    35.   120.    15.    58.   190.   3 Q320135HII77
PRINT
RAW DATA
CORR
RAW DATA
CORRPP
RAW DATA
AUTO
RAW DATA  AUTO                1
AUTO
RAW DATA  AUTO                2
AUTO
RAW DATA  AUTO                3
AUTO
RAW DATA  AUTO                4
AUTO
AUTO
KHPRE
AUTO
AUTO
RAW DATA  AUTO
SELECT
AUTO
AUTO
RAW DATA  AUTO
SLT
AUTO      SLT DATA
AUTO
SLT DATA
2DPLOT
SLT DATA
HISTO
RAW DATA
    1    10 VAR 1
    2    10 VAR 2
    5    10 VAR 5

NLM
SLT DATA
AUTO
SLT DATA
HIER
```

```
SLT D
KNEAR
SLT DATA
LEAST
SLT DATA
MULTCL
SLT DATA
STOP
```

II. PRINTED OUTPUT

```
KEEP80      COMPLETE IN        0.14 SECONDS
INPUT       COMPLETE IN        0.43 SECONDS
PRINTING PATTERN SET RAW DATA
PATTERN    1       101K-1A          1      1.0000000E+00
 1.069E+03  3.750E+02  5.100E+01  9.580E+02  4.290E+02  4.200E+01  1.000E+02  5.100E+01  4.700E+01  1.280E+02
PATTERN    2       201K-1B          1      1.0000000E+00
 1.173E+03  4.170E+02  5.400E+01  9.610E+02  4.410E+02  4.700E+01  1.350E+02  5.500E+01  6.000E+01  1.450E+02
PATTERN    3       301K-2           1      1.0000000E+00
 1.164E+03  4.040E+02  5.600E+01  9.160E+02  4.460E+02  4.200E+01  1.200E+02  5.800E+01  4.500E+01  1.480E+02
PATTERN    4       401K-3A          1      1.0000000E+00
 1.030E+03  3.730E+02  5.900E+01  9.200E+02  4.870E+02  3.800E+01  1.280E+02  5.300E+01  5.800E+01  1.380E+02
PATTERN    5       501K-1C          1      1.0000000E+00
 1.077E+03  3.730E+02  5.500E+01  8.880E+02  4.550E+02  3.800E+01  9.700E+01  5.100E+01  5.400E+01  1.450E+02
PATTERN    6       601K-1D          1      1.0000000E+00
 1.050E+03  4.030E+02  5.300E+01  9.190E+02  4.420E+02  4.100E+01  1.330E+02  6.000E+01  4.500E+01  1.550E+02
PATTERN    7       701K-3B          1      1.0000000E+00
 1.020E+03  3.600E+02  5.900E+01  8.830E+02  4.730E+02  4.300E+01  1.190E+02  4.000E+01  5.000E+01  1.340E+02
PATTERN    8       801K-4R          1      1.0000000E+00
 1.050E+03  3.960E+02  5.600E+01  9.240E+02  4.820E+02  4.800E+01  1.400E+02  7.400E+01  7.100E+01  1.570E+02
PATTERN    9       901K-4B          1      1.0000000E+00
 1.100E+03  3.730E+02  5.300E+01  9.100E+02  4.770E+02  5.100E+01  1.370E+02  6.100E+01  5.800E+01  1.520E+02
PATTERN   10       102BL-1          2      2.0000000E+00
 1.166E+03  2.570E+02  1.000E+01  9.400E+02  4.310E+02  4.000E+01  1.210E+02  2.000E+01  5.300E+01  7.300E+01
PATTERN   11       202BL-2          2      2.0000000E+00
 1.210E+03  2.760E+02  1.000E+01  9.660E+02  4.300E+02  4.400E+01  1.170E+02  2.000E+01  4.400E+01  7.300E+01
PATTERN   12       302BL-3          2      2.0000000E+00
 1.205E+03  2.910E+02  1.000E+01  9.750E+02  4.200E+02  4.300E+01  1.150E+02  2.500E+01  5.800E+01  7.300E+01
PATTERN   13       402              2      2.0000000E+00
 5.200E+02  2.150E+02  6.000E+00  6.500E+02  4.350E+02  3.700E+01  1.220E+02  1.500E+01  6.500E+01  7.500E+01
PATTERN   14       502BL-6          2      2.0000000E+00
 1.100E+03  2.670E+02  1.000E+01  9.100E+02  5.000E+02  4.000E+01  1.450E+02  2.500E+01  6.500E+01  9.500E+01
PATTERN   15       602BL-7          2      2.0000000E+00
 1.100E+03  2.800E+02  1.000E+01  8.720E+02  5.150E+02  4.900E+01  1.450E+02  3.800E+01  6.000E+01  6.500E+01
PATTERN   16       702BL-8          2      2.0000000E+00
 8.600E+02  1.820E+02  7.000E+00  7.220E+02  4.180E+02  3.300E+01  1.150E+02  2.000E+01  5.500E+01  5.300E+01
PATTERN   17       103SH-1          3      3.0000000E+00
 5.520E+02  1.310E+02  3.700E+01  3.200E+02  4.300E+02  3.400E+01  1.180E+02  2.500E+01  6.500E+01  1.650E+02
PATTERN   18       203SH-15         3      3.0000000E+00
 9.330E+02  1.200E+02  3.600E+01  3.210E+02  4.140E+02  3.100E+01  1.250E+02  1.000E+01  5.900E+01  1.630E+02
PATTERN   19       303SH-51         3      3.0000000E+00
 9.990E+02  1.290E+02  3.800E+01  3.430E+02  4.460E+02  3.400E+01  1.210E+02  1.500E+01  5.200E+01  1.610E+02
PATTERN   20       403SH-68         3      3.0000000E+00
 9.750E-02  1.360E+02  3.800E+01  3.330E+02  4.180E+02  3.600E+01  1.110E+02  1.000E+01  5.300E+01  1.470E+02
PATTERN   21       503SH-2          3      3.0000000E+00
 8.850E+02  1.180E+02  3.200E+01  2.940E+02  3.820E+02  2.700E+01  9.500E+01  1.500E+01  5.500E+01  1.340E+02
PATTERN   22       603SH-3          3      3.0000000E+00
 9.280E+02  1.270E+02  3.700E+01  3.370E+02  4.550E+02  3.000E+01  1.090E+02  1.500E+01  4.700E+01  1.510E+02
PATTERN   23       703SH-5          3      3.0000000E+00
 8.500E+02  1.220E+02  3.300E+01  3.150E+02  3.800E+02  3.400E+01  1.060E+02  1.500E+01  6.000E+01  1.550E+02
PATTERN   24       803SH-13         3      3.0000000E+00
 8.400E+02  1.330E+02  4.200E+01  3.200E+02  4.050E+02  3.100E+01  1.000E+02  1.000E+01  5.500E+01  1.970E+02
PATTERN   25       124ANA-1         4      4.0000000E+00
 1.720E+03  3.920E+02  5.800E+01  8.900E+02  3.440E+02  6.400E+01  9.700E+01  4.800E+01  5.000E+01  1.810E+02
PATTERN   26       224ANA-2         4      4.0000000E+00
 1.525E+03  2.700E+02  5.400E+01  8.600E+02  3.450E+02  6.500E+01  8.300E+01  4.700E+01  6.000E+01  2.030E+02
PATTERN   27       324ANA-3         4      4.0000000E+00
 1.565E+03  3.740E+02  5.400E+01  8.130E+02  2.950E+02  5.900E+01  8.800E+01  4.200E+01  4.900E+01  1.870E+02
PATTERN   28       424ANA-4         4      4.0000000E+00
 1.705E+03  4.410E+02  6.600E+01  8.350E+02  3.100E+02  6.600E+01  9.100E+01  4.400E+01  4.200E+01  1.870E+02
PATTERN   29       524ANA-5         4      4.0000000E+00
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 1.650E+0    1.940E+02  6.000E+01  9.450E+02  3.670E+02  6.200E+01  9.100E+01  3.900E+01  5.800E+01  1.920E+02
PATTERN   30       624ANA-6        4      4.0000000E+00
 1.630E+03  3.140E+02  5.400E+01  9.340E+02  3.400E+02  6.700E+01  9.500E+01  3.300E+01  3.800E+01  2.200E+02
PATTERN   31       724ANA-7        4      4.0000000E+00
 1.635E+03  4.050E+02  5.600E+01  8.680E+02  3.110E+02  5.600E+01  8.300E+01  4.700E+01  6.000E+01  1.540E+02
PATTERN   32       824ANA-8        4      4.0000000E+00
 1.635E+03  3.650E+02  5.500E+01  8.450E+02  2.900E+02  6.200E+01  8.500E+01  4.700E+01  5.800E+01  1.960E+02
PATTERN   33       924ANA-9        4      4.0000000E+00
 1.480E+03  3.100E+02  5.400E+01  8.500E+02  3.200E+02  6.600E+01  7.100E+01  2.700E+01  4.700E+01  1.840E+02
PATTERN   34      1024ANA-10       4      4.0000000E+00
 1.720E+03  4.250E+02  5.600E+01  8.930E+02  3.160E+02  6.500E+01  9.300E+01  3.300E+01  4.400E+01  1.920E+02
PATTERN   35      1124ANA-11       4      4.0000000E+00
 1.560E+03  2.650E+02  5.600E+01  9.150E+02  3.500E+02  6.400E+01  9.600E+01  4.700E+01  5.200E+01  1.940E+02
PATTERN   36      1224ANA-12       4      4.0000000E+00
 1.705E+03  3.330E+02  5.500E+01  1.010E+03  3.450E+02  7.400E+01  9.400E+01  4.500E+01  6.100E+01  2.170E+02
PATTERN   37      1324ANA-13       4      4.0000000E+00
 1.700E+03  3.600E+02  5.500E+01  9.450E+02  3.550E+02  6.000E+01  1.000E+02  4.700E+01  5.800E+01  1.830E+02
PATTERN   38      1424ANA-14       4      4.0000000E+00
 1.675E+03  3.420E+02  5.600E+01  9.200E+02  3.600E+02  6.100E+01  9.100E+01  4.900E+01  5.900E+01  2.150E+02
PATTERN   39      1524ANA-15       4      4.0000000E+00
 1.655E+03  3.580E+02  5.700E+01  9.200E+02  3.470E+02  6.700E+01  9.300E+01  4.200E+01  7.100E+01  1.920E+02
PATTERN   40      1624ANA-16       4      4.0000000E+00
 1.645E+03  3.270E+02  6.500E+01  9.400E+02  3.220E+02  6.900E+01  8.800E+01  4.400E+01  6.000E+01  2.080E+02
PATTERN   41      1724ANA-17       4      4.0000000E+00
 1.620E+03  3.650E+02  5.500E+01  8.350E+02  2.950E+02  5.900E+01  8.700E+01  2.200E+01  6.000E+01  2.030E+02
PATTERN   42      1824ANA-18       4      4.0000000E+00
 1.615E+03  3.370E+02  5.000E+01  8.500E+02  3.200E+02  6.600E+01  9.200E+01  4.800E+01  6.600E+01  2.120E+02
PATTERN   43      1924ANA-19       4      4.0000000E+00
 1.675E+03  3.250E+02  6.200E+01  9.300E+02  3.500E+02  6.600E+01  8.900E+01  5.000E+01  6.300E+01  2.240E+02
PATTERN   44      2024ANA-20       4      4.0000000E+00
