STUDY OF A RECURSIVE METHOD FOR MATRIX INVERSION
VIA
SIGNAL PROCESSING EXPERIMENTS

by

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B.S., Kansas State University, 1975

A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

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1977

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CHAPTER I

INTRODUCTION

The main objective of this report is to discuss a recursive matrix inversion formula suggested by Graupe [1] for real symmetric matrices. The use of this formula is explained in connection with two problems of interest in the following areas of communication and signal processing: (i) digital filtering via nonrecursive filters, and (ii) pattern classification via a least-squares minimum distance classifier.

In chapter II a sequential regression formula is used to arrive at an algorithm which could be used in connection with signal processing applications. The need to invert a matrix recursively is pointed out with respect to this algorithm. Illustrative examples related to the matrix inversion formula are also included.

Chapter III briefly reviews some basic ideas associated with pattern classification via a least-squares minimum distance classifier. Again, in connection with this classifier, the need to invert a real symmetric matrix recursively is identified. With the aid of examples it is demonstrated that Graupe's formula can be used effectively.

The data used in this study is included in the form of appendices. Some of the computer programs used to carry out the computations involved in Graupe's are also included in an appendix.

CHAPTER II

ADAPTIVE FILTERING

The purpose of this chapter is to introduce the adaptive digital filter (ADF) via a sequential regression formulation. We shall restrict our attention to nonrecursive filters. It will be shown that the formulation leads to a recursive relation which involves the computation of the inverse of a symmetric matrix.

2.1. Sequential Regression Formulation

Consider a time-varying nonrecursive digital filter transfer function $H_k(Z)$ given by

$$H_k(Z) = a_{o,k} Z^m + a_{1,k} Z^{m-1} + \dots + a_{m,k} \qquad (2.1\text{-}1)$$

It follows that the corresponding input-output relation can be expressed as

$$g(k) = a_k^T x_k \qquad (2.1\text{-}2)$$

where

$$a_k^T = [\; a_{o,k} \; a_{1,k} \; \dots \; a_{m,k} \;]$$

$$x_k^T = [\; x(k) \; x(k-1) \; \dots \; x(k-m) \;]$$

Equation (2.1-2) can alternately be written in the form

$$g(k) = \alpha_k^T \beta_k \qquad (2.1\text{-}3)$$

where

$$\alpha_k^T = [\ a_{o,k}\ a_{1,k}\ .\ .\ .\ a_{m,k}\ ]$$

and

$$\beta_k^T = [\ x(k)\ x(k-1)\ .\ .\ .\ x(k-m)\ ]$$

We now define a cost function $R(\hat{\alpha}_r)$, such that

$$R(\hat{\alpha}_r) = \sum_{k=1}^{r} [\ y(k) - \hat{g}(k)\ ]^2 \qquad (2.1\text{-}4)$$

where

$$\hat{g}(k) = \hat{\alpha}_r^T\ \beta_k$$

y(k) is the k-th data point of the desired output and r is an index that denotes the current iteration; see Fig. (2.1-1).

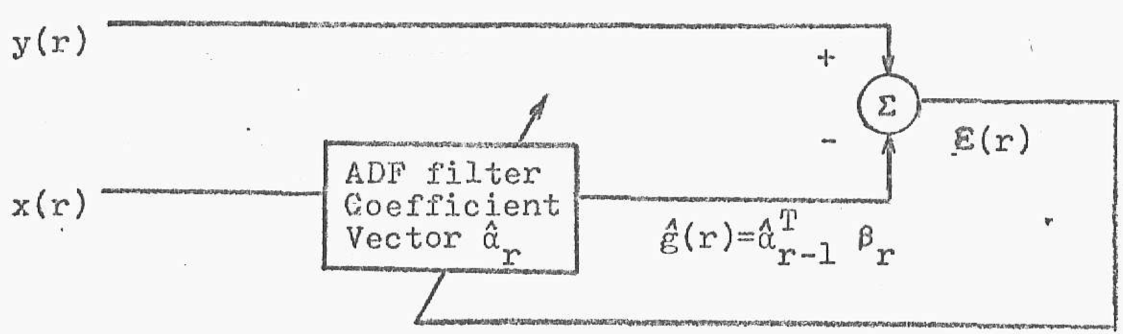

Fig. (2.1-1) ADF (Adaptive Digital Filter) Configuration.

We seek to minimize $R(\hat{\alpha}_r)$ with respect to $\hat{\alpha}_r$. This requires that the gradient of $R(\hat{\alpha}_r)$ be equal to zero; i.e., $\nabla_{\hat{\alpha}_r} R(\hat{\alpha}_r)=0$. Thus, assuming the $\nabla_{\hat{\alpha}_r}\ y(k)=0$, from (2.1-4) we obtain

$$\nabla_{\hat{\alpha}_r}\ R(\hat{\alpha}_r) = -2 \sum_{k=1}^{r} [\ y(k) - \hat{g}(k)\ ]\ \nabla_{\hat{\alpha}_r}\ \hat{g}(k) \qquad (2.1\text{-}5)$$

Now, from (2.1-3) we have

$$\nabla_{\hat{\alpha}_r} \hat{g}(k) = \beta_k \tag{2.1-6}$$

Substitution of (2.1-6) in (2.1-5) results in

$$\nabla_{\hat{\alpha}_r} R(\hat{\alpha}_r) = -2 \sum_{k=1}^{r} [\ y(k) - \hat{\alpha}_r^T \ \beta_k \ ] \ \beta_k \tag{2.1-7}$$

Since the quantity $\alpha_r^T \beta_k$ is a scalar, (2.1-7) can alternately be expressed as

$$\nabla_{\hat{\alpha}_r} R(\hat{\alpha}_r) = -2 \sum_{k=1}^{r} [\ y(k)\ \beta_k - \beta_k\ B_k^T\ \hat{\alpha}_r \ ] \tag{2.1-8}$$

Thus the condition $\nabla_{\hat{\alpha}_r} R(\hat{\alpha}_r)=0$ causes (2.1-8) to yield

$$\hat{\alpha}_r = P_r^{-1} \ [\ \sum_{k=1}^{r} y(k)\ \beta_k \ ] \tag{2.1-9}$$

where

$$P_r = \sum_{k=1}^{r} \beta_k\ \beta_k^T$$

and $\hat{\alpha}_r^T = [\ \hat{a}_{o,r}\ \hat{a}_{1,r} \ . \ . \ . \ \hat{a}_{m,r} \ ]$ is the desired estimate of the filter coefficient vector associated with the r-th iteration.

2.2 Recursive Computation

From (2.1-9) it is clear that $\hat{\alpha}_r$ is obtained using the data pertinent to r iterations. However, this is actually not necessary. We now show that $\hat{\alpha}_r$ can be computed recursively. First, (2.1-9) is rewritten in the form

$$P_r\ \hat{\alpha}_r = \sum_{k=1}^{r-1} y(k)\ \beta_k + y(r)\ \beta_r \tag{2.2-1}$$

Next, addition and subtraction of $\beta_r B_r^T \hat{\alpha}_{r-1}$ to the right-hand

side of (2.2-1) results in

$$P_r \hat{\alpha}_r = [\sum_{k=1}^{r-1} \beta_k \beta_k^T + \beta_r \beta_r^T] \hat{\alpha}_{r-1} + \beta_r [y(r) - \beta_r^T \hat{\alpha}_{r-1}]$$

$$= P_r \hat{\alpha}_{r-1} + \beta_r [y(r) - \beta_r^T \hat{\alpha}_{r-1}] \qquad (2.2\text{-}2)$$

Finally, premultiplying by P_r^{-1} we obtain

$$\hat{\alpha}_r = \hat{\alpha}_{r-1} + P_r^{-1} \beta_r [y(r) - \beta_r^T \hat{\alpha}_{r-1}] \qquad (2.2\text{-}3)$$

That is, [see Fig. (1)]

$$\hat{\alpha}_r = \hat{\alpha}_{r-1} + P_r^{-1} \beta_r \mathcal{E}(r) \qquad (2.2\text{-}4)$$

where $\mathcal{E}(r)$ is the error associated with the r-th iteration.

Thus from (2.2-4) we conclude that $\hat{\alpha}_r$ can be computed recursively using the relation

$$\hat{\alpha}_k = \hat{\alpha}_{k-1} + P_k^{-1} \beta_k \mathcal{E}(k) , \quad k=1, 2, ... , r \qquad (2.2\text{-}5)$$

2.3. Recurrence Relation for P_k^{-1}

We now show that P_k^{-1} in (2.2-5) can be computed in a recursive manner. From the definition of P_r in (2.1-9), we observe that it is real-symmetric, and can be expressed as

$$P_k = P_{k-1} + H_k H_k^T \qquad (2.3\text{-}1)$$

where H_k is an $(m \times 1)$ vector*. Premultiplication by P_k^{-1} and postmultiplication by P_{k-1}^{-1} of both sides of (2.3-1) results in

$$P_k^{-1} P_k P_{k-1}^{-1} = P_k^{-1} P_{k-1} P_{k-1}^{-1} + P_k^{-1} H_k H_k^T P_{k-1}^{-1}$$

---

*

which yields

$$P_{k-1}^{-1} = P_k^{-1} + P_k^{-1} H_k H_k^T P_{k-1}^{-1} \qquad (2.3\text{-}2)$$

Now, postmultiplying (2.3-2) by H_k we obtain

$$P_{k-1}^{-1} H_k = P_k^{-1} H_k (1 + H_k^T P_{k-1}^{-1} H_k) \qquad (2.3\text{-}3)$$

Postmultiplication of both sides of (2.3-3) by

$$(1 + H_k^T P_{k-1}^{-1} H_k)^{-1} H_k^T P_{k-1}^{-1}$$

leads to

$$P_{k-1}^{-1} H_k (1 + H_k^T P_{k-1}^{-1} H_k)^{-1} H_k^T P_{k-1}^{-1} = P_k^{-1} H_k H_k^T P_{k-1}^{-1} \qquad (2.3\text{-}4)$$

Again, from (2.3-2) it follows that

$$P_{k-1}^{-1} - P_k^{-1} = P_k^{-1} H_k H_k^T P_{k-1}^{-1} \qquad (2.3\text{-}5)$$

Substituting (2.3-5) in (2.3-4) we obtain

$$P_{k-1}^{-1} H_k (1 + H_k^T P_{k-1}^{-1} H_k)^{-1} H_k^T P_{k-1}^{-1} = P_{k-1}^{-1} - P_k^{-1}$$

which yields

$$P_k^{-1} = P_{k-1}^{-1} - P_{k-1}^{-1} H_k (1 + H_k^T P_{k-1}^{-1} H_k)^{-1} H_k^T P_{k-1}^{-1} \qquad (2.3\text{-}6)$$

In (2.3-6) it is important to note that the quantity

$$\gamma = (1 + H_k^T P_{k-1}^{-1} H_k) \qquad (2.3\text{-}7)$$

is a scalar. Thus (2.3-6) can be written as

$$P_k^{-1} = P_{k-1}^{-1} - \frac{1}{\gamma} P_{k-1}^{-1} H_k H_k^T P_{k-1}^{-1} \tag{2.3-8}$$

From (2.3-8) it is clear that P_k^{-1} can be computed recursively, provided some initial P_{k-1}^{-1} is known. However, even this is not necessary according to the following argument by Graupe [1].