 1.665E+03  3.530E+02  5.900E+01  8.750E+02  3.180E+02  6.000E+01  9.100E+01  4.100E+01  6.000E+01  2.030E+02
PATTERN   45      2124ANA-21       4      4.0000000E+00
 1.600E+03  3.160E+02  5.400E+01  9.150E+02  3.470E+02  8.300E+01  8.200E+01  5.200E+01  6.600E+01  2.090E+02
PATTERN   46       1128LAV7       Q2      2.0000000E+00
 6.850E+02  1.140E+02  9.000E+00  5.340E+02  4.040E+02  2.600E+01  1.100E+02  2.500E+01  5.000E+01  5.500E+01
PATTERN   47       2128LAV15      Q2      2.0000000E+00
 8.630E+02  1.630E+02  8.000E+00  6.260E+02  4.520E+02  3.400E+01  1.210E+02  1.500E+01  5.800E+01  7.000E+01
PATTERN   48       111K AVG       Q1      1.0000000E+00
 1.100E+03  3.900E+02  5.500E+01  9.200E+02  4.600E+02  4.500E+01  1.200E+02  5.700E+01  5.800E+01  1.420E+02
PATTERN   49       3128LAV9       Q2      2.0000000E+00
 1.105E+03  2.650E+02  7.000E+00  7.830E+02  4.260E+02  4.100E+01  1.090E+02  1.500E+01  5.700E+01  6.700E+01
PATTERN   50       21129098       Q1      1.0000000E+00
 1.850E+03  1.950E+02  4.600E+01  8.650E+02  4.000E+02  3.600E+01  9.700E+01  1.000E+01  5.000E+01  1.600E+02
PATTERN   51       11325099       Q3      3.0000000E+00
 5.200E+02  1.270E+02  3.900E+01  4.750E+02  4.300E+02  3.400E+01  9.800E+01  5.000E+00  6.000E+01  1.560E+02
PATTERN   52       21325101A      Q3      3.0000000E+00
 9.000E+02  1.150E+02  3.700E+01  3.100E+02  4.400E+02  3.400E+01  1.080E+02  3.000E+01  6.000E+01  1.750E+02
PATTERN   53       31325101B      Q3      3.0000000E+00
 5.200E+02  1.380E+02  4.100E+01  3.500E+02  4.500E+02  3.400E+01  1.100E+02  2.000E+01  6.200E+01  1.570E+02
PATTERN   54       311130960      Q1      1.0000000E+00
 1.010E+03  3.570E+02  6.500E+01  9.000E+02  4.550E+02  4.200E+01  1.120E+02  6.500E+01  5.500E+01  1.450E+02
PATTERN   55       412131319      Q2      2.0000000E+00
 7.600E+02  1.400E+02  1.200E+01  6.050E+02  4.150E+02  3.500E+01  1.300E+02  1.500E+01  5.000E+01  7.000E+01
PATTERN   56       41113138       Q1      1.0000000E+00
 5.200E+02  3.200E+02  6.000E+01  8.300E+02  4.400E+02  3.300E+01  1.100E+02  4.300E+01  6.000E+01  1.430E+02
PATTERN   57       5121           Q2      2.0000000E+00
 6.600E+02  1.050E+02  1.000E+01  4.600E+02  4.000E+02  3.100E+01  1.270E+02  1.500E+01  5.700E+01  8.700E+01
PATTERN   58       41369534       Q3      3.0000000E+00
 7.750E+02  1.100E+02  3.500E+01  3.270E+02  3.370E+02  3.400E+01  9.300E+01  1.500E+01  6.500E+01  1.320E+02
PATTERN   59       51165535       Q1      1.0000000E+00
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 1.000E+0_  1.940E+02  5.800E+01  5.650E+02  4.600E+02  4.200E+01  1.250E+02  3.000E+01  6.000E+01  1.450E+02
PATTERN    60       51369536       Q3      3.0000000E+00
 5.350E+02  1.310E+02  3.800E+01  3.600E+02  4.200E+02  3.700E+01  1.050E+02  1.000E+01  8.500E+01  1.500E+02
PATTERN    61       6135HII70      Q3      3.0000000E+00
 8.900E+02  1.190E+02  3.700E+01  2.720E+02  3.840E+02  3.200E+01  1.170E+02  1.500E+01  5.000E+01  1.600E+02
PATTERN    62       7135HV18       Q3      3.0000000E+00
 1.000E+03  1.350E+02  3.600E+01  3.350E+02  3.850E+02  3.200E+01  1.000E+02  1.500E+01  5.000E+01  1.350E+02
PATTERN    63       8135HIL10      Q3      3.0000000E+00
 5.300E+02  1.310E+02  3.200E+01  3.420E+02  3.850E+02  2.800E+01  1.000E+02  1.000E+01  5.500E+01  1.400E+02
PATTERN    64       9135HIL13      Q3      3.0000000E+00
 8.800E+02  1.560E+02  3.600E+01  2.790E+02  3.880E+02  3.700E+01  1.030E+02  1.500E+01  5.300E+01  1.430E+02
PATTERN    65       10135HIII8     Q3      3.0000000E+00
 5.600E+02  1.370E+02  3.500E+01  3.150E+02  3.900E+02  3.400E+01  1.100E+02  1.000E+01  6.000E+01  1.670E+02
PATTERN    66       1113SHV12      Q3      3.0000000E+00
 5.700E+02  1.330E+02  4.000E+01  3.100E+02  3.900E+02  3.600E+01  1.150E+02  1.500E+01  6.500E+01  1.600E+02
PATTERN    67       12135HV24      Q3      3.0000000E+00
 8.190E+02  1.310E+02  3.800E+01  4.350E+02  3.920E+02  3.500E+01  1.080E+02  1.500E+01  5.400E+01  1.500E+02
PATTERN    68       1313SHII54     Q3      3.0000000E+00
 5.320E+02  1.470E+02  3.700E+01  3.180E+02  3.930E+02  3.200E+01  1.220E+02  2.800E+01  5.600E+01  1.740E+02
PATTERN    69       14135HIIK5     Q3      3.0000000E+00
 5.700E+02  1.400E+02  4.000E+01  3.380E+02  3.940E+02  3.600E+01  1.180E+02  1.500E+01  6.100E+01  1.600E+02
PATTERN    70       1513SHIL15     Q3      3.0000000E+00
 1.000E+03  1.460E+02  4.100E+01  3.600E+02  3.940E+02  3.300E+01  1.250E+02  1.500E+01  4.800E+01  1.700E+02
PATTERN    71       1613SHV12      Q3      3.0000000E+00
 5.700E+02  1.330E+02  4.000E+01  3.100E+02  3.900E+02  3.600E+01  1.150E+02  1.500E+01  6.500E+01  1.600E+02
PATTERN    72       1713SHII0      Q3      3.0000000E+00
 5.300E+02  1.400E+02  3.600E+01  3.350E+02  3.950E+02  3.300E+01  1.000E+02  1.000E+01  6.500E+01  1.700E+02
PATTERN    73       1813SHII3      Q3      3.0000000E+00
 5.600E+02  1.380E+02  3.500E+01  3.230E+02  3.950E+02  5.200E+01  1.030E+02  1.000E+01  5.500E+01  1.450E+02
PATTERN    74       1913SHV14      Q3      3.0000000E+00
 5.900E+02  1.420E+02  3.800E+01  4.050E+02  4.000E+02  3.700E+01  1.220E+02  1.500E+01  6.000E+01  1.550E+02
PATTERN    75       2013SHII77     Q3      3.0000000E+00
 5.160E+02  1.330E+02  3.500E+01  3.170E+02  4.080E+02  3.500E+01  1.200E+02  1.500E+01  5.800E+01  1.900E+02
CLASS     1 IS CALLED  1
CLASS     2 IS CALLED  2
CLASS     3 IS CALLED  3
CLASS     4 IS CALLED  4
TRAINING PATTERN ID'S FOLLOW
    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15   16   17   18   19   20
   21   22   23   24   25   26   27   28   29   30   31   32   33   34   35   36   37   38   39   40
   41   42   43   44   45
CLASS  1     CONTAINS      9 PATTERNS IN TRANING SET
CLASS  2     CONTAINS      7 PATTERNS IN TRANING SET
CLASS  3     CONTAINS      8 PATTERNS IN TRANING SET
CLASS  4     CONTAINS     21 PATTERNS IN TRANING SET
PRINT       COMPLETE IN        0.56 SECONDS
RAW DATA
    1    1   1.00000
    2    1   0.72562    2    2   1.00000
    3    1   0.58600    3    2   0.57807    3    3   1.00000
    4    1   0.67018    4    2   0.88373    4    3   0.37724    4    4   1.00000
    5    1  -0.66040    5    2  -0.18794    5    3  -0.37479    5    4  -0.07563    5    5   1.00000
    6    1   0.53400    6    2   0.70237    6    3   0.56872    6    4   0.68241    6    5  -0.59705    6    6   1.00000
    7    1  -0.59828    7    2  -0.19557    7    3  -0.44996    7    4  -0.12859    7    5   0.81747    7    6  -0.55126
    7    7   1.00000
    8    1   0.55386    8    2   0.85414    8    3   0.63696    8    4   0.76251    8    5  -0.02757    8    6   0.59779
    8    7  -0.06193    8    8   1.00000
    9    1  -0.06540    9    2  -0.15539    9    3  -0.03766    9    4  -0.13442    9    5   0.08164    9    6   0.00099
    9    7   0.06193    9    8  -0.02318    9    9   1.00000
   10    1   0.60795   10    2   0.25896   10    3   0.81113   10    4   0.07498   10    5  -0.59626   10    6   0.57928
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  10       -0.57423   10    8   0.30721   10    9   0.07471   10   10   1.00000
VARIABLES ORDERED ON CORRELATION
   6    1   0.93400    4    2   0.88373    8    2   0.85414    7    5   0.81747   10    3   0.81113    8    4   0.76251
   2    1   0.72562    6    2   0.70237    6    4   0.68241    4    1   0.67018    5    1  -0.66040    8    3   0.63656
  10    1   0.60795    7    1  -0.59828    8    6   0.59779    6    5  -0.59705   10    5  -0.59626    3    1   0.58600
  10    6   0.57928    3    2   0.57807   10    7  -0.57423    6    3   0.56872    8    1   0.55386    7    6  -0.55126
CORR        COMPLETE IN        0.23 SECONDS
VARIABLE-PREDICTED PROPERTY ANALYSIS FOR RAW DATA
    1   1   0.74141    2    2  -0.03731    3    3   0.34155    4    4  -0.05215    5    5  -0.86823    6    6   0.65367
    7   7  -0.79100    8    8  -0.14633    9    9   0.07277   10   10   0.68548
ORDERED ON ABSOLUTE VALUE OF CC.