First, from (2.3-1) we have (with k=1)

$$P_1 = P_o + H_1 H_1^T \tag{2.3-9}$$

However, by definition

$$P_1 = H_1 H_1^T \tag{2.3-10}$$

Clearly, for (2.3-9) and (2.3-10) to be satisfied, the condition to be satisfied is that

$$P_o = 0 \tag{2.3-11}$$

Thus, to avoid the singularity problem,we let

$$P_o = \epsilon I \tag{2.3-12}$$

where $\epsilon \longrightarrow 0$ and I is the (mxm) identity matrix; i.e.

$$P_o^{-1} = \frac{1}{\epsilon} I \tag{2.3-13}$$

In (2.3-13) $1/\epsilon$ can be chosen almost arbitrarily between 10 and the highest number that can be stored in the computer. Thus, with the initial value of P_o^{-1} as given by (2.3-13), successive P_k^{-1} can be computed recursively using (2.3-8). It has been stated that the P_k^{-1} computed with this initial guess converges to the exact value of the inverse.

2.4. Numerical Examples

The purpose of this section is to present two numerical examples which employ the recurrence relation in (2.3-8) starting with an initial guess.

<u>Example 2.4-1</u> A sequence of 2000 gaussian random numbers (see Appendix I) are grouped into (1x8) vectors, H_k^T, to obtain a set of 250 vectors. Compute the inverse of correlation matrix

$$P_{250} = \sum_{k=1}^{250} H_k H_k^T$$

using the recurrence relation in (2.3-8), and compare the same with the exact inverse obtained via the IBM subroutine INVERS.

Solution: Let $\hat{P}_k$ denote the exact inverse of the k-th iteration, then the corresponding "deviation matrix" is given by

$$D_k = P_k^{-1} - \hat{P}_k$$

The related mean square value is

$$\overline{\|D_k\|^2} = \frac{1}{64} \sum_i \sum_j d_{ij}^2$$

where d_{ij} denotes an element of D_k. Hence the root-mean square (RMS) error is given by

$$e_{rms} = \sqrt{\overline{\|D_k\|^2}} \qquad (2.4\text{-}1)$$

The results obtained using the above data are summarized in Table (2.4-1) for three values of ϵ , where ϵ defines the

Table 2.4-1. RMS error versus number of vectors processed.

Mean=0.0

Variance=0.50

NUMBER OF VECTORS	RMS ERROR		
	ϵ =0.0001	ϵ =0.01	ϵ =1.0
10	0.279	13.782	48.228
20	0.011	0.026	1.442
30	0.008	0.011	0.754
40	0.007	0.006	0.451
50	0.005	0.005	0.399
60	0.005	0.003	0.251
70	0.003	0.002	0.168
80	0.002	0.002	0.148
90	0.002	0.001	0.113
100	0.002	0.001	0.092
110	0.002	0.001	0.087
120	0.001	0.001	0.075
130	0.001	0.001	0.069
140	0.001	0.001	0.063
150	0.001	0.001	0.061
160	0.001	0.001	0.056
170	0.001	0.001	0.051
180	0.001	0.001	0.047
190	0.001	0.001	0.044
200	0.001	0.000	0.040
210	0.001	0.000	0.037
220	0.001	0.000	0.037
230	0.001	0.000	0.036
240	0.001	0.000	0.035
250	0.001	0.000	0.034

initial guess; see (2.3-13).

Similar results are presented in Tables (2.4-2) through (2.4-4) for the cases when the variances of the data sequences are 2, 20, and 50 respectively for three values of ϵ , namely 0.0001, 0.01, and 1.0.

From the above results it is apparent that values of $\epsilon \leq 0.01$ work satisfactorily for all three data sequences regardless of their variances which vary from 0.5 to 50.

Example 2.4-2 Using the sequence of 2000 numbers* given in Appendix II, compute the inverse of the correlation matrix

$$P_{250} = \sum_{k=1}^{250} H_k \, H_k^T$$

where the H_k's are (8x1) vectors. Use the recurrence relation in (2.3-8), and compare the same with the exact inverse obtained via the IBM subroutine INVERS.

Solution: As in the case of Example 2.4-1 we denote the exact inverse at the k-th iteration by $\hat{P}_k$. Then, using the same notation as in Example 2.4-1, we obtain the results summarized in Table 2.4-5. We observe that even here, a value of ϵ less than or equal to 0.01 works satisfactorily.

The solution to Example 2.4-1 and 2.4-2 is accomplished by the computer program listed in Appendix III.

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*Data obtained from Scandia Laboratories, Alburquerque, N.M.

Table 2.4-2. RMS error versus number of vectors processed.

Mean=0.0

Variance=2

NUMBER OF VECTORS	RMS ERROR		
	ϵ=0.0001	ϵ=0.01	ϵ=1.0
10	0.190	0.073	2.176
20	0.009	0.000	0.010
30	0.005	0.000	0.004
40	0.004	0.000	0.002
50	0.003	0.000	0.002
60	0.003	0.000	0.001
70	0.002	0.000	0.001
80	0.001	0.000	0.001
90	0.001	0.000	0.000
100	0.001	0.000	0.000
110	0.001	0.000	0.000
120	0.001	0.000	0.000
130	0.001	0.000	0.000
140	0.001	0.000	0.000
150	0.001	0.000	0.000
160	0.000	0.000	0.000
170	0.000	0.000	0.000
180	0.000	0.000	0.000
190	0.000	0.000	0.000
200	0.000	0.000	0.000
210	0.000	0.000	0.000
220	0.000	0.000	0.000
230	0.000	0.000	0.000
240	0.000	0.000	0.000
250	0.000	0.000	0.000

Table 2.4-3. RMS error versus number of vectors processed.

Mean=0.0

Variance=20

NUMBER OF VECTORS	RMS ERROR		
	ϵ=0.0001	ϵ=0.01	ϵ=1.0
10	0.058	0.002	0.000
20	0.002	0.000	0.000
30	0.001	0.000	0.000
40	0.000	0.000	0.000
50	0.000	0.000	0.000
60	0.000	0.000	0.000
70	0.000	0.000	0.000
80	0.000	0.000	0.000
90	0.000	0.000	0.000
100	0.000	0.000	0.000
110	0.000	0.000	0.000
120	0.000	0.000	0.000
130	0.000	0.000	0.000
140	0.000	0.000	0.000
150	0.000	0.000	0.000
160	0.000	0.000	0.000
170	0.000	0.000	0.000
180	0.000	0.000	0.000
190	0.000	0.000	0.000
200	0.000	0.000	0.000
210	0.000	0.000	0.000
220	0.000	0.000	0.000
230	0.000	0.000	0.000
240	0.000	0.000	0.000
250	0.000	0.000	0.000

Table 2.4-4. RMS error versus number of vectors processed.

Mean=0.0

Variance=50.00

NUMBER OF VECTORS	RMS ERROR		
	ϵ=0.0001	ϵ=0.01	ϵ=1.0
10	0.060	0.001	0.000
20	0.004	0.000	0.000
30	0.000	0.000	0.000
40	0.000	0.000	0.000
50	0.000	0.000	0.000
60	0.000	0.000	0.000
70	0.000	0.000	0.000
80	0.000	0.000	0.000
90	0.000	0.000	0.000
100	0.000	0.000	0.000
110	0.000	0.000	0.000
120	0.000	0.000	0.000
130	0.000	0.000	0.000
140	0.000	0.000	0.000
150	0.000	0.000	0.000
160	0.000	0.000	0.000
170	0.000	0.000	0.000
180	0.000	0.000	0.000
190	0.000	0.000	0.000
200	0.000	0.000	0.000
210	0.000	0.000	0.000
220	0.000	0.000	0.000
230	0.000	0.000	0.000
240	0.000	0.000	0.000
250	0.000	0.000	0.000

Table 2.4-5. RMS error versus number of vectors processed.

Mean=5.45

Variance=16.37

NUMBER OF VECTORS	RMS ERROR $\epsilon=0.0001$	RMS ERROR $\epsilon=0.01$	RMS ERROR $\epsilon=1.0$
10	9.222	2.295	17.425
20	1.300	0.039	1.270
30	0.419	0.028	1.247
40	0.372	0.030	0.568
50	0.161	0.023	0.434
60	0.110	0.017	0.288
70	0.102	0.015	0.261
80	0.082	0.016	0.270
90	0.064	0.009	0.187
100	0.059	0.007	0.161
110	0.053	0.005	0.146
120	0.051	0.004	0.143
130	0.031	0.003	0.061
140	0.029	0.002	0.053
150	0.023	0.002	0.040
160	0.023	0.001	0.038
170	0.012	0.001	0.014
180	0.011	0.001	0.014
190	0.011	0.001	0.014
200	0.011	0.001	0.014
210	0.010	0.001	0.014
220	0.008	0.004	0.016
230	0.006	0.007	0.021
240	0.006	0.010	0.023
250	0.007	0.009	0.022

CHAPTER III

PATTERN CLASSIFICATION

In this chapter it is demonstrated that the matrix inversion recurrence relation given by (2.3-8) can be used to design a least-square pattern classifier on an adaptive basis. This demonstration is carried out via three examples. Before presenting these examples, a brief discussion related to the notion of a pattern recognition system, and a specific least-squares classifier will be presented in Sections 3.1 through 3.3. The pertinent material is essentially taken from [2].

3.1. Introduction

A pattern recognition system mainly consists of two parts: 1) feature selection; 2) classifier design.

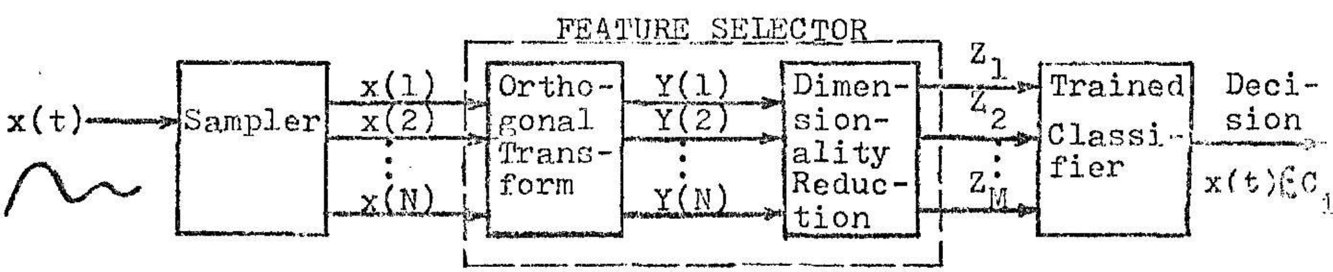

Fig. (3.1.1) A pattern recognition system

In the feature selection part the sampled values of x(t) go through the process of transformation and dimensionality reduction[1]. The reduced output vector is referred to as "pattern

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[1]This dimensionality reduction must be achieved such that the corresponding increase in classification error is relatively small.

vector" which is used as an input to the second part of the system, the trained classifier. The "classifier" is a decision making device that is trained to classify an incoming signal, x(t), as belonging to one of the K classes denoted by C_1, C_2, . . . , C_K. In designing classifiers one is concerned with the concept of "training" — i.e., a process in which one uses a set of pattern vectors whose true classification is known (called the training set) to find a discriminant function, g(z), which represents the classifier. The general form of g(z) is as follows:

$$g(z) = W_1 Z_1 + W_2 Z_2 + \cdots + W_d Z_d - \theta \qquad (3.1\text{-}1)$$

By means of the discriminant function in (3.1-1) and an appropriate decision rule, one is able to perform the desired classification of patterns.

3.2. Minimum-Distance Classifier

In a minimum distance classifier, the discriminant function and the decision rule are such that it would classify the given pattern Z as belonging to C_i if Z is closest to its mean vector $\overline{Z}_i$ for i=1, 2, . . . , K. The design of such classifiers is based on the assumption that the pattern classes in the feature space cluster around their respective means $\overline{Z}_i$, for i=1, 2, . . . , K. However, this may not be a reasonable assumption in many applications and this leads to the idea of "least-squares mapping technique".

The least-squares mapping technique consists of mapping the given patterns into a decision space wherein the patterns belonging to C_i are made to cluster around a preselected point V_i, i=1, 2, ... , K. This mapping is achieved by the transformation matrix A, and A is chosen such that the overall mean-square mapping error is minimized. Next, a minimum distance classifier which uses this mapping technique is described. It is referred to as a "least-squares minimum distance classifier".

3.3. Least-Squares Minimum Distance Classifier

For the purposes of discussion, it suffices to consider the case where three classes are present. The extension to the general K-class case is straightforward.

Suppose we are given a set of d-dimensional pattern vectors $\{Z\}$. We first augment Z with a new component equal to '-1' to obtain $\hat{Z}$. Now, we seek a transformation matrix, A, which maps $Z \in C_k$ into V_k for k=1, 2, 3 in the least-square sense, and we take V_k to be the vertices of the three unit vectors as shown in Fig. (3.3-1).

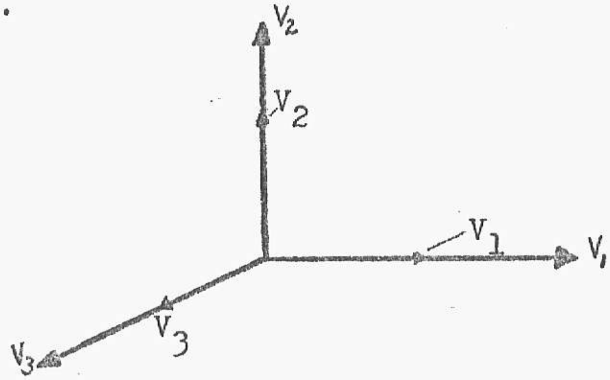

Fig. (3.3-1) Decision space for a 3-class classifier.

The transformation matrix which yields the minimum mean square mapping error is given by [2]:

$$A = \left[\frac{1}{N_i} \sum_{j=1}^{N_i} V_i Z_{ij}^T \right] \left[\frac{1}{N_i} \sum_{j=1}^{N_i} Z_{ij} Z_{ij}^T \right]^{-1} \qquad (3.3\text{-}1)$$

where N_i denotes the number of patterns in class i, and Z_{ij} denotes the pattern belonging to class i, for each class. If we suppose that the a priori probability of C_k is P_k, k=1, 2, 3, then A becomes

$$A \left[\frac{P_1}{N_1} \sum_{j=1}^{N_1} \hat{Z}_{1j} \hat{Z}_{1j}^T + \frac{P_2}{N_2} \sum_{j=1}^{N_2} \hat{Z}_{2j} \hat{Z}_{2j}^T + \frac{P_3}{N_3} \sum_{j=1}^{N_3} \hat{Z}_{3j} \hat{Z}_{3j}^T \right]$$

$$= \left[\frac{P_1}{N_1} \sum_{j=1}^{N_1} V_1 \hat{Z}_{1j}^T + \frac{P_2}{N_2} \sum_{j=1}^{N_2} V_2 \hat{Z}_{2j}^T + \frac{P_3}{N_3} \sum_{j=1}^{N_3} V_3 \hat{Z}_{3j}^T \right]$$

That is

$$A = \left[\sum_{i=1}^{3} \frac{P_i}{N_i} \sum_{j=1}^{N_i} V_i \hat{Z}_{ij}^T \right] \left[\sum_{i=1}^{3} \frac{P_i}{N_i} \sum_{j=1}^{N_i} \hat{Z}_{ij} \hat{Z}_{ij}^T \right]^{-1}$$

$$= \left[\sum_{i=1}^{3} \sum_{j=1}^{N_i} \frac{P_i}{N_i} V_i \hat{Z}_{ij}^T \right] \left[\sum_{i=1}^{3} \sum_{j=1}^{N_i} \frac{P_i}{N_i} \hat{Z}_{ij} \hat{Z}_{ij}^T \right]^{-1}$$

Now, by definition

$$S_{v\hat{z}} = \sum_{i=1}^{3} \sum_{j=1}^{N_i} \frac{P_i}{N_i} (V_i \hat{Z}_{ij}^T) \equiv E(V\hat{Z}^T)$$

$$S_{\hat{z}\hat{z}} = \sum_{i=1}^{3} \sum_{j=1}^{N_i} \frac{P_i}{N_i} (\hat{Z}_{ij} \hat{Z}_{ij}^T) \equiv E(\hat{Z}\hat{Z}^T)$$

where $S_{v\hat{z}}$ and $S_{\hat{z}\hat{z}}$ are called crosscorrelation and autocorrelation matrices respectively. Hence A can be expressed as

$$A = (S_{V\hat{Z}})(S_{\hat{Z}\hat{Z}})^{-1} \qquad (3.3\text{-}2)$$

We also note that V is a (3x1) matrix and $\hat{Z}^T$ is a [1x(d+1)] matrix. Hence $S_{V\hat{Z}}$ is a 3x(d+1) matrix and $S_{\hat{Z}\hat{Z}}$ is a (d+1) x (d+1) matrix. Thus the transformation matrix A is a [3x(d+1)] matrix.

Having the transformation matrix, we can map Z into the decision space. At this stage we proceed to construct the discriminant function such that it satisfies the minimum distance criteria.

Let L be the transformed pattern of $\hat{Z}$ via transformation matrix A. That is, $L=A\hat{Z}$.

We want to have $\hat{Z}$ classified as belonging to C_{io} if L is closest to V_{io}. Thus, it is necessary to find the distances between L and the preselected vectors V_i for i=1, 2, 3 and select the minimum of the three, i.e.

$$D_i^2 = \|L-V_i\|^2 = \|L\|^2 - 2V_i^TL + \|V_i\|^2 \text{ , } i = 1, 2, 3 \qquad (3.3\text{-}3)$$

where D_i is the distance between L and V_i. Now, since $\|V_i\|^2 = 1$ for i=1, 2, 3, (3.3-3) simplifies to

$$D_i^2 = \|L\|^2 + 1 - 2V_i^TL \quad \text{for } i=1, 2, 3 \qquad (3.3\text{-}4)$$

It can be observed that D_i^2, and consequently D_i, is minimum when V_i^TL is maximum. Therefore, it is sufficient for us to design our classifier such that it would only check on the value of V_i^TL. Let $b_i=V_i^TL$ for i=1, 2, 3, where $L = A\hat{Z}$ and

$$V_1^T = [\ 1\ 0\ 0\ ]$$

$$V_2^T = [\ 0\ 1\ 0\ ]$$

$$V_3^T = [\ 0\ 0\ 1\ ]$$

We can write this in matrix form as follows

$$\begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad A\hat{Z} = A\hat{Z} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1d} & \theta_1 \\ a_{21} & a_{22} & \cdots & a_{2d} & \theta_2 \\ a_{31} & a_{32} & \cdots & a_{3d} & \theta_3 \end{bmatrix} \begin{bmatrix} Z_1 \\ Z_2 \\ \vdots \\ Z_d \\ -1 \end{bmatrix}$$

Thus the discriminant functions are

$$g_1(z) = a_{11} Z_1 + a_{12} Z_2 + \ldots + a_{1d} Z_d - \theta_1$$

$$g_2(z) = a_{21} Z_1 + a_{22} Z_2 + \ldots + a_{2d} Z_d - \theta_2$$

$$g_3(z) = a_{31} Z_1 + a_{32} Z_2 + \ldots + a_{3d} Z_d - \theta_3$$

To classify a given pattern, the classifier computes $g_1(z)$, $g_2(z)$ and $g_3(z)$ and assigns the pattern to C_{io}, if Max $[g_i(z)] = g_{io}$ for i=1, 2, 3.