    1   5  -0.86823    2    7  -0.79100    3    1   0.74141    4   10   0.68548    5    6   0.65367    6    3   0.34155
    7   8  -0.14633    8    5   0.07277    9    4  -0.05215   10    2  -0.03731
CORRPP      COMPLETE IN        0.05 SECONDS
AUTOSCALED RAW DATA   WILL BE STORED IN AUTO       WEIGHT CODE    1
FOR VARIABLE     1 XB= 1.1594000E+03 X2= 2.7497364E+03 WEIGHT= 1.5047660E+00
FOR VARIABLE     2 XB= 2.4722667E+02 X2= 9.5758297E+02 WEIGHT= 9.0731575E-01
FOR VARIABLE     3 XB= 4.1640000E+01 X2= 1.4743568E+02 WEIGHT= 7,0239484E-01
FOR VARIABLE     4 XB= 6.6652000E+02 X2= 2.3570848E+03 WEIGHT= 8.4746270E-01
FOR VARIABLE     5 XB= 3.9773333E+02 X2= 4.5404258E+02 WEIGHT= 1.0753208E+00
FOR VARIABLE     6 XB= 4.4800000E+01 X2= 1.1902941E+02 WEIGHT= 1.3776523E+00
FOR VARIABLE     7 XB= 1.0809333E+02 X2= 1.3934973E+02 WEIGHT= 1.0040747E+00
FOR VARIABLE     8 XB= 3.0173333E+01 X2= 1.5055480E+02 WEIGHT= 6.6380923E-01
FOR VARIABLE     9 XB= 5.6773333E+01 X2= 6.4491446E+01 WEIGHT= 1.6191884E-01
FOR VARIABLE    10 XB= 1.5294667E+02 X2= 3.7152360E+02 WEIGHT= 9.1871087E-01
AUTO        COMPLETE IN        0.11 SECONDS
AUTOSCALED RAW DATA   WILL BE STORED IN AUTO       WEIGHT CODE    2
FOR VARIABLE     1 XB= 1.1594000E+03 X2= 2.7497364E+03 WEIGHT= 1.7041613E+08
FOR VARIABLE     2 XB= 2.4722667E+02 X2= 9.5758297E+02 WEIGHT= 1.5981639E+07
FOR VARIABLE     3 XB= 4.1640000E+01 X2= 1.4743568E+02 WEIGHT= 1.9602500E+05
FOR VARIABLE     4 XB= 6.6652000E+02 X2= 2.3570848E+03 WEIGHT= 4.8218937E+07
FOR VARIABLE     5 XB= 3.9773333E+02 X2= 4.5404258E+02 WEIGHT= 8.3871320E+06
FOR VARIABLE     6 XB= 4.4800000E+01 X2= 1.1902941E+02 WEIGHT= 3.1427900E+05
FOR VARIABLE     7 XB= 1.0809333E+02 X2= 1.3934973E+02 WEIGHT= 4.9100100E+05
FOR VARIABLE     8 XB= 3.0173333E+01 X2= 1.5055480E+02 WEIGHT= 1.1497910E+06
FOR VARIABLE     9 XB= 5.6773333E+01 X2= 6.4491446E+01 WEIGHT= 4.3196000E+04
FOR VARIABLE    10 XB= 1.5294667E+02 X2= 3.7152360E+02 WEIGHT= 8.9862240E+06
AUTO        COMPLETE IN        0.31 SECONDS
AUTOSCALED RAW DATA   WILL BE STORED IN AUTO       WEIGHT CODE    3
FOR VARIABLE     1 XB= 1.1594000E+03 X2= 2.7497364E+03 WEIGHT= 1.3941268E-08
FOR VARIABLE     2 XB= 2.4722667E+02 X2= 9.5758297E+02 WEIGHT= 2.2335468E-07
FOR VARIABLE     3 XB= 4.1640000E+01 X2= 1.4743568E+02 WEIGHT= 1.6272599E-05
FOR VARIABLE     4 XB= 6.6652000E+02 X2= 2.3570848E+03 WEIGHT= 9.0695108E-08
FOR VARIABLE     5 XB= 3.9773333E+02 X2= 4.5404258E+02 WEIGHT= 2.9346796E-07
FOR VARIABLE     6 XB= 4.4800000E+01 X2= 1.1902941E+02 WEIGHT= 6.9068405E-06
FOR VARIABLE     7 XB= 1.0809333E+02 X2= 1.3934973E+02 WEIGHT= 4.7234201E-06
FOR VARIABLE     8 XB= 3.0173333E+01 X2= 1.5055480E+02 WEIGHT= 2.5815845E-06
FOR VARIABLE     9 XB= 5.6773333E+01 X2= 6.4491446E+01 WEIGHT= 6.3079543E-05
FOR VARIABLE    10 XB= 1.5294667E+02 X2= 3.7152360E+02 WEIGHT= 2.4988511E-07
AUTO        COMPLETE IN        0.31 SECONDS
AUTOSCALED RAW DATA   WILL BE STORED IN AUTO       WEIGHT CODE    4
FOR VARIABLE     1 XB= 1.1594000E+03 X2= 2.7497364E+03 WEIGHT= 2.3758170E+00
FOR VARIABLE     2 XB= 2.4722667E+02 X2= 9.5758297E+02 WEIGHT= 3.5695739E+00
FOR VARIABLE     3 XB= 4.1640000E+01 X2= 1.4743568E+02 WEIGHT= 3.1898361E+00
FOR VARIABLE     4 XB= 6.6652000E+02 X2= 2.3570848E+03 WEIGHT= 4.3732217E+00
FOR VARIABLE     5 XB= 3.9773333E+02 X2= 4.5404258E+02 WEIGHT= 2.4613545E+00
FOR VARIABLE     6 XB= 4.4800000E+01 X2= 1.1902941E+02 WEIGHT= 2.1706749E+00
FOR VARIABLE     7 XB= 1.0809333E+02 X2= 1.3934973E+02 WEIGHT= 2.3192040E+00
FOR VARIABLE     8 XB= 3.0173333E+01 X2= 1.5055480E+02 WEIGHT= 2.9682827E+00
FOR VARIABLE     9 XB= 5.6773333E+01 X2= 6.4491446E+01 WEIGHT= 2.7247840E+00
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FOR VA.....E    10 XB=  1.5294667E+02 X2=  3.7152360E+02 WEIGHT=  2.2383346E+00
AUTO       COMPLETE IN       0.38 SECONDS
AUTOSCALED AUTO       WILL BE STORED IN AUTO       WEIGHT CODE   -0
FOR VARIABLE     1 XB=  1.1723955E-15 X2= 2.3758170E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     2 XB= -1.2789769E-14 X2=  3.5695739E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     3 XB=  2.0013620E-15 X2=  3.1898361E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     4 XB= -6.2527761E-15 X2=  4.3732217E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     5 XB=  4.0856207E-15 X2=  2.4613545E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     6 XB= -2.0724163E-15 X2=  2.1706749E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     7 XB= -1.1131836E-15 X2=  2.3192040E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     8 XB= -8.1238719E-15 X2=  2.9682827E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     9 XB=  2.7059836E-15 X2=  2.7247840E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE    10 XB=  6.8804222E-15 X2=  2.2383346E+00 WEIGHT=  1.0000000E+00
AUTO       COMPLETE IN       0.09 SECONDS
K-L TRANSFORMATION ON AUTO       STORING RESULTS IN AUTO       RETAINING   10 VARIABLES
       100.000 PERCENT SCATTER RETAINED
  5.251959E+00   2.078429E+00   1.081521E+00   8.381904E-01   2.949462E-01   1.744321E-01   1.204480E-01   6.938496E-02
  5.596897E-02   3.472058E-02
KHPRE      COMPLETE IN       0.46 SECONDS
AUTOSCALED RAW DATA   WILL BE STORED IN AUTO       WEIGHT CODE   -0
FOR VARIABLE     1 XB=  1.1594000E+03 X2=  2.7497364E+03 WEIGHT=  1.0000000E+00