3.4. Adaptive Considerations

We observe that the classifier described in Section 3.3 is completely defined by the transformation matrix A, which is given by

$$A = S_{v\hat{z}}\ S_{\hat{z}\hat{z}}^{-1} \qquad (3.4\text{-}1)$$

Equation (3.4-1) implies that there is a matrix inversion involved in the computation of A. Moreover, the autocorrelation matrix $S_{\hat{z}\hat{z}}$ is a symmetric matrix and hence can be computed recursively using (2.3-8). This aspect is illustrated in what follows via two examples.

Example 3.4-1. Consider a 2-dimensional training set to be as follows:

$$C_1: \begin{bmatrix} 0 \\ 3 \end{bmatrix}, \begin{bmatrix} -1 \\ 3 \end{bmatrix}, \begin{bmatrix} -2 \\ 3 \end{bmatrix}, \begin{bmatrix} -3 \\ 3 \end{bmatrix}, \begin{bmatrix} -4 \\ 3 \end{bmatrix}$$

$$C_2: \begin{bmatrix} 5 \\ 5 \end{bmatrix} \begin{bmatrix} 6 \\ 5 \end{bmatrix} \begin{bmatrix} 6 \\ 6 \end{bmatrix} \begin{bmatrix} 6 \\ 7 \end{bmatrix} \begin{bmatrix} 7 \\ 5 \end{bmatrix}$$

$$C_3: \begin{bmatrix} 6 \\ -1 \end{bmatrix} \begin{bmatrix} 7 \\ 0 \end{bmatrix} \begin{bmatrix} 8 \\ 1 \end{bmatrix} \begin{bmatrix} 9 \\ 1 \end{bmatrix} \begin{bmatrix} 10 \\ 1 \end{bmatrix}$$

Assuming that $P_1 = P_2 = P_3 = 1/3$, compute and print $S_{\hat{z}\hat{z}}$, $S_{\hat{z}\hat{z}}^{-1}$, $S_{v\hat{z}}$ and A, as the above training set vectors are processed.

Solution: The solution to this example is obtained using the following steps:

Step 1 - Augment the training set vectors by adding a component -1.

Step 2 - Use Eq. (2.3-8) to compute the inverse autocorrelation matrix, $S_{\hat{z}\hat{z}}^{-1}$ with $\epsilon = 0.01$.

Step 3 - Compute the crosscorrelation matrix $S_{v\hat{z}}$.

Step 4 - Multiply the results obtained in steps 2 and 3 to obtain the transformation matrix A as defined in (3.4-1).

Steps 2 through 4 are accomplished by the computer program listed in Appendix III, and the corresponding results are summarized in Table 3.4-1. From this table it is apparent that the

Table 3.4-1. Pertaining to Example 3.4-1.

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	0.0	0.0	0.0	100.00	0.0	0.0	0.0	3.000	-1.000	0.0	0.300	-0.100
1	0.0	9.000	-3.000	0.0	10.090	29.970	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	-3.000	1.000	0.0	29.970	90.010	0.0	0.0	0.0	0.0	0.0	0.0
	0.500	-1.500	0.500	3.920	0.588	-0.196	-0.500	3.000	-1.000	-0.001	0.300	-0.100
2	-1.500	9.000	-3.000	0.588	20.178	59.941	0.0	0.0	0.0	0.0	0.0	0.0
	0.500	-3.000	1.000	-0.196	59.941	180.020	0.0	0.0	0.0	0.0	0.0	0.0
	1.667	-3.000	1.000	1.492	0.447	-0.149	-1.000	3.000	-1.000	-0.000	0.300	-0.100
3	-3.000	9.000	-3.000	0.447	30.224	89,925	0.0	0.0	0.0	0.0	0.0	0.0
	1.000	-3.000	1.000	-0.149	89.925	270.025	0.0	0.0	0.0	0.0	0.0	0.0
	3.500	-4.500	1.500	0.798	0.359	-0.120	-1.500	3.000	-1.000	-0.000	0.300	-0.100
4	-4.500	9.000	-3.000	0.359	40.252	119.916	0.0	0.0	0.0	0.0	0.0	0.0
	1.500	-3.000	1.000	-0.120	119.916	360.028	0.0	0.0	0.0	0.0	0.0	0.0
	6.000	-6.000	2.000	0.499	0.300	-0.100	-2.000	3.000	-1.000	-0.000	0.300	-0.100
5	-6.000	9.000	-3.000	0.300	50.270	149.910	0.0	0.0	0.0	0.0	0.0	0.0
	2.000	-3.000	1.000	-0.100	149.910	450.030	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.4-1. Pertaining to Example 3.4-1. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	9.167	-0.833	0.833	0.516	-1.738	-6.213	-1.667	2.500	-0.833	-0.027	-0.383	-2.083
6	-0.833	11.667	-3.333	-1.738	7.593	26.716	0.833	0.833	-0.167	0.017	0.427	1.240
	0.833	-3.333	1.000	-6.213	26.716	95.073	0.0	0.0	0.0	0.0	0.0	0.0
	13.000	3.571	-0.143	0.566	-2.075	-7.319	-1.429	2.143	-0.714	-0.028	-0.383	-2.084
7	3.571	13.571	-3.571	-2.075	8.796	31.075	1.571	1.429	-0.286	0.017	0.427	1.240
	-0.143	-3.571	1.000	-7.319	31.075	110.779	0.0	0.0	0.0	0.0	0.0	0.0
	15.875	7.625	-0.875	0.479	-1.473	-5.280	-1.250	1.875	-0.625	-0.060	-0.210	-1.491
8	7.625	16.375	-3.875	-1.473	5.250	19.032	2.125	2.000	-0.375	0.053	0.234	0.578
	-0.875	-3.875	1.000	-5.280	19.032	70.042	0.0	0.0	0.0	0.0	0.0	0.0
	18.111	11.444	-1.444	0.337	-0.822	-2.980	-1.111	1.667	-0.556	-0.088	-0.093	-1.074
9	11.444	20.000	-4.222	-0.822	2.461	9.194	2.556	2.556	-0.444	0.085	0.103	0.113
	-1.444	-4.222	1.000	-2.980	9.194	35.478	0.0	0.0	0.0	0.0	0.0	0.0
	21.200	13.800	-2.000	0.261	-0.669	-2.352	-1.000	1.500	-0.500	-0.088	-0.094	-1.080
10	13.800	20.500	-4.300	-0.669	2.209	8.155	3.000	2.800	-0.500	0.085	0.102	0.111
	-2.000	-4.300	1.000	-2.352	8.155	31.329	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.4-1. Pertaining to Example 3.4-1. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S_{\hat{z}\hat{z}}^{-1}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	22.545	12.000	-2.364	0.067	-0.048	-0.025	-0.909	1.364	-0.455	-0.116	-0.006	-0.751
11	12.000	18.727	-3.818	-0.048	0.275	0.934	2.727	2.545	-0.455	0.072	0.143	0.263
	-2.364	-3.818	1.000	-0.025	0.934	4.505	0.545	-0.091	-0.091	0.043	-0.136	-0.508
	24.750	11.000	-2.750	0.060	-0.017	0.105	-0.833	1.250	-0.417	-0.114	-0.010	-0.765
12	11.000	17.167	-3.500	-0.017	0.208	0.680	2.500	2.333	-0.417	0.066	0.159	0.322
	-2.750	-3.500	1.000	0.105	0.680	3.667	1.083	-0.083	-0.167	0.048	-0.149	-0.554
	27.769	10.769	-3.154	0.056	-0.004	0.164	-0.769	1.154	-0.385	-0.111	-0.016	-0.786
13	10.769	15.923	-3.308	-0.004	0.201	0.651	2.308	2.154	-0.385	0.058	0.173	0.370
	-3.154	-3.308	1.000	0.164	0.651	3.668	1.615	0.0	-0.231	0.053	-0.156	-0.581
	31.571	10.643	-3.571	0.053	0.006	0.210	-0.714	1.071	-0.357	-0.106	-0.022	-0.807
14	10.643	14.857	-3.143	0.006	0.201	0.654	2.143	2.000	-0.357	0.052	0.182	0.399
	-3.571	-3.143	1.000	0.210	0.654	3.801	2.143	0.071	-0.286	0.055	-0.159	-0.590
	36.133	10.600	-4.000	0.051	0.014	0.245	-0.667	1.000	-0.333	-0.101	-0.028	-0.823
15	10.600	13.933	-3.000	0.014	0.206	0.676	2.000	1.867	-0.333	0.046	0.189	0.417
	-4.000	-3.000	1.000	0.245	0.676	4.007	2.667	0.133	-0.333	0.055	-0.160	-0.591

final value of the transformation matrix A is given by

$$A = \begin{bmatrix} -0.101 & -0.028 & -0.823 \\ 0.046 & 0.189 & 0.417 \\ 0.055 & -0.160 & -0.591 \end{bmatrix}$$

It is found that this value for A is exactly the same as that obtained directly (see [2]) i.e., without resorting to the recurrence relation in (2.3-8).

Example 3.4-2. Consider the training set given in Table 3.4-2. Assuming that $P_1 = P_2 = P_3 = 1/3$, compute and print $S_{\hat{z}\hat{z}}$, $S_{\hat{z}\hat{z}}^{-1}$, $S_{v\hat{z}}$ and A as the training set vectors are processed.

Locate the boundaries corresponding to the final value of the transformation matrix A.

Solution: Using the four steps cited in the solution to the previous example, we obtain the results that are summarized in Table 3.4-3. From this table it is apparent that the final value of A is given by

$$A = \begin{bmatrix} 0.032 & -0.002 & 0.321 \\ -0.025 & 0.029 & 0.377 \\ -0.007 & -0.026 & -1.660 \end{bmatrix}$$

The corresponding boundaries are located in Fig. 3.4-1, from which it is apparent that the position of the boundaries separate the patterns of the three classes C_1, C_2, and C_3 adequately.

Table 3.4-2. Training set for Example 3.5-2.

CLASS #	Z_1	Z_2	CLASS #	Z_1	Z_2	CLASS #	Z_1	Z_2
1	44	61	2	19	59	3	20	40
1	40	59	2	13	58	3	22	45
1	41	55	2	11	56	3	18	42
1	39	53	2	20	56	3	24	42
1	44	53	2	16	55	3	14	41
1	43	50	2	10	53	3	20	41
1	41	50	2	15	50	3	17	40
1	43	46	2	12	50	3	20	38
1	40	45	2	6	48	3	24	38
1	44	44	2	11	46	3	9	39
1	40	42	2	8	44	3	4	36
1	39	40	2	11	43	3	15	36
1	42	40	2	3	41	3	10	35
1	36	36	2	5	37	3	19	34
1	43	36	2	8	36	3	10	31
1	39	33	2	5	34	3	15	31

Table 3.4-3. Pertaining to Example 3.4-2.

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	1936.000	2684.000	-44.000	65.783	-47.437	0.778	44.000	61.000	-1.000	0.009	0.012	-0.000
1	2684.000	3721.000	-61.000	-47.437	34.235	1.078	0.0	0.0	0.0	0.0	0.0	0.0
	-44.000	-61.000	1.000	0.778	1.078	99.982	0.0	0.0	0.0	0.0	0.0	0.0
	1768.000	2522.000	-42.000	0.673	-0.513	-2.542	42.000	60.000	-1.000	0.053	-0.019	0.001
2	2522.000	3601.000	-60.000	-0.513	0.444	5.110	0.0	0.0	0.0	0.0	0.0	0.0
	-42.000	-60.000	1.000	-2.542	5.110	199.836	0.0	0.0	0.0	0.0	0.0	0.0
	1739.000	2433.000	-41.667	0.432	-0.256	3.025	41.667	58.333	-1.000	0.028	0.003	0.298
3	2433.000	3409.000	-58.333	-0.256	0.211	1.595	0.0	0.0	0.0	0.0	0.0	0.0
	-41.667	-58.333	1.00	3.025	1.595	218.811	0.0	0.0	0.0	0.0	0.0	0.0
	1684.500	2341.500	-41.000	0.562	-0.317	4.968	41.000	57.000	-1.000	0.030	0.000	0.192
4	2341.500	3259.000	-57.000	-0.317	0.236	0.450	0.0	0.0	0.0	0.0	0.0	0.0
	-41.000	-57.000	1.000	4.968	0.450	229.123	0.0	0.0	0.0	0.0	0.0	0.0
	1734.800	2339.600	-41.600	0.189	-0.070	3.919	41.600	56.200	-1.000	0.012	0.012	0.113
5	2339.600	3169.000	-56.200	-0.070	0.088	2.015	0.0	0.0	0.0	0.0	0.0	0.0
	-41.600	-56.200	1.000	3.919	2.015	276.198	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	1753.833	2308.000	-41.833	0.171	-0.035	5.243	41.833	55.167	-1.000	0.013	0.010	0.098
6	2308.000	3057.500	-55.167	-0.035	0.062	1.939	0.0	0.0	0.0	0.0	0.0	0.0
	-41.833	-55.167	1.000	5.243	1.939	326.194	0.0	0.0	0.0	0.0	0.0	0.0
	1734.428	2271.143	-41.714	0.199	-0.038	6.215	41.714	54.429	-1.000	0.013	0.009	0.035
7	2271.143	2977.857	-54.429	-0.038	0.061	1.706	0.0	0.0	0.0	0.0	0.0	0.0
	-41.714	-54.429	1.000	5.215	1.706	352.076	0.0	0.0	0.0	0.0	0.0	0.0
	1756.625	2234.500	-41.875	0.198	-0.016	7.424	41.875	53.375	-1.000	0.015	0.008	0.018
8	2234.500	2870.125	-53.375	-0.016	0.043	1.650	0.0	0.0	0.0	0.0	0.0	0.0
	-41.875	-53.375	1.000	7.424	1.650	398.925	0.0	0.0	0.0	0.0	0.0	0.0
	1739.222	2186.222	-41.667	0.218	-0.025	7.776	41.667	52.444	-1.000	0.014	0.006	-0.147
9	2186.222	2776.222	-52.444	-0.025	0.039	1.013	0.0	0.0	0.0	0.0	0.0	0.0
	-41.667	-52.444	1.000	7.776	1.013	377.256	0.0	0.0	0.0	0.0	0.0	0.0
	1758.900	2161.200	-41.900	0.202	-0.007	8.127	41.900	51.600	-1.000	0.014	0.006	-0.147
10	2161.200	2692.200	-51.600	-0.007	0.032	1.393	0.0	0.0	0.0	0.0	0.0	0.0
	-41.900	-51.600	1.000	8.127	1.393	412.529	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	1744.454	2117.454	-41.727	0.215	-0.014	8.256	41.727	50.727	-1.000	0.012	0.004	-0.279
11	2117.454	2607.818	-50.727	-0.014	0.029	0.880	0.0	0.0	0.0	0.0	0.0	0.0
	-41.727	-50.727	1.000	8.256	0.880	389.433	0.0	0.0	0.0	0.0	0.0	0.0
	1725.833	2071.000	-41.500	0.223	-0.023	8.077	41.500	49.833	-1.000	0.011	0.003	-0.413
12	2071.000	2523.833	-49.833	-0.023	0.027	0.367	0.0	0.0	0.0	0.0	0.0	0.0
	-41.500	-49.833	1.000	8.077	0.367	353.878	0.0	0.0	0.0	0.0	0.0	0.0
	1728.769	2040.923	-41.538	0.233	-0.019	8.749	41.538	49.077	-1.000	0.011	0.003	-0.413
13	2040.923	2452.769	-49.077	-0.019	0.024	0.398	0.0	0.0	0.0	0.0	0.0	0.0
	-41.538	-49.077	1.000	8.749	0.398	383.368	0.0	0.0	0.0	0.0	0.0	0.0
	1697.857	1987.714	-41.143	0.199	-0.030	6.726	41.143	48.143	-1.000	0.007	0.002	-0.626
14	1987.714	2370.143	-48.143	-0.030	0.024	-0.111	0.0	0.0	0.0	0.0	0.0	0.0
	-41.143	-48.143	1.000	6.726	-0.111	271.994	0.0	0.0	0.0	0.0	0.0	0.0
	1707.933	1958.400	-41.267	0.184	-0.019	6.692	41.267	47.333	-1.000	0.007	0.002	-0.623
15	1958.400	2298.533	-47.333	-0.019	0.019	0.117	0.0	0.0	0.0	0.0	0.0	0.0
	-41.267	-47.333	1.000	6.692	0.117	282.314	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	1696.250	1916.438	-41.125	0.196	-0.022	7.010	41.125	46.438	-1.000	0.007	0.002	-0.656
16	1916.438	2222.938	-46.438	-0.022	0.018	-0.095	0.0	0.0	0.0	0.0	0.0	0.0
	-41.125	-46.438	1.000	7.010	-0.095	284.510	0.0	0.0	0.0	0.0	0.0	0.0
	1617.706	1869.647	-39.824	0.032	0.004	1.438	38.706	43.706	-0.941	0.038	-0.003	0.428
17	1869.647	2296.941	-47.176	0.004	0.015	0.835	1.118	3.471	-0.059	-0.036	0.006	-1.228
	-39.824	-47.176	1.000	1.438	0.835	97.454	0.0	0.0	0.0	0.0	0.0	0.0
	1537.222	1807.667	-38.333	0.016	0.005	0.879	36.556	41.278	-0.889	0.036	-0.003	0.340
18	1807.667	2356.222	-47.778	0.005	0.015	0.930	1.778	6.500	-0.111	-0.034	0.005	-1.164
	-38.333	-47.778	1.000	0.879	0.930	78.948	0.0	0.0	0.0	0.0	0.0	0.0
	1462.684	1744.947	-36.895	0.012	0.005	0.682	34.632	39.105	-0.842	0.035	-0.003	0.274
19	1744.947	2397.263	-48.211	0.005	0.016	0.973	2.263	9.105	-0.158	-0.033	0.006	-1.110
	-36.895	-48.211	1.000	0.682	0.973	72.897	0.0	0.0	0.0	0.0	0.0	0.0
	1409.550	1713.700	-36.050	0.011	0.006	0.684	32.900	37.150	-0.800	0.036	-0.004	0.324
20	1713.700	2434.200	-48.600	0.006	0.017	1.032	3.150	11.450	-0.200	-0.035	0.006	-1.161
	-36.050	-48.600	1.000	0.684	1.032	75.680	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	1354.619	1674.000	-35.095	0.010	0.006	0.656	31.333	35.381	-0.762	0.037	-0.004	0.343
21	1674.000	2462.333	-48.905	0.006	0.018	1.082	3.762	13.524	-0.238	-0.035	0.006	-1.182
	-35.095	-48.905	1.000	0.656	1.082	76.767	0.0	0.0	0.0	0.0	0.0	0.0
	1297.591	1622.000	-33.955	0.009	0.006	0.574	29.909	33.773	-0.727	0.035	-0.004	0.266
22	1622.000	2478.091	-49.091	0.006	0.018	1.095	4.045	15.318	-0.273	-0.034	0.006	-1.115
	-33.955	-49.091	1.000	0.574	1.095	74.086	0.0	0.0	0.0	0.0	0.0	0.0
	1250.956	1584.087	-33.130	0.008	0.005	0.532	28.609	32.304	-0.696	0.036	-0.004	0.292
23	1584.087	2479.043	-49.130	0.005	0.019	1.106	4.522	16.826	-0.304	-0.034	0.006	-1.147
	-33.130	-49.130	1.000	0.532	1.106	72.797	0.0	0.0	0.0	0.0	0.0	0.0
	1204.833	1543.083	-32.250	0.007	0.005	0.485	27.417	30.958	-0.667	0.035	-0.004	0.270
24	1543.083	2479.917	-49.167	0.005	0.019	1.113	4.833	18.208	-0.333	-0.034	0.006	-1.132
	-32.250	-49.167	1.000	0.485	1.113	71.239	0.0	0.0	0.0	0.0	0.0	0.0
	1158.080	1492.880	-31.200	0.006	0.004	0.404	26.320	29.720	-0.640	0.034	-0.005	0.148
25	1492.880	2472.880	-49.120	0.004	0.019	1.082	4.880	19.400	-0.360	-0.033	0.007	-1.022
	-31.200	-49.120	1.000	0.404	1.082	66.599	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	1118.192	1454.923	-30.423	0.006	0.004	0.358	25.308	28.577	-0.615	0.034	-0.005	0.140
26	1454.923	2459.154	-49.000	0.004	0.019	1.062	5.115	20.423	-0.385	-0.033	0.007	-1.023
	-30.423	-49.000	1.000	0.358	1.062	63.795	0.0	0.0	0.0	0.0	0.0	0.0
	1079.148	1414.074	-29.593	0.005	0.003	0.301	24.370	27.519	-0.593	0.033	-0.006	0.092
27	1414.074	2439.778	-48.815	0.003	0.019	1.019	5.222	21.296	-0.407	-0.032	0.008	-0.985
	-29.593	-48.815	1.000	0.301	1.019	59.526	0.0	0.0	0.0	0.0	0.0	0.0
	1044.928	1380.464	-28.929	0.005	0.002	0.264	23.500	26.536	-0.571	0.033	-0.006	0.099
28	1380.464	2418.678	-48.607	0.002	0.019	0.989	5.429	22.071	-0.429	-0.032	0.008	-1.000
	-28.929	-48.607	1.000	0.264	0.989	56.591	0.0	0.0	0.0	0.0	0.0	0.0
	1009.207	1337.103	-28.034	0.005	0.002	0.204	22.690	25.621	-0.552	0.032	-0.007	-0.007
29	1337.103	2393.241	-48.345	0.002	0.018	0.930	5.345	22.724	-0.448	-0.032	0.009	-0.905
	-28.034	-48.345	1.000	0.204	0.930	51.603	0.0	0.0	0.0	0.0	0.0	0.0
	976.400	1298.700	-27.267	0.004	0.001	0.153	21.933	24.767	-0.533	0.032	-0.008	-0.052
30	1298.700	2359.100	-47.967	0.001	0.017	0.848	5.333	23.200	-0.467	-0.031	0.009	-0.871
	-27.267	-47.967	1.000	0.153	0.848	45.781	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	946.968	1266.097	-26.645	0.004	0.000	0.121	21.226	23.968	-0.516	0.032	-0.008	-0.044
31	1266.097	2324.806	-47.581	0.000	0.016	0.786	5.419	23.613	-0.484	-0.031	0.009	-0.888
	-26.645	-47.581	1.000	0.121	0.786	41.563	0.0	0.0	0.0	0.0	0.0	0.0
	918.156	1231.844	-25.969	0.004	-0.000	0.087	20.563	23.219	-0.500	0.032	-0.008	-0.068
32	1231.844	2288.281	-47.156	-0.000	0.016	0.722	5.406	23.038	-0.500	-0.031	0.009	-0.873
	-25.969	-47.156	1.000	0.087	0.722	37.272	0.0	0.0	0.0	0.0	0.0	0.0
	902.454	1222.394	-25.788	0.004	-0.000	0.088	19.939	22.515	-0.485	0.032	-0.008	-0.045
33	1222.394	2283.061	-47.121	-0.000	0.016	0.744	5.242	23.212	-0.485	-0.031	0.010	-0.826
	-25.788	-47.121	1.000	0.088	0.744	38.273	0.606	1.394	-0.030	-0.001	-0.000	-0.069
	890.147	1215.559	-25.676	0.004	-0.000	0.090	19.353	21.853	-0.471	0.032	-0.008	-0.013
34	1215.559	2275.470	-47.059	-0.000	0.017	0.764	5.088	22.529	-0.471	-0.031	0.010	-0.777
	-25.676	-47.059	1.000	0.090	0.764	39.187	1.235	2.676	-0.059	-0.001	-0.001	-0.150
	873.971	1202.428	-25.457	0.004	-0.001	0.088	18.800	21.229	-0.457	0.032	-0.007	0.028
35	1202.428	2260.857	-46.914	-0.001	0.017	0.774	4.943	21.886	-0.457	-0.030	0.012	-0.676
	-25.457	-46.914	1.000	0.088	0.774	39.468	1.714	3.800	-0.086	-0.002	-0.003	-0.293