FOR VARIABLE     2 XB=  2.4722667E+02 X2=  9.5758297E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     3 XB=  4.1640000E+01 X2=  1.4743568E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     4 XB=  5.6652000E+02 X2=  2.3570848E+03 WEIGHT=  1.0000000E+00
FOR VARIABLE     5 XB=  3.9773333E+02 X2=  4.5404258E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     6 XB=  4.4800000E+01 X2=  1.1902941E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     7 XB=  1.0809333E+02 X2=  1.3934973E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     8 XB=  3.0173333E+01 X2=  1.5055480E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     9 XB=  5.6773333E+01 X2=  6.4491446E+01 WEIGHT=  1.0000000E+00
FOR VARIABLE    10 XB=  1.5294667E+02 X2=  3.7152360E+02 WEIGHT=  1.0000000E+00
AUTO       COMPLETE IN       0.10 SECONDS
SELECTION OF VARIABLES FROM AUTO       STORING IN AUTO       AND RETAINING    10 RETAINING CODE IS   -0
VARIABLE     1 WAS     5      CC=  -0.86823
VARIABLE     2 WAS     2      CC=  -0.26774
VARIABLE     3 WAS     1      CC=   0.43802
VARIABLE     4 WAS     7      CC=  -0.09751
VARIABLE     5 WAS     3      CC=   0.05863
VARIABLE     6 WAS    10      CC=  -0.06993
VARIABLE     7 WAS     9      CC=   0.05126
VARIABLE     8 WAS     6      CC=   0.03995
VARIABLE     9 WAS     4      CC=  -0.02218
VARIABLE    10 WAS     8      CC=   0.01749
SELECT     COMPLETE IN       0.42 SECONDS
AUTOSCALED RAW DATA   WILL BE STORED IN AUTO       WEIGHT CODE   -0
FOR VARIABLE     1 XB=  1.1594000E+03 X2=  2.7497364E+03 WEIGHT=  1.0000000E+00
FOR VARIABLE     2 XB=  2.4722667E+02 X2=  9.5758297E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     3 XB=  4.1640000E+01 X2=  1.4743568E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     4 XB=  5.6652000E+02 X2=  2.3570848E+03 WEIGHT=  1.0000000E+00
FOR VARIABLE     5 XB=  3.9773333E+02 X2=  4.5404258E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     6 XB=  4.4800000E+01 X2=  1.1902941E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     7 XB=  1.0809333E+02 X2=  1.3934973E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     8 XB=  3.0173333E+01 X2=  1.5055480E+02 WEIGHT=  1.0000000E+00
FOR VARIABLE     9 XB=  5.6773333E+01 X2=  6.4491446E+01 WEIGHT=  1.0000000E+00
FOR VARIABLE    10 XB=  1.5294667E+02 X2=  3.7152360E+02 WEIGHT=  1.0000000E+00
AUTO       COMPLETE IN       0.10 SECONDS
    AUTO       SLTED AND STORED IN SLT DATA
SLT        COMPLETE IN       0.31 SECONDS
AUTOSCALED SLT DATA   WILL BE STORED IN SLT DATA   WEIGHT CODE   -0
FOR VARIABLE     1 XB= -4.0876234E-01 X2=  6.2111595E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE     2 XB=  5.7226481E-02 X2=  6.7159395E+00 WEIGHT=  1.0000000E+00
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FOR \.....IBLE      3 XB=  8.9787021E-01 X2=  7.5397403E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE        4 XB=  4.0261987E-01 X2=  6.4901827E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE        5 XB=  2.6874521E-01 X2=  5.6659710E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE        6 XB= -1.3073474E-01 X2=  6.9725764E+00 WEIGHT=  1.0000000E+00
AUTO        COMPLETE IN        0.06 SECONDS
2-DIMENSIONAL PLOTTING OF SLT DATA
PERCENTAGE RETAINED    87.418
2DPLOT      COMPLETE IN        0.52 SECONDS
HISTOGRAMS FOR PATTERN SET RPW DATA
HISTO       COMPLETE IN        2.27 SECONDS
NLM ON SLT DATA          -0  250   -0        1.000E-04
PERCENTAGE RETAINED    87.418
ITERATION    1      1.54353E+00      2.50546E+00      4.75146E-01
ITERATION    2      1.45061E+00      1.54353E+00      6.20654E-02
ITERATION    3      1.43150E+00      1.45061E+00      1.32594E-02
ITERATION    4      1.42573E+00      1.43150E+00      4.04236E-03
ITERATION    5      1.42464E+00      1.42573E+00      7.60261E-04
ITERATION    6      1.42443E+00      1.42464E+00      1.47672E-04
ITERATION    7      1.42432E+00      1.42443E+00      8.26783E-05
ITERATION    8      1.42431E+00      1.42432E+00      7.75001E-06
NLM         COMPLETE IN       17.95 SECONDS
AUTOSCALED SLT DATA   WILL BE STORED IN SLT DATA   WEIGHT CODE   -0
FOR VARIABLE        1 XB= -6.5169292E-15 X2=  1.0000000E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE        2 XB=  4.8264086E-16 X2=  1.0000000E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE        3 XB=  1.1555941E-14 X2=  1.0000000E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE        4 XB=  6.2853426E-15 X2=  1.0000000E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE        5 XB=  4.5741189E-15 X2=  1.0000000E+00 WEIGHT=  1.0000000E+00
FOR VARIABLE        6 XB= -2.2737368E-15 X2=  1.0000000E+00 WEIGHT=  1.0000000E+00
AUTO        COMPLETE IN        0.06 SECONDS
HIERARCHICAL LEARNING FOR SLT DATA      1    -0    4    -0  1.00E-02
MAXI-CONNECTION
AFTER CONNECTING    71 WITH    66 THERE ARE     74 CLUSTERS      1.00000E+00
AFTER CONNECTING    39 WITH    29 THERE ARE     73 CLUSTERS      9.99828E-01
AFTER CONNECTING    19 WITH    17 THERE ARE     72 CLUSTERS      9.99758E-01
AFTER CONNECTING    12 WITH    11 THERE ARE     71 CLUSTERS      9.99726E-01
AFTER CONNECTING     8 WITH     4 THERE ARE     70 CLUSTERS      9.99606E-01
AFTER CONNECTING    43 WITH    11 THERE ARE     69 CLUSTERS      9.99489E-01
AFTER CONNECTING    60 WITH    17 THERE ARE     68 CLUSTERS      9.99458E-01
AFTER CONNECTING    68 WITH    47 THERE ARE     67 CLUSTERS      9.99404E-01
AFTER CONNECTING    58 WITH    18 THERE ARE     66 CLUSTERS      9.99317E-01
AFTER CONNECTING    17 WITH    15 THERE ARE     65 CLUSTERS      9.99311E-01
AFTER CONNECTING    61 WITH    58 THERE ARE     64 CLUSTERS      9.99309E-01
AFTER CONNECTING    31 WITH    25 THERE ARE     63 CLUSTERS      9.99285E-01
AFTER CONNECTING    30 WITH    28 THERE ARE     62 CLUSTERS      9.99148E-01
AFTER CONNECTING    16 WITH    15 THERE ARE     61 CLUSTERS      9.99129E-01
AFTER CONNECTING    13 WITH    12 THERE ARE     60 CLUSTERS      9.99108E-01
AFTER CONNECTING     8 WITH     7 THERE ARE     59 CLUSTERS      9.99035E-01
AFTER CONNECTING    56 WITH    55 THERE ARE     58 CLUSTERS      9.98997E-01
AFTER CONNECTING    34 WITH    25 THERE ARE     57 CLUSTERS      9.98971E-01
AFTER CONNECTING    16 WITH    13 THERE ARE     56 CLUSTERS      9.98929E-01
AFTER CONNECTING    54 WITH    13 THERE ARE     55 CLUSTERS      9.98924E-01
AFTER CONNECTING    35 WITH     2 THERE ARE     54 CLUSTERS      9.98878E-01
AFTER CONNECTING     9 WITH     8 THERE ARE     53 CLUSTERS      9.98878E-01
AFTER CONNECTING    40 WITH    33 THERE ARE     52 CLUSTERS      9.98803E-01
AFTER CONNECTING    21 WITH    20 THERE ARE     51 CLUSTERS      9.98748E-01
AFTER CONNECTING    45 WITH    36 THERE ARE     50 CLUSTERS      9.98734E-01
AFTER CONNECTING     5 WITH     2 THERE ARE     49 CLUSTERS      9.98683E-01
AFTER CONNECTING    35 WITH    11 THERE ARE     48 CLUSTERS      9.98679E-01
AFTER CONNECTING    21 WITH    15 THERE ARE     47 CLUSTERS      9.98679E-01
AFTER CONNECTING    12 WITH    11 THERE ARE     46 CLUSTERS      9.98633E-01
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AFTER ____ECTING   26 WITH   18 THERE ARE    45 CLUSTERS     9.98578E-01
AFTER CONNECTING   41 WITH   11 THERE ARE    44 CLUSTERS     9.98541E-01
AFTER CONNECTING   39 WITH   11 THERE ARE    43 CLUSTERS     9.98525E-01
AFTER CONNECTING   26 WITH   24 THERE ARE    42 CLUSTERS     9.98514E-01
AFTER CONNECTING   16 WITH   14 THERE ARE    41 CLUSTERS     9.98512E-01
AFTER CONNECTING    6 WITH    2 THERE ARE    40 CLUSTERS     9.98391E-01
AFTER CONNECTING   16 WITH   14 THERE ARE    39 CLUSTERS     9.98342E-01
AFTER CONNECTING   28 WITH   10 THERE ARE    38 CLUSTERS     9.98300E-01
AFTER CONNECTING   38 WITH   10 THERE ARE    37 CLUSTERS     9.98295E-01
AFTER CONNECTING   16 WITH   13 THERE ARE    36 CLUSTERS     9.98260E-01
AFTER CONNECTING   11 WITH   10 THERE ARE    35 CLUSTERS     9.98134E-01
AFTER CONNECTING   27 WITH    2 THERE ARE    34 CLUSTERS     9.98100E-01
AFTER CONNECTING   18 WITH   13 THERE ARE    33 CLUSTERS     9.98090E-01
AFTER CONNECTING   19 WITH   13 THERE ARE    32 CLUSTERS     9.98064E-01
AFTER CONNECTING   31 WITH   10 THERE ARE    31 CLUSTERS     9.97940E-01
AFTER CONNECTING   15 WITH   13 THERE ARE    30 CLUSTERS     9.97498E-01
AFTER CONNECTING   25 WITH   10 THERE ARE    29 CLUSTERS     9.97444E-01
AFTER CONNECTING   13 WITH   12 THERE ARE    28 CLUSTERS     9.97123E-01
AFTER CONNECTING    4 WITH    2 THERE ARE    27 CLUSTERS     9.97060E-01
AFTER CONNECTING   25 WITH    9 THERE ARE    26 CLUSTERS     9.96673E-01
AFTER CONNECTING    4 WITH    2 THERE ARE    25 CLUSTERS     9.96596E-01
AFTER CONNECTING   12 WITH   10 THERE ARE    24 CLUSTERS     9.96536E-01
AFTER CONNECTING   12 WITH   10 THERE ARE    23 CLUSTERS     9.96401E-01
AFTER CONNECTING   13 WITH   10 THERE ARE    22 CLUSTERS     9.96097E-01
AFTER CONNECTING    3 WITH    2 THERE ARE    21 CLUSTERS     9.95836E-01
AFTER CONNECTING   12 WITH    4 THERE ARE    20 CLUSTERS     9.95796E-01
AFTER CONNECTING    6 WITH    4 THERE ARE    19 CLUSTERS     9.95789E-01
AFTER CONNECTING   10 WITH    8 THERE ARE    18 CLUSTERS     9.95675E-01
AFTER CONNECTING   16 WITH    6 THERE ARE    17 CLUSTERS     9.95472E-01
AFTER CONNECTING   17 WITH    6 THERE ARE    16 CLUSTERS     9.95460E-01
AFTER CONNECTING   10 WITH    3 THERE ARE    15 CLUSTERS     9.95136E-01
AFTER CONNECTING    2 WITH    1 THERE ARE    14 CLUSTERS     9.95042E-01
AFTER CONNECTING   14 WITH   10 THERE ARE    13 CLUSTERS     9.95003E-01
AFTER CONNECTING    3 WITH    2 THERE ARE    12 CLUSTERS     9.94929E-01
AFTER CONNECTING    5 WITH    4 THERE ARE    11 CLUSTERS     9.93377E-01
AFTER CONNECTING   10 WITH    2 THERE ARE    10 CLUSTERS     9.92853E-01
AFTER CONNECTING    9 WITH    1 THERE ARE     9 CLUSTERS     9.92773E-01
AFTER CONNECTING    8 WITH    4 THERE ARE     8 CLUSTERS     9.92725E-01
AFTER CONNECTING    3 WITH    2 THERE ARE     7 CLUSTERS     9.92528E-01
AFTER CONNECTING    5 WITH    4 THERE ARE     6 CLUSTERS     9.83217E-01
AFTER CONNECTING    6 WITH    5 THERE ARE     5 CLUSTERS     9.81819E-01
AFTER CONNECTING    5 WITH    1 THERE ARE     4 CLUSTERS     9.76002E-01
   1    1    2    2    3    3    4    4
   1    1    2    1    3    1    4    1    5    1    6    1    7    1    8    1    9    1   10    2
  11    2   12    2   13    2   14    2   15    2   16    2   17    3   18    3   19    3   20    3
  21    3   22    3   23    3   24    3   25    4   26    4   27    4   28    4   29    4   30    4
  31    4   32    4   33    4   34    4   35    4   36    4   37    4   38    4   39    4   40    4
  41    4   42    4   43    4   44    4   45    4   46    2   47    2   48    1   49    2   50    1
  51    3   52    3   53    3   54    1   55    2   56    1   57    2   58    3   59    1   60    3