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S^{-1}_{\hat{z}\hat{z}}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	865.694	1197.028	-25.417	0.005	-0.001	0.090	18.278	20.639	-0.444	0.032	-0.006	0.088
36	1197.028	2247.055	-46.778	-0.001	0.017	0.785	4.806	21.278	-0.444	-0.030	0.013	-0.617
	-25.417	-46.778	1.000	0.090	0.785	39.925	2.333	4.861	-0.111	-0.002	-0.005	-0.413
	847.594	1180.189	-25.108	0.005	-0.001	0.083	17.784	20.081	-0.432	0.032	-0.006	0.108
37	1180.189	2231.757	-46.622	-0.001	0.017	0.791	4.676	20.703	-0.432	-0.029	0.014	-0.495
	-25.108	-46.622	1.000	0.083	0.791	39.894	2.649	5.838	-0.135	-0.003	-0.007	-0.555
	835.816	1170.710	-24.974	0.005	-0.001	0.083	17.316	19.553	-0.421	0.033	-0.005	0.153
38	1170.710	2217.263	-46.474	-0.001	0.018	0.798	4.553	20.158	-0.421	-0.029	0.016	-0.420
	-24.974	-46.474	1.000	0.083	0.798	40.074	3.105	6.763	-0.158	-0.004	-0.009	-0.677
	821.795	1158.128	-24.769	0.005	-0.001	0.079	16.872	19.051	-0.410	0.033	-0.005	0.187
39	1158.128	2201.436	-46.308	-0.001	0.018	0.800	4.436	19.641	-0.410	-0.028	0.017	-0.326
	-24.796	-46.308	1.000	0.079	0.800	39.952	3.462	7.615	-0.179	-0.004	-0.011	-0.804
	811.250	1148.175	-24.650	0.005	-0.001	0.078	16.450	18.575	-0.400	0.033	-0.004	0.244
40	1148.175	2182.500	-46.100	-0.001	0.018	0.792	4.325	19.150	-0.400	-0.028	0.018	-0.248
	-24.650	-46.100	1.000	0.078	0.792	39.398	3.875	8.375	-0.200	-0.004	-0.014	-0.941

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S_{\hat{z}\hat{z}}^{-1}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	805.512	1142.415	-24.634	0.005	-0.001	0.081	16.049	18.122	-0.390	0.033	-0.002	0.316
41	1142.415	2164.488	-45.902	-0.001	0.018	0.787	4.220	18.683	-0.390	-0.028	0.019	-0.201
	-24.634	-45.902	1.000	0.081	0.787	39.046	4.366	9.098	-0.220	-0.004	-0.016	-1.062
	788.262	1123.571	-24.262	0.005	-0.001	0.070	15.667	17.690	-0.381	0.033	-0.002	0.298
42	1123.571	2149.167	-45.738	-0.001	0.018	0.787	4.119	18.238	09.381	-0.027	0.021	-0.079
	-24.262	-45.738	1.000	0.070	0.787	38.634	4.476	9.810	-0.238	-0.005	-0.018	-1.167
	770.302	1100.791	-23.791	0.005	-0.002	0.051	15.302	17.279	-0.372	0.032	-0.003	0.243
43	1100.791	2129.325	-45.512	-0.002	0.018	0.773	4.023	17.814	-0.372	-0.026	0.023	0.078
	-23.791	-45.512	1.000	0.051	0.773	37.330	4.465	10.419	-0.256	-0.006	-0.019	-1.272
	757.909	1088.045	-23.591	0.005	-0.002	0.047	14.955	16.886	-0.364	0.032	-0.003	0.266
44	1088.045	2110.386	-45.295	-0.002	0.018	0.760	3.932	17.409	-0.364	-0.025	0.025	0.150
	-23.591	-45.295	1.000	0.047	0.760	36.485	4.705	11.000	-0.273	-0.007	-0.021	-1.369
	743.289	1071.644	-23.289	0.005	-0.002	0.037	14.622	16.511	-0.356	0.032	-0.003	0.258
45	1071.644	2090.711	-45.067	-0.002	0.018	0.745	3.844	17.022	-0.356	-0.025	0.026	0.241
	-23.289	-45.067	1.000	0.037	0.745	35.400	4.822	11.533	-0.289	-0.007	-0.022	-1.454

Table 3.4-3. Pertaining to Example 3.4-2. (cont.)

# OF VECT.	$S_{\hat{z}\hat{z}}$ AUTOCORRELATION MATRIX			$S_{\hat{z}\hat{z}}^{-1}$ INVERSE-AUTOCORRELATION MATRIX			$S_{v\hat{z}}$ CROSSCORRELATION MATRIX			A TRANSFORMATION MATRIX		
	734.987	1062.391	-23.196	0.005	-0.002	0.037	14.304	16.152	-0.348	0.032	-0.002	0.307
46	1062.391	2070.391	-44.826	-0.002	0.017	0.725	3.761	16.652	-0.348	-0.025	0.027	0.275
	-23.196	-44.826	1.000	0.037	0.725	34.323	5.130	12.022	-0.304	-0.007	-0.024	-1.539
	721.468	1046.383	-22.915	0.005	-0.002	0.028	14.000	15.809	-0.340	0.032	-0.002	0.296
47	1046.383	2046.787	-44.532	-0.002	0.017	0.692	3.681	16.298	-0.340	-0.025	0.028	0.344
	-22.915	-44.532	1.000	0.028	0.692	32.404	5.234	12.426	-0.319	-0.007	-0.025	-1.601
	711.125	1034.271	-22.750	0.006	-0.002	0.026	13.708	15.479	-0.333	0.032	-0.002	0.321
48	1034.271	2024.167	-44.250	-0.002	0.016	0.662	3.604	15.958	-0.333	-0.025	0.029	0.377
	-22.750	-44.250	1.000	0.026	0.662	30.864	5.438	12.813	-0.333	-0.007	-0.026	-1.660

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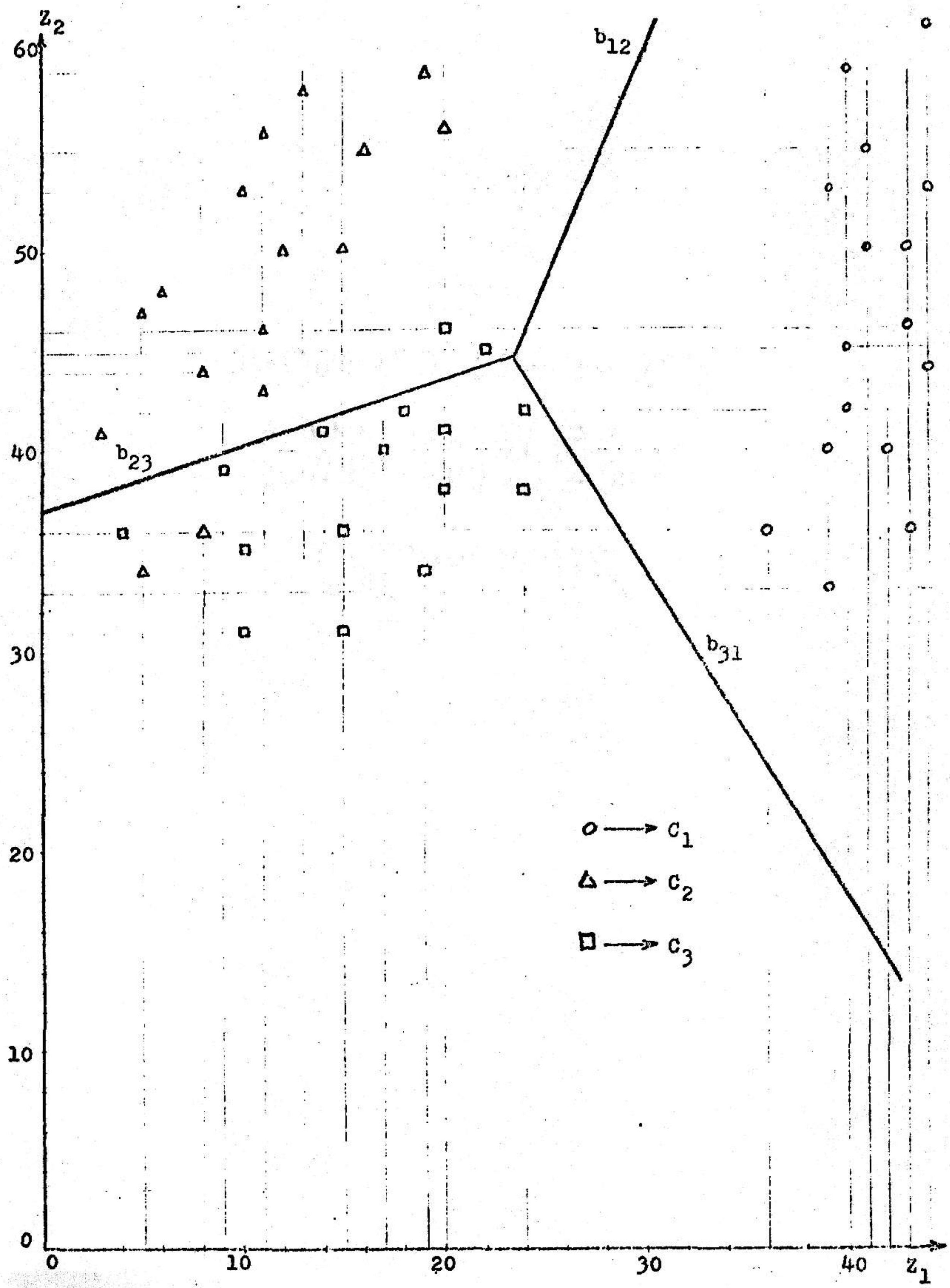

Fig. 3.4-1. Boundaries corresponding to Example 3.4-2.

CHAPTER IV

CONCLUDING REMARKS

From the results presented in Chapters II and III it could be concluded that Graupe's recursive method of inverting real-symmetric matrices (e.g. autocorrelation matrices) can be used effectively in adaptive filtering and pattern classification applications. In each case, an initial guess of the form $P_o^{-1} = \frac{1}{\epsilon} \cdot I$ was considered, and values of $\epsilon \leq 0.01$ were found to be satisfactory.

In this report, Graupe's algorithm was studied entirely on an empirical basis. Future efforts should consider the convergence properties (e.g., rate of convergence) of the alogarithm[1]. References that should be used to carry out such a study are listed in the bibliography [3-5].

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[1] Perhaps an optimum value of ϵ could be determined which depends on the data variance.

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APPENDIX I

DATA RELATED TO EXAMPLE 2.4-1, TABLES 2.4-1 TO 2.4-4.

THIS BOOK CONTAINS NUMEROUS PAGES WITH THE ORIGINAL PRINTING ON THE PAGE BEING CROOKED.

THIS IS THE BEST IMAGE AVAILABLE.

MEAN= 0.0

VARIANCE= 0.50

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
1	0.43	-0.53	-0.73	-0.10	0.62	-0.02	-0.21	0.37
2	-0.28	-0.53	-0.28	0.71	0.31	-0.10	0.54	-0.46
3	0.80	0.09	0.60	-0.65	-0.06	0.70	0.57	-0.04
4	-0.16	0.21	-0.52	0.56	-0.57	-0.02	0.68	0.14
5	-0.49	0.19	-0.11	0.07	-0.29	0.87	-0.34	0.56
6	0.50	-0.11	0.39	-0.86	-0.30	0.47	0.32	-0.80
7	-1.02	-0.33	-0.96	0.49	-0.17	0.40	0.46	-0.43
8	0.12	-0.60	-0.63	-0.14	-0.47	-0.23	-0.61	-0.37
9	0.10	-0.56	0.46	-0.01	0.71	0.69	-0.61	0.39
10	0.09	-0.34	-0.17	0.12	-0.19	-0.71	0.77	-1.17
11	0.78	-0.09	1.55	-0.01	0.75	0.17	-0.66	0.44
12	-0.67	0.06	1.16	-0.16	-0.04	-0.56	-0.11	-0.80
13	-0.57	-0.52	-0.28	-0.10	-0.14	-0.28	0.22	-0.38
14	0.24	0.02	0.28	-0.09	0.39	-0.38	0.64	-0.84
15	-0.05	-0.94	-0.12	-0.39	-0.05	0.25	-0.06	0.33
16	-0.27	-1.05	-0.41	-0.26	-0.01	-0.76	0.43	0.11
17	0.76	-0.45	0.94	0.54	-0.08	-0.32	0.41	-0.01
18	0.20	0.74	-0.51	-0.25	0.18	-0.30	-0.32	0.46
19	0.75	-0.13	0.80	-0.90	0.18	-0.09	0.03	-0.00
20	-0.43	0.31	0.40	0.33	-0.14	-0.09	-0.23	0.10
21	-0.17	0.41	-0.14	0.18	0.13	-0.66	-0.29	-0.24
22	0.23	-0.44	0.22	-0.11	-0.07	0.29	0.13	0.46
23	-0.58	-0.41	0.03	0.20	0.19	-0.12	-0.15	0.18
24	-0.91	-0.11	0.35	0.34	0.32	-0.78	0.16	-0.07
25	-0.09	-0.19	0.73	-0.45	-0.75	0.94	-0.14	-0.83
26	0.06	-1.28	-0.29	1.08	0.41	0.13	-0.24	0.92
27	-0.29	-0.02	-0.15	0.16	0.72	0.42	0.15	0.14
28	-0.96	-0.05	-0.31	-0.47	0.12	-0.59	-0.16	-0.67
29	-0.27	-0.00	0.30	0.42	-0.98	0.23	-0.88	-0.01
30	-0.05	-0.02	-0.29	-0.92	0.35	-0.02	0.31	0.08
31	-0.13	1.27	0.49	0.24	-0.46	0.28	0.19	-0.38
32	-0.32	0.23	-0.33	0.64	-0.49	0.23	-0.44	0.07
33	0.05	-0.28	-0.68	0.52	-0.31	-0.04	0.24	-0.56
34	-1.35	0.60	0.48	-1.38	1.00	0.58	-0.48	0.21
35	0.16	0.23	0.20	-0.32	0.83	-0.30	0.20	0.37
36	0.76	-0.01	0.04	-0.07	-0.26	-0.57	0.08	0.90
37	-0.38	0.23	-0.46	0.12	0.52	0.39	0.47	-0.20
38	-0.09	0.31	-0.24	-0.03	-0.87	-0.31	0.66	0.05
39	-0.68	0.10	0.24	0.74	0.50	-0.05	-0.55	0.14
40	-0.48	-0.53	0.04	0.15	0.57	-0.23	0.15	0.56
41	-0.32	-0.23	0.21	-0.05	-0.25	0.26	-0.45	-0.21
42	-0.52	1.37	0.30	0.38	-0.53	0.56	-0.04	-0.16
43	0.60	1.13	-0.14	0.16	-1.35	0.26	0.18	0.18
44	0.71	-0.08	0.44	-0.45	-0.27	-0.02	-0.50	-0.20
45	-1.01	-0.40	-0.91	0.28	0.13	0.33	-0.76	0.19
46	0.12	0.53	0.36	0.08	-0.23	0.43	0.68	-0.16
47	-0.74	-0.92	-0.20	-0.30	-0.42	-0.61	0.14	0.74
48	0.09	-0.40	-0.53	-0.13	-0.51	0.82	0.41	-0.13
49	-0.70	-0.53	-0.09	0.34	-0.08	0.34	0.28	-0.27
50	0.56	-0.46	-0.32	0.84	0.29	1.05	0.58	-0.20