  61    3   62    3   63    3   64    3   65    3   66    3   67    3   68    3   69    3   70    3
  71    3   72    3   73    3   74    3   75    3
OCCUPANCY FOR CLUSTER    1
   1    2    3    4    5    6    7    8    9   48   50   54   56   59
OCCUPANCY FOR CLUSTER    2
  10   11   12   13   14   15   16   46   47   49   55   57
OCCUPANCY FOR CLUSTER    3
  17   18   19   20   21   22   23   24   51   52   53   58   60   61   62   63   64   65   66   67
  68   69   70   71   72   73   74   75
OCCUPANCY FOR CLUSTER    4
  25   26   27   28   29   30   31   32   33   34   35   36   37   38   39   40   41   42   43   44
```

CENTROID CONNECTION

AFTER CONNECTING	71	WITH	66	THERE ARE	74	CLUSTERS	1.00000E+00
AFTER CONNECTING	39	WITH	29	THERE ARE	73	CLUSTERS	9.99828E-01
AFTER CONNECTING	19	WITH	17	THERE ARE	72	CLUSTERS	9.99758E-01
AFTER CONNECTING	12	WITH	11	THERE ARE	71	CLUSTERS	9.99726E-01
AFTER CONNECTING	8	WITH	4	THERE ARE	70	CLUSTERS	9.99606E-01
AFTER CONNECTING	39	WITH	9	THERE ARE	69	CLUSTERS	9.99469E-01
AFTER CONNECTING	55	WITH	13	THERE ARE	68	CLUSTERS	9.99458E-01
AFTER CONNECTING	61	WITH	41	THERE ARE	67	CLUSTERS	9.99404E-01
AFTER CONNECTING	51	WITH	13	THERE ARE	66	CLUSTERS	9.99317E-01
AFTER CONNECTING	58	WITH	53	THERE ARE	65	CLUSTERS	9.99309E-01
AFTER CONNECTING	57	WITH	25	THERE ARE	64	CLUSTERS	9.99260E-01
AFTER CONNECTING	24	WITH	22	THERE ARE	63	CLUSTERS	9.99148E-01
AFTER CONNECTING	10	WITH	9	THERE ARE	62	CLUSTERS	9.99108E-01
AFTER CONNECTING	7	WITH	6	THERE ARE	61	CLUSTERS	9.99035E-01
AFTER CONNECTING	50	WITH	8	THERE ARE	60	CLUSTERS	9.99031E-01
AFTER CONNECTING	45	WITH	44	THERE ARE	59	CLUSTERS	9.98997E-01
AFTER CONNECTING	44	WITH	9	THERE ARE	58	CLUSTERS	9.98924E-01
AFTER CONNECTING	27	WITH	2	THERE ARE	57	CLUSTERS	9.98878E-01
AFTER CONNECTING	31	WITH	25	THERE ARE	56	CLUSTERS	9.98803E-01
AFTER CONNECTING	49	WITH	9	THERE ARE	55	CLUSTERS	9.98676E-01
AFTER CONNECTING	44	WITH	36	THERE ARE	54	CLUSTERS	9.98630E-01
AFTER CONNECTING	48	WITH	42	THERE ARE	53	CLUSTERS	9.98601E-01
AFTER CONNECTING	21	WITH	18	THERE ARE	52	CLUSTERS	9.98514E-01
AFTER CONNECTING	41	WITH	32	THERE ARE	51	CLUSTERS	9.98470E-01
AFTER CONNECTING	36	WITH	5	THERE ARE	50	CLUSTERS	9.98376E-01
AFTER CONNECTING	38	WITH	11	THERE ARE	49	CLUSTERS	9.98367E-01
AFTER CONNECTING	23	WITH	6	THERE ARE	48	CLUSTERS	9.98134E-01
AFTER CONNECTING	41	WITH	8	THERE ARE	47	CLUSTERS	9.98093E-01
AFTER CONNECTING	14	WITH	13	THERE ARE	46	CLUSTERS	9.98064E-01
AFTER CONNECTING	13	WITH	7	THERE ARE	45	CLUSTERS	9.97912E-01
AFTER CONNECTING	33	WITH	26	THERE ARE	44	CLUSTERS	9.97703E-01
AFTER CONNECTING	43	WITH	39	THERE ARE	43	CLUSTERS	9.97699E-01
AFTER CONNECTING	32	WITH	3	THERE ARE	42	CLUSTERS	9.97694E-01
AFTER CONNECTING	33	WITH	32	THERE ARE	41	CLUSTERS	9.97601E-01
AFTER CONNECTING	36	WITH	11	THERE ARE	40	CLUSTERS	9.97573E-01
AFTER CONNECTING	28	WITH	16	THERE ARE	39	CLUSTERS	9.97521E-01
AFTER CONNECTING	37	WITH	34	THERE ARE	38	CLUSTERS	9.97138E-01
AFTER CONNECTING	30	WITH	27	THERE ARE	37	CLUSTERS	9.96862E-01
AFTER CONNECTING	36	WITH	30	THERE ARE	36	CLUSTERS	9.96653E-01
AFTER CONNECTING	23	WITH	3	THERE ARE	35	CLUSTERS	9.96277E-01
AFTER CONNECTING	10	WITH	7	THERE ARE	34	CLUSTERS	9.96097E-01
AFTER CONNECTING	30	WITH	28	THERE ARE	33	CLUSTERS	9.96061E-01
AFTER CONNECTING	27	WITH	26	THERE ARE	32	CLUSTERS	9.95980E-01
AFTER CONNECTING	26	WITH	6	THERE ARE	31	CLUSTERS	9.95979E-01
AFTER CONNECTING	28	WITH	6	THERE ARE	30	CLUSTERS	9.95797E-01
AFTER CONNECTING	25	WITH	19	THERE ARE	29	CLUSTERS	9.95682E-01
AFTER CONNECTING	17	WITH	14	THERE ARE	28	CLUSTERS	9.95460E-01
AFTER CONNECTING	15	WITH	9	THERE ARE	27	CLUSTERS	9.95003E-01
AFTER CONNECTING	7	WITH	3	THERE ARE	26	CLUSTERS	9.94929E-01
AFTER CONNECTING	17	WITH	11	THERE ARE	25	CLUSTERS	9.94600E-01
AFTER CONNECTING	17	WITH	16	THERE ARE	24	CLUSTERS	9.94593E-01
AFTER CONNECTING	13	WITH	11	THERE ARE	23	CLUSTERS	9.94339E-01
AFTER CONNECTING	18	WITH	9	THERE ARE	22	CLUSTERS	9.93894E-01
AFTER CONNECTING	13	WITH	5	THERE ARE	21	CLUSTERS	9.93623E-01
AFTER CONNECTING	17	WITH	14	THERE ARE	20	CLUSTERS	9.93331E-01
AFTER CONNECTING	6	WITH	2	THERE ARE	19	CLUSTERS	9.92773E-01
AFTER CONNECTING	10	WITH	8	THERE ARE	18	CLUSTERS	9.91146E-01
AFTER CONNECTING	12	WITH	1	THERE ARE	17	CLUSTERS	9.90241E-01

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AFTER CONNECTING    10 WITH     6 THERE ARE    16 CLUSTERS      9.90230E-01
AFTER CONNECTING    11 WITH     7 THERE ARE    15 CLUSTERS      9.90065E-01
AFTER CONNECTING    10 WITH     5 THERE ARE    14 CLUSTERS      9.89018E-01
AFTER CONNECTING    11 WITH     5 THERE ARE    13 CLUSTERS      9.88189E-01
AFTER CONNECTING     8 WITH     4 THERE ARE    12 CLUSTERS      9.85398E-01
AFTER CONNECTING    10 WITH     1 THERE ARE    11 CLUSTERS      9.85092E-01
AFTER CONNECTING     8 WITH     6 THERE ARE    10 CLUSTERS      9.84284E-01
AFTER CONNECTING     6 WITH     4 THERE ARE     9 CLUSTERS      9.83687E-01
AFTER CONNECTING     3 WITH     2 THERE ARE     8 CLUSTERS      9.81819E-01
AFTER CONNECTING     5 WITH     2 THERE ARE     7 CLUSTERS      9.75693E-01
   1    1    2    2    3    3    4    4    5    5    6    6    7    7
   1    2    2    2    3    2    4    2    5    2    6    2    7    2    8    2    9    2   10    5
  11    5   12    5   13    3   14    5   15    5   16    5   17    7   18    7   19    7   20    7
  21    7   22    7   23    7   24    7   25    4   26    4   27    4   28    1   29    4   30    4
  31    4   32    4   33    4   34    4   35    4   36    4   37    4   38    4   39    4   40    4
  41    4   42    4   43    4   44    4   45    4   46    3   47    3   48    2   49    5   50    6
  51    7   52    7   53    7   54    2   55    3   56    2   57    3   58    7   59    6   60    7
  61    7   62    7   63    7   64    7   65    7   66    7   67    7   68    7   69    7   70    7
  71    7   72    7   73    7   74    7   75    7
OCCUPANCY FOR CLUSTER    2
   1    2    3    4    5    6    7    8    9   48   54   56
OCCUPANCY FOR CLUSTER    3
  13   46   47   55   57
OCCUPANCY FOR CLUSTER    4
  25   26   27   29   30   31   32   33   34   35   36   37   38   39   40   41   42   43   44   45
OCCUPANCY FOR CLUSTER    5
  10   11   12   14   15   16   49
OCCUPANCY FOR CLUSTER    6
  50   59
OCCUPANCY FOR CLUSTER    7
  17   18   19   20   21   22   23   24   51   52   53   58   60   61   62   63   64   65   66   67
  68   69   70   71   72   73   74   75
AFTER CONNECTING     5 WITH     3 THERE ARE     6 CLUSTERS      9.55056E-01
AFTER CONNECTING     3 WITH     1 THERE ARE     5 CLUSTERS      9.54855E-01
   1    1    2    2    3    3    4    4    5    5
   1    1    2    1    3    1    4    1    5    1    6    1    7    1    8    1    9    1   10    4
  11    4   12    4   13    4   14    4   15    4   16    4   17    3   18    3   19    3   20    3
  21    3   22    3   23    3   24    3   25    5   26    5   27    5   28    5   29    5   30    5
  31    5   32    5   33    5   34    5   35    5   36    5   37    5   38    5   39    5   40    5
  41    5   42    5   43    5   44    5   45    5   46    4   47    4   48    1   49    4   50    2
  51    3   52    3   53    3   54    1   55    4   56    1   57    4   58    3   59    2   60    3
  61    3   62    3   63    3   64    3   65    3   66    3   67    3   68    3   69    3   70    3
  71    3   72    3   73    3   74    3   75    3
OCCUPANCY FOR CLUSTER    1
   1    2    3    4    5    6    7    8    9   48   54   56
OCCUPANCY FOR CLUSTER    2
  50   59
OCCUPANCY FOR CLUSTER    3
  17   18   19   20   21   22   23   24   51   52   53   58   60   61   62   63   64   65   66   67
  68   69   70   71   72   73   74   75
OCCUPANCY FOR CLUSTER    4
  10   11   12   13   14   15   16   46   47   49   55   57
OCCUPANCY FOR CLUSTER    5
  25   26   27   28   29   30   31   32   33   34   35   36   37   38   39   40   41   42   43   44
  45
AFTER CONNECTING     2 WITH     1 THERE ARE     4 CLUSTERS      9.31462E-01
   1    1    2    2    3    3    4    4
   1    4    2    4    3    4    4    4    5    4    6    4    7    4    8    4    9    4   10    2
  11    2   12    2   13    2   14    2   15    2   16    2   17    1   18    1   19    1   20    1
  21    1   22    1   23    1   24    1   25    3   26    3   27    3   28    3   29    3   30    3
```

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  31     1    32     3    33     3    34     3    35     3    36     3    37     3    38     3    39     3    40     3
  41     3    42     3    43     3    44     3    45     3    46     2    47     2    48     4    49     2    50     4
  51     1    52     1    53     1    54     4    55     2    56     4    57     2    58     1    59     4    60     1
  61     1    62     1    63     1    64     1    65     1    66     1    67     1    68     1    69     1    70     1
  71     1    72     1    73     1    74     1    75     1
OCCUPANCY FOR CLUSTER     1
  17    18    19    20    21    22    23    24    51    52    53    58    60    61    62    63    64    65    66    67
  68    69    70    71    72    73    74    75
OCCUPANCY FOR CLUSTER     2
  10    11    12    13    14    15    16    46    47    49    55    57
OCCUPANCY FOR CLUSTER     3
  25    26    27    28    29    30    31    32    33    34    35    36    37    38    39    40    41    42    43    44
  45
OCCUPANCY FOR CLUSTER     4
   1     2     3     4     5     6     7     8     9    48    50    54    56    59
HIER        COMPLETE IN        13.45 SECONDS
K-NEAREST NEIGHBOR ANALYSIS ON SLT DATA
  46    46    Q2          1    2         2    2         3    2         4    2         5    2         6    2         7    2
  47    47    Q2          1    2         2    2         3    2         4    2         5    2         6    2         7    2
  48    48    Q1          1    1         2    1         3    1         4    1         5    1         6    1         7    1
  49    49    Q2          1    2         2    2         3    2         4    2         5    2         6    2         7    2
  50    50    Q1          1    1         2    1         3    1         4    1         5    1         6    1         7    1
  51    51    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  52    52    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  53    53    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  54    54    Q1          1    1         2    1         3    1         4    1         5    1         6    1         7    1
  55    55    Q2          1    2         2    2         3    2         4    2         5    2         6    2         7    2
  56    56    Q1          1    1         2    1         3    1         4    1         5    1         6    1         7    1
  57    57    Q2          1    2         2    2         2    2         3    2         3    2         4    2         4    2
  58    58    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  59    59    Q1          1    1         2    1         3    1         4    1         5    1         6    1         7    1
  60    60    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  61    61    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  62    62    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  63    63    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  64    64    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  65    65    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  66    66    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  67    67    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  68    68    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  69    69    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  70    70    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  71    71    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  72    72    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  73    73    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  74    74    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
  75    75    Q3          1    3         2    3         3    3         4    3         5    3         6    3         7    3
                          0              0              0              0              0              0              0
                    0.              0.             0.             0.             0.             0.             0.
          1               0              0              0              0              0              0              0
          2               0              0              0              0              0              0              0
          3               0              0              0              0              0              0              0
          4               0              0              0              0              0              0              0
KNEAR       COMPLETE IN        1.07 SECONDS
CURVE FITTING ON PATTERN SET SLT DATA
WEIGHT VECTOR FOLLOWS
 1.4350E+00 -1.3864E+00 -8.8637E-01  7.2343E+00  3.0672E+00  1.5592E+00  2.7957E+00
  45    46              2.00000             1.99011
  47    47              2.00000             1.93943
  48    48              1.00000             1.11929
```

49	49	2.00000	2.17007
50	50	1.00000	2.24458
51	51	3.00000	2.76267
52	52	3.00000	2.93585
53	53	3.00000	2.82681
54	54	1.00000	1.02541
55	55	2.00000	1.99869
56	56	1.00000	1.01609
57	57	2.00000	2.08585
58	58	3.00000	2.97620
59	59	1.00000	1.69241
60	60	3.00000	3.09679
61	61	3.00000	3.11049
62	62	3.00000	3.42465
63	63	3.00000	3.13055
64	64	3.00000	2.96543
65	65	3.00000	3.21200
66	66	3.00000	3.31038
67	67	3.00000	2.54030
68	68	3.00000	2.94397
69	69	3.00000	3.18929
70	70	3.00000	3.13211
71	71	3.00000	3.31038
72	72	3.00000	3.06124
73	73	3.00000	3.40424
74	74	3.00000	3.10617
75	75	3.00000	2.92940

P8= 2.91111E+00 P2= 7.97775E+00 SD= 1.61534E-01 PSD= 5.54888E+00

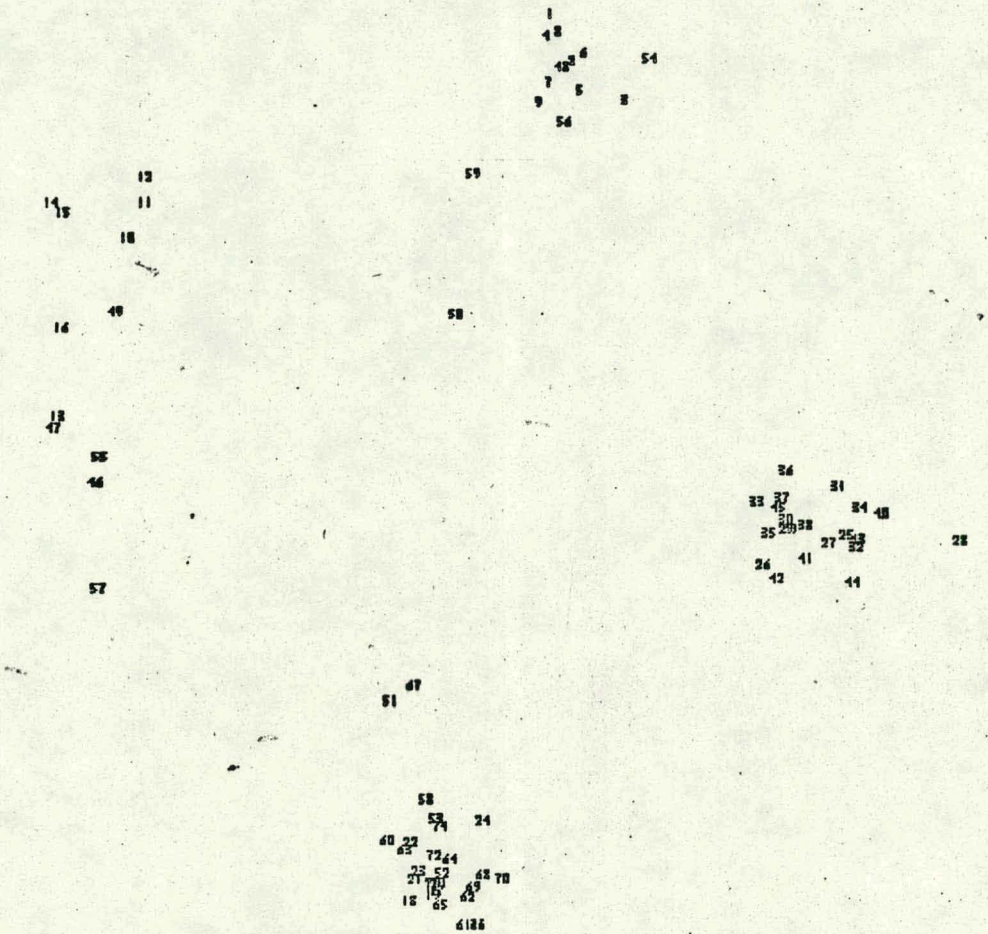
LEAST COMPLETE IN 0.11 SECONDS

MULTICLASS LINEAR LEARNING ON SLT DATA

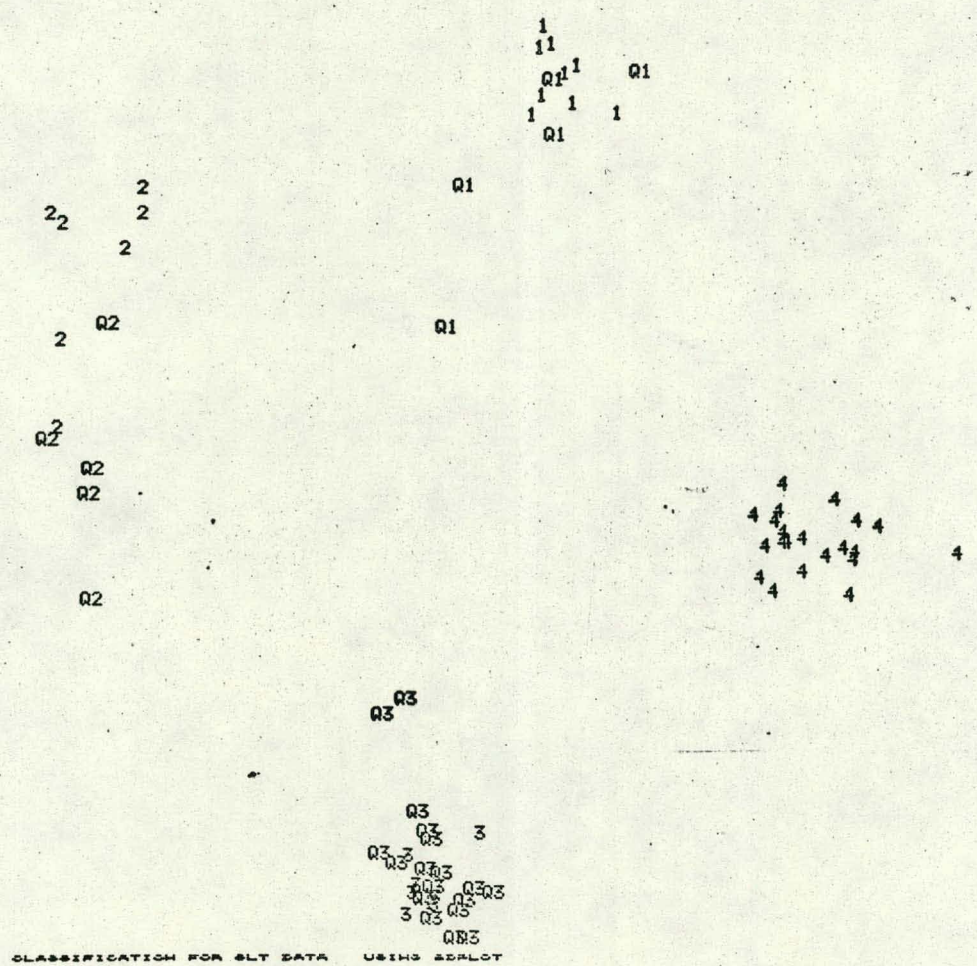
46	46	Q2	2	SEP
47	47	Q2	2	SEP
48	48	Q1	1	SEP
49	49	Q2	2	SEP
50	50	Q1	1	SEP
51	51	Q3	3	SEP
52	52	Q3	3	SEP
53	53	Q3	3	SEP
54	54	Q1	1	SEP
55	55	Q2	2	SEP
56	56	Q1	1	SEP
57	57	Q2	2	SEP
58	58	Q3	3	SEP
59	59	Q1	1	SEP
60	60	Q3	3	SEP
61	61	Q3	3	SEP
62	62	Q3	3	SEP
63	63	Q3	3	SEP
64	64	Q3	3	SEP
65	65	Q3	3	SEP
66	66	Q3	3	SEP
67	67	Q3	3	SEP
68	68	Q3	3	SEP
69	69	Q3	3	SEP
70	70	Q3	3	SEP
71	71	Q3	3	SEP
72	72	Q3	3	SEP
73	73	Q3	3	SEP
74	74	Q3	3	SEP
75	75	Q3	3	SEP

```
  0 M....S OUT OF    45 IN THE TRAINING SET
    CLASS  1       0
    CLASS  2       0
    CLASS  3       0
    CLASS  4       0
MULTCL     COMPLETE IN       0.32 SECONDS
UNRECOGNIZED VERB     STOP
RECOGB     COMPLETE IN      59.46 SECONDS
```

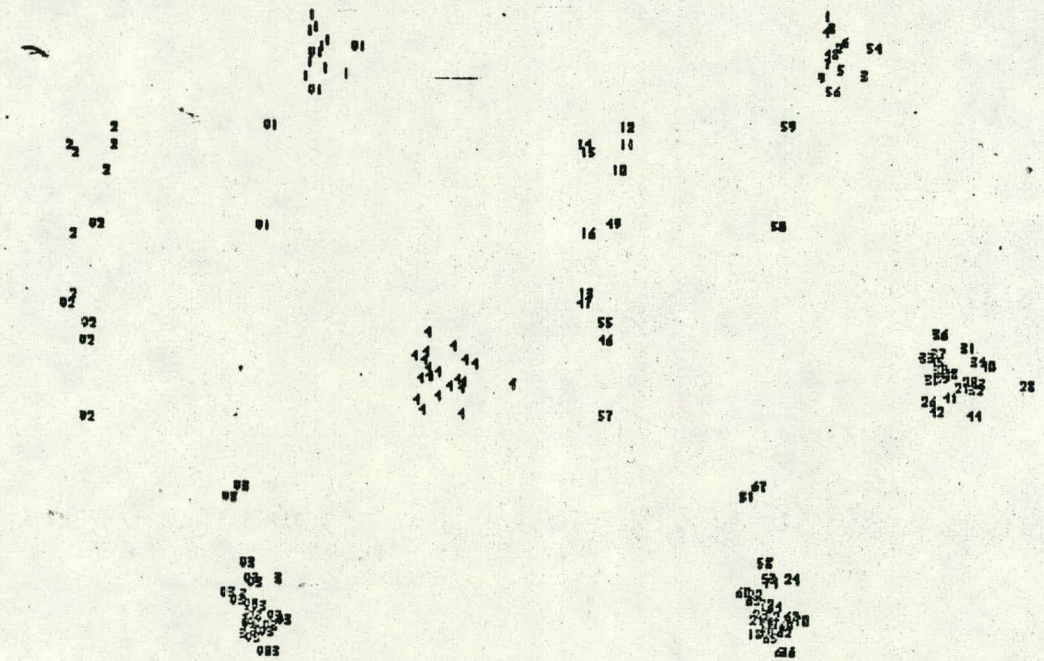
III. PLOTTED OUTPUT



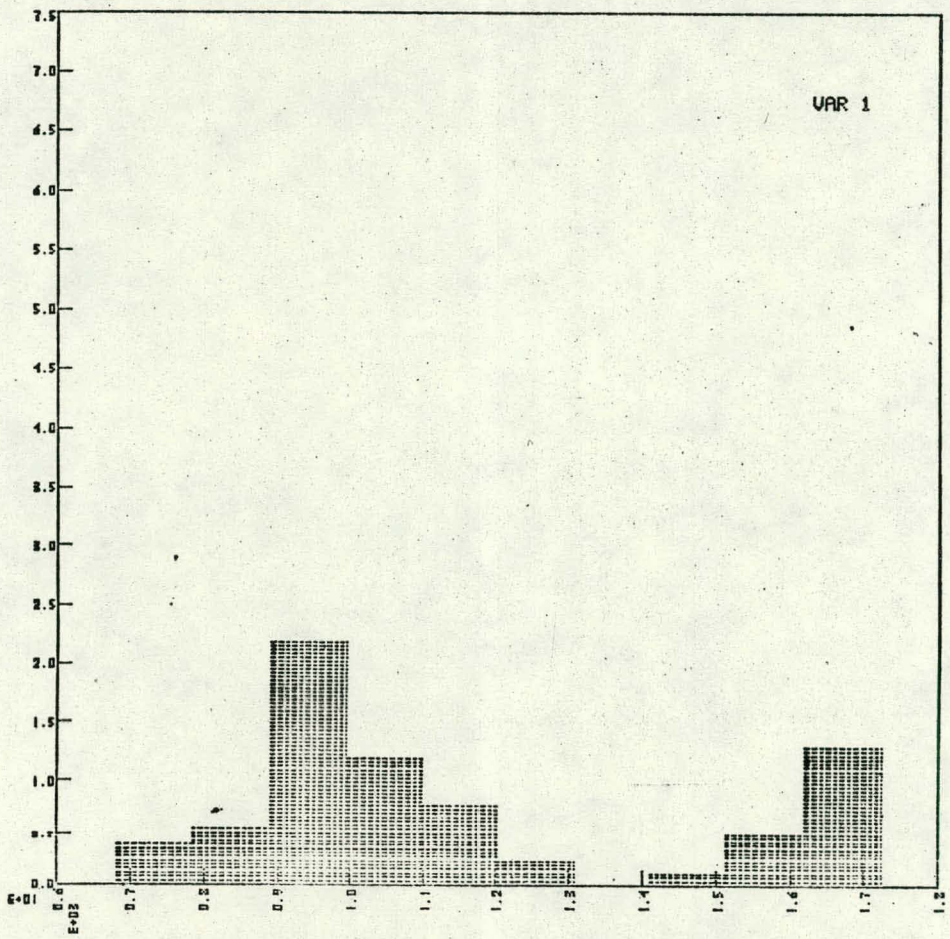
ID. NO. PLOT FOR SLT DATA



CLASSIFICATION FOR SLT DATA USING ZSPLOT



CLASSIFICATION FOR SLT DATA USING 2DPLOT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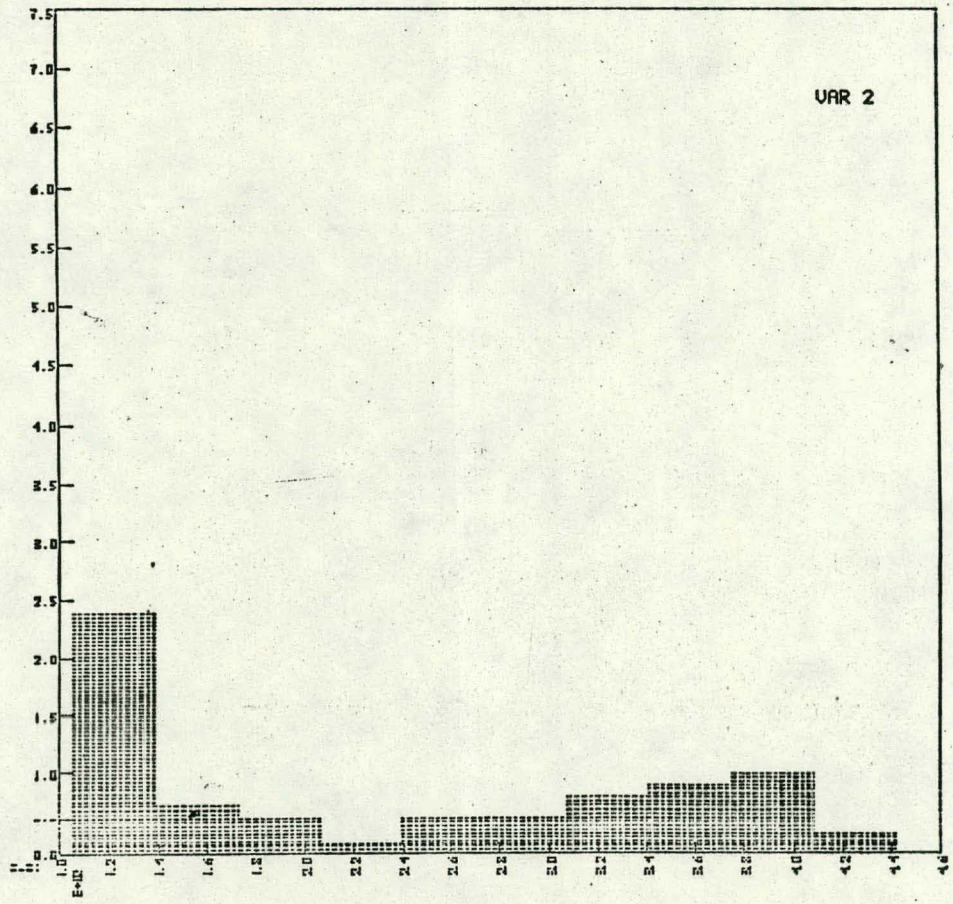
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
E+01
0.6
E+02
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8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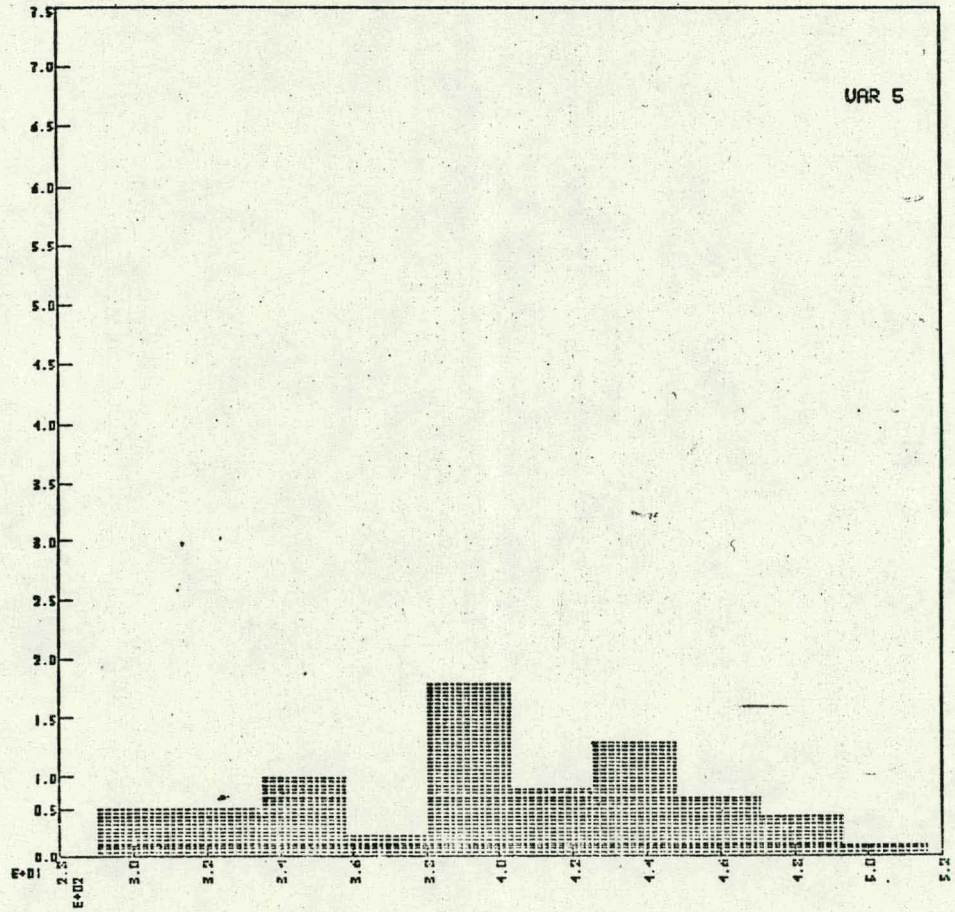
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
E+00


VAR 5
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6.5
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5.5
5.0
4.5
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3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
E+01
E+02
3.0
3.2
3.4
3.6
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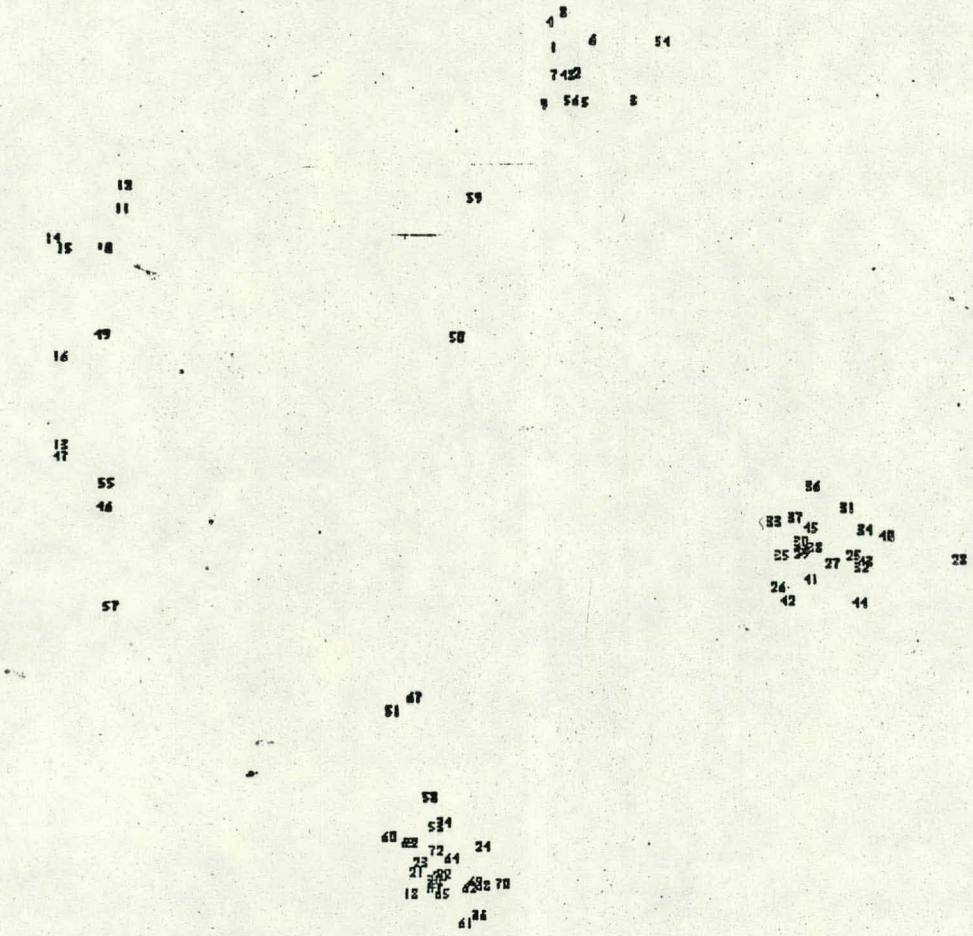
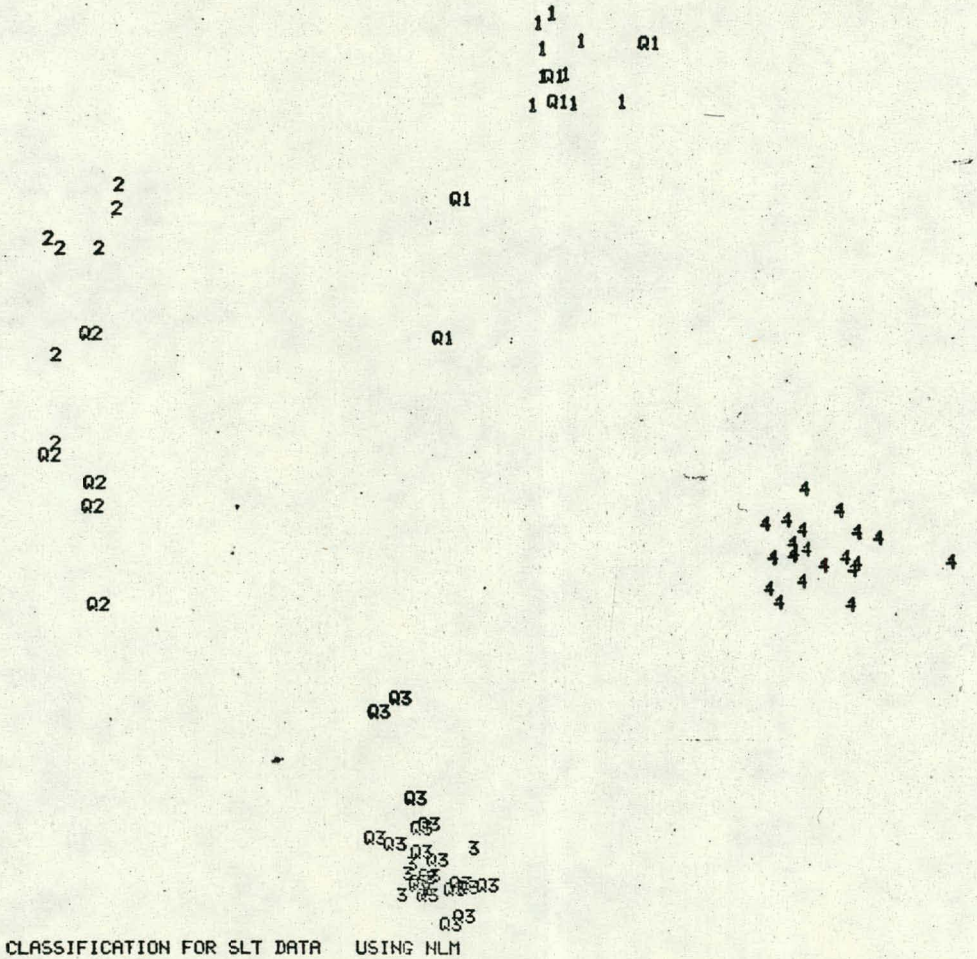
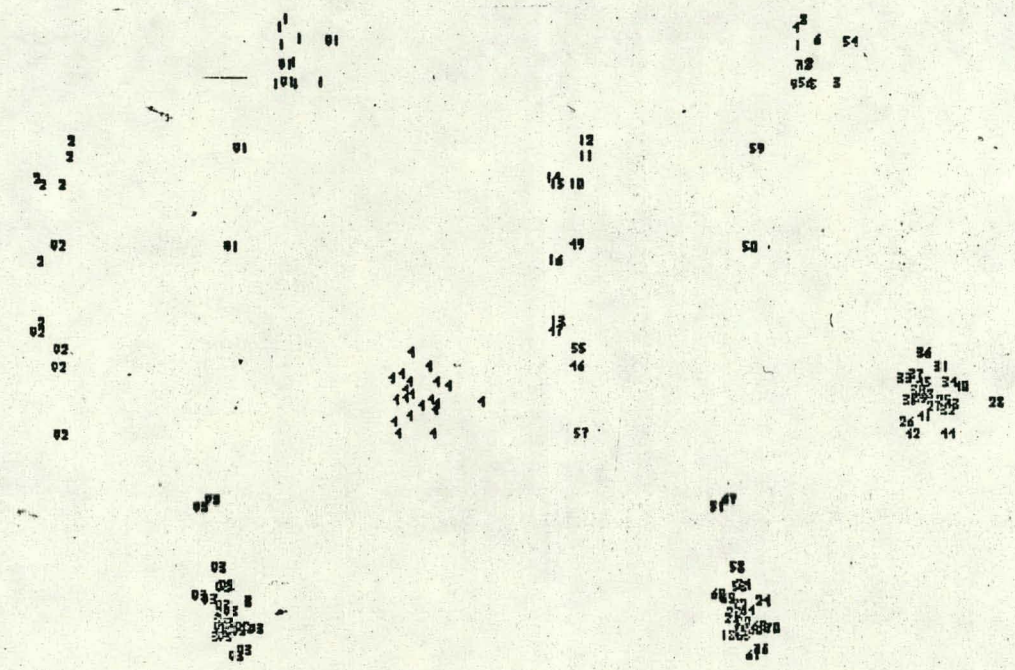
4.4
4.6
4.8
5.0
5.2



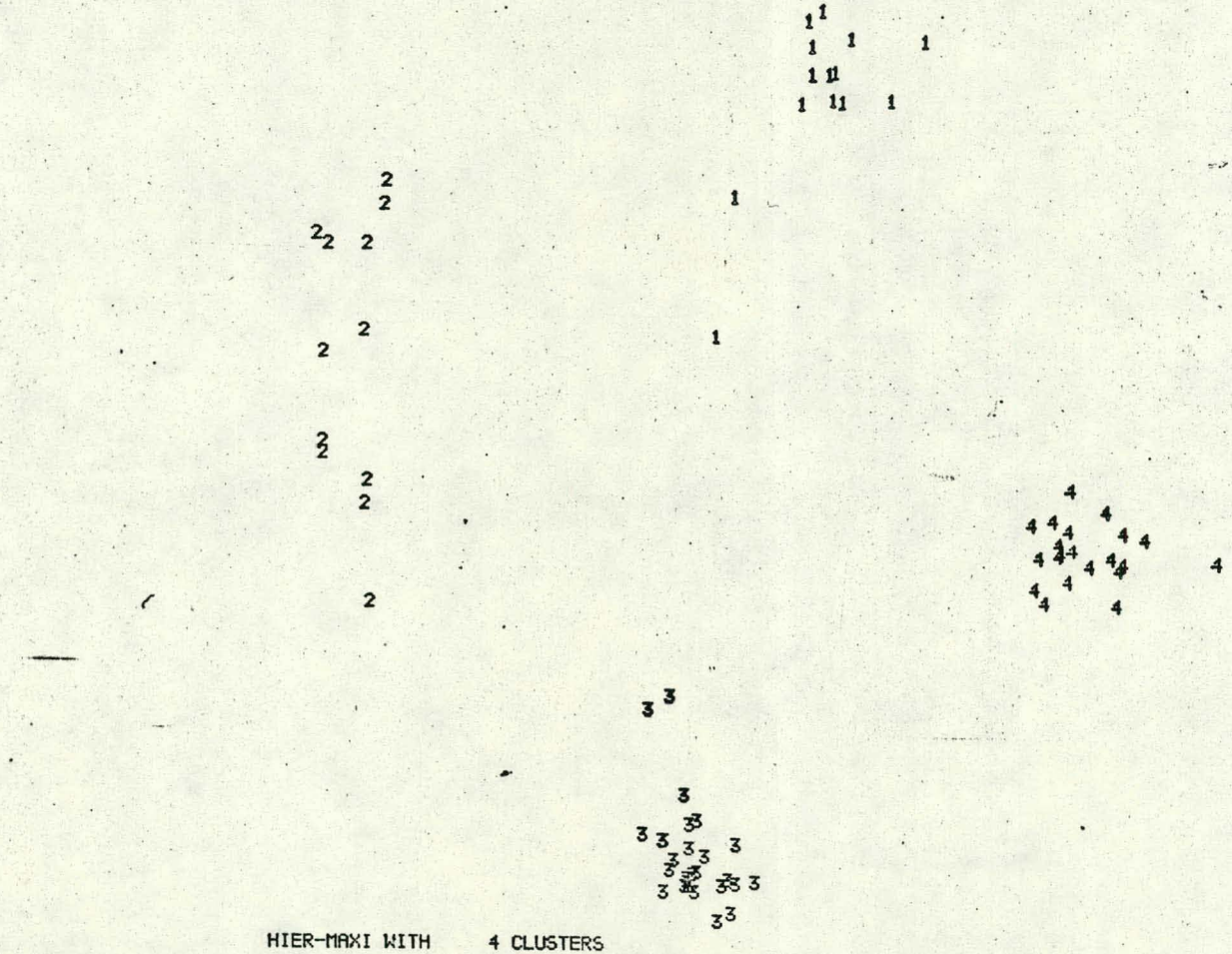
ID. NO. PLOT FOR SLT DATA



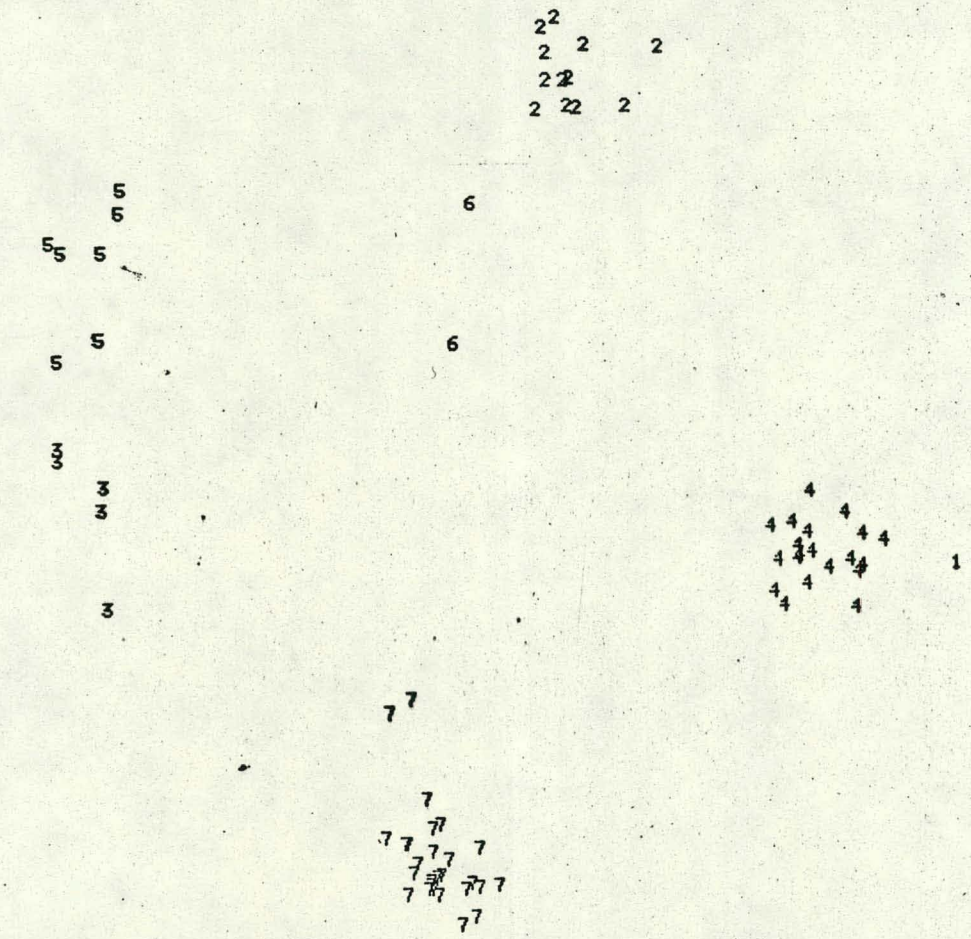
CLASSIFICATION FOR SLT DATA USING NLM



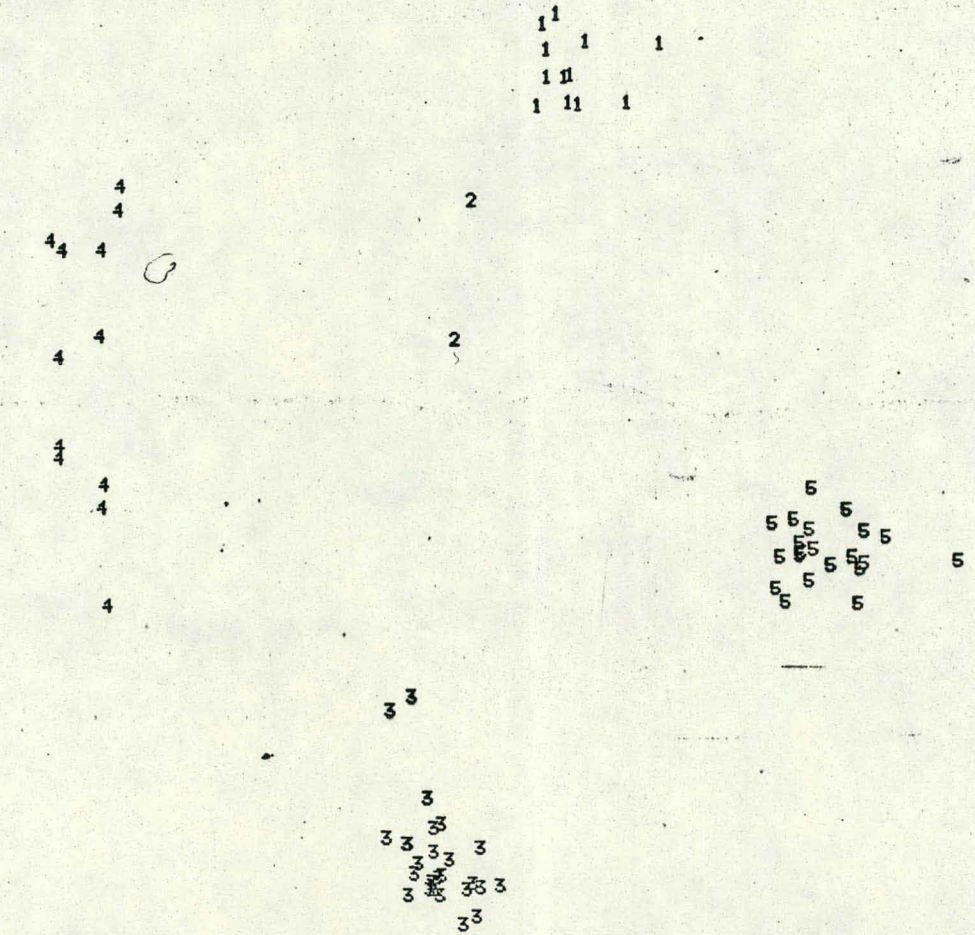
CLASSIFICATION FOR SLT DATA USING MLH



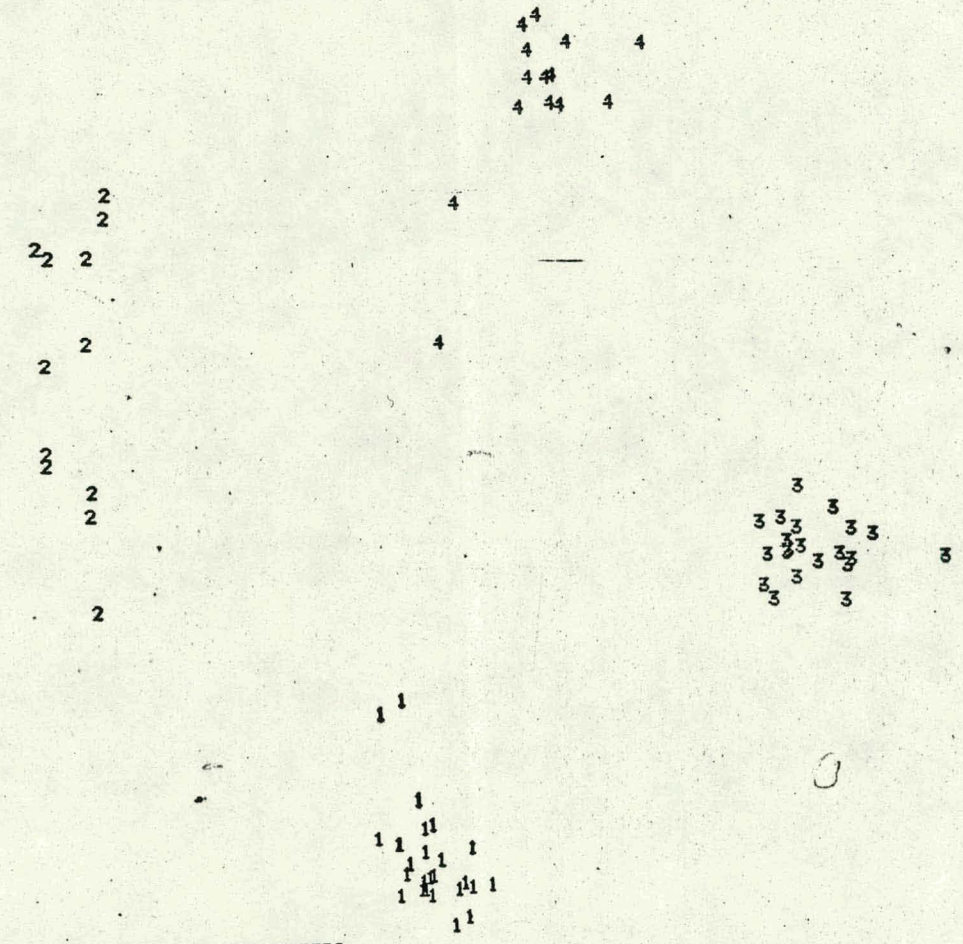
HIER-MAXI WITH 4 CLUSTERS



HIER-SUM WITH 7 CLUSTERS



HIER-SUM WITH 5 CLUSTERS



HIER-SUM WITH 4 CLUSTERS

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