MEAN= 0.0

VARIANCE= 0.50

INDEX	GROUPS OF (1X8) DATA VECTORS							
51	0.03	0.18	-0.18	-0.90	0.54	-0.92	0.08	0.57
52	0.41	-0.24	0.89	-0.62	0.59	0.04	1.60	-0.47
53	-0.14	-0.38	0.43	0.39	-0.14	-0.46	-0.06	-0.83
54	1.06	0.65	0.01	-0.60	-0.72	0.18	0.39	-0.53
55	0.18	0.20	0.66	0.12	-0.22	-0.90	-0.24	-0.57
56	-0.59	-0.87	0.95	0.30	-0.72	-0.11	-0.16	-0.48
57	0.41	0.31	0.91	-0.31	0.20	-0.32	-0.05	0.25
58	0.87	0.11	0.10	-0.49	-0.02	1.07	0.87	0.10
59	0.96	0.38	0.58	-1.00	0.54	0.18	0.41	0.05
60	0.35	0.48	0.39	-0.09	0.31	0.13	-0.12	0.10
61	0.22	0.29	0.58	-0.03	0.20	0.01	-0.44	-0.27
62	-0.76	0.17	0.21	-0.58	-0.35	-0.04	-0.23	0.43
63	0.10	-0.03	-0.17	-0.00	0.59	-0.42	-0.20	0.20
64	0.47	0.06	0.47	-0.06	0.93	-0.01	-0.04	-0.99
65	0.02	-0.19	-0.29	-0.51	0.11	0.29	-0.96	-0.65
66	-0.58	0.57	0.58	0.39	0.04	0.61	-0.16	-0.77
67	0.87	1.22	-0.35	-0.14	-0.34	0.55	0.17	1.11
68	0.02	-0.39	-0.05	0.65	0.39	0.23	0.33	-0.50
69	0.56	0.61	0.54	0.01	0.66	-0.24	-0.88	-0.62
70	-0.33	-0.92	-0.53	0.15	-0.61	0.26	-0.17	-0.27
71	0.01	0.38	-0.21	0.84	0.01	0.34	0.28	-0.45
72	0.26	-0.12	-0.44	-0.21	-0.55	0.61	0.75	-0.17
73	0.11	-0.06	0.32	-0.24	-0.38	-0.32	0.56	0.54
74	-0.78	-0.07	0.12	-0.03	-0.54	-0.33	-0.51	-0.31
75	0.77	-0.30	0.51	0.68	0.40	0.19	0.86	0.75
76	-0.56	0.63	-0.44	-0.39	0.35	0.36	-1.04	1.23
77	-0.10	0.57	-0.71	0.50	-0.26	-0.21	0.60	-1.39
78	-0.17	-0.12	-0.22	0.10	-0.00	0.08	0.07	0.36
79	0.41	-0.06	0.06	-0.87	0.06	0.36	-0.32	-0.01
80	-0.20	0.10	-0.31	-0.65	-0.17	-0.76	-0.28	0.48
81	-0.31	0.23	0.22	0.48	0.26	0.34	0.00	-0.19
82	0.75	0.19	-0.30	-0.73	0.75	-0.75	-0.18	0.49
83	0.66	-0.66	-0.32	-0.55	-0.76	0.60	-0.52	-0.01
84	-0.40	-0.45	-0.28	0.27	0.16	0.01	-0.23	-0.20
85	-0.27	-0.32	-0.15	-0.55	0.43	0.08	0.51	-0.08
86	0.24	-0.41	-0.36	-0.25	-0.53	0.43	-0.51	-1.17
87	0.79	0.15	-0.87	-0.11	0.21	-0.84	-0.49	0.51
88	-0.92	-0.28	0.38	0.12	-0.42	0.40	0.37	0.46
89	-0.74	-0.34	-0.07	-0.83	0.50	0.76	-0.13	-1.33
90	0.03	-0.66	-0.16	-0.22	1.40	-0.15	0.32	-0.38
91	0.55	0.62	0.16	-0.31	-1.29	-0.21	0.02	-0.20
92	0.49	-0.64	-0.07	0.14	-1.16	-1.32	-0.24	0.21
93	1.05	-0.57	0.21	-0.13	0.23	-0.36	0.35	-0.18
94	-0.12	0.69	-0.94	0.11	0.31	0.29	0.58	0.63
95	0.17	1.00	0.51	0.10	-0.02	-1.27	-0.24	0.12
96	0.09	0.73	0.12	-0.91	-0.80	-0.41	-0.80	-0.22
97	0.83	-0.76	-0.55	0.81	-0.13	-0.04	0.18	0.11
98	1.04	0.39	0.53	-0.01	-0.08	-0.52	0.51	-0.41
99	-0.08	-0.45	-0.57	-0.12	0.79	-0.76	0.49	-0.30
100	0.63	-0.93	-0.30	-0.28	0.39	-0.63	-0.58	-0.06

MEAN= 0.0

VARIANCE= 0.50

INDEX	GROUPS OF (1X8) DATA VECTORS							
101	-1.15	-0.17	-0.12	0.24	1.15	-1.02	0.61	-0.70
102	-0.23	0.19	0.52	0.68	0.51	0.17	0.35	-0.74
103	0.54	0.00	0.19	0.28	-0.13	0.57	0.45	0.81
104	-0.15	0.64	-0.09	0.27	0.18	-1.21	0.20	0.94
105	-0.12	-0.54	0.76	-0.59	0.35	1.44	-0.09	-0.36
106	-0.20	-0.17	-0.22	-0.08	-0.69	-0.37	-0.13	-0.61
107	0.28	-0.38	-0.49	-0.46	-1.52	0.47	0.39	-0.31
108	0.01	-0.82	0.02	-0.49	-0.70	-0.41	0.77	0.52
109	0.15	-0.62	-0.15	0.07	0.19	0.09	-0.20	-0.13
110	-0.11	-0.42	-0.46	-0.04	0.57	0.08	-0.70	-0.27
111	0.90	0.65	0.67	-0.09	0.87	-0.31	-0.44	0.08
112	0.35	-0.06	0.26	-0.33	0.52	-0.49	-0.62	-0.57
113	-0.08	0.33	-0.12	-1.03	0.94	-0.82	-0.44	0.24
114	-1.21	0.18	-0.93	0.55	0.55	-1.21	0.91	0.52
115	0.64	0.34	-0.11	-1.35	-0.21	-0.03	0.21	-0.25
116	-0.37	0.68	0.39	0.50	0.08	0.32	-0.21	1.42
117	0.44	0.07	1.11	0.36	0.84	-0.04	-0.07	0.02
118	0.26	-0.63	-0.38	-1.56	0.00	-0.49	-0.57	1.03
119	-0.25	0.44	-0.05	0.00	-0.01	0.57	0.60	0.44
120	0.09	1.15	-0.34	-0.23	-0.27	0.26	-0.26	0.25
121	0.46	-0.65	-1.20	-0.01	0.65	-0.31	0.65	0.43
122	0.03	0.41	-0.08	-0.61	-0.33	-0.02	-0.38	-0.01
123	0.48	0.71	-0.42	0.22	0.22	0.74	-1.03	-0.60
124	0.48	-0.92	-0.18	0.21	0.72	0.58	-0.51	-0.34
125	0.22	-0.09	-0.31	-0.39	0.61	0.11	-0.03	0.25
126	-0.64	0.06	0.24	-0.36	-0.70	-0.04	0.23	0.66
127	0.08	0.38	0.03	0.05	0.22	0.73	-0.43	-0.62
128	0.57	-0.26	0.61	-0.42	-0.19	0.53	0.28	-0.10
129	-0.02	-0.49	-1.48	-0.54	-0.53	-0.02	-0.34	-0.29
130	0.50	-0.45	-0.17	-0.06	-0.35	-0.31	-0.98	1.29
131	0.31	0.22	-0.43	-0.75	0.26	-0.22	0.15	-0.36
132	0.08	-0.12	-0.21	-0.37	-0.27	-0.64	-1.14	0.73
133	0.49	0.40	-0.44	0.31	-0.01	0.04	-0.05	-0.43
134	0.21	-0.36	-1.08	0.54	-0.54	0.43	0.22	-0.37
135	-0.09	-0.03	-0.08	0.06	0.57	-0.35	-0.04	-0.09
136	-0.22	0.24	-0.39	0.10	0.25	0.32	-0.51	-0.11
137	-0.01	-1.18	-0.95	0.90	-0.09	0.04	-0.90	1.07
138	-0.28	0.08	-1.22	0.20	-0.51	0.42	-0.41	-0.07
139	0.64	-0.12	-0.15	-0.26	0.41	0.59	0.26	0.46
140	-0.08	-0.43	-0.18	-0.25	0.10	0.66	0.91	-0.36
141	0.75	0.03	-0.26	-0.52	-0.01	0.73	0.35	0.47
142	-0.21	-0.38	0.15	0.66	-1.01	-0.58	0.38	0.43
143	-0.27	0.70	-0.39	0.53	-0.97	-0.65	0.29	-0.48
144	0.24	0.13	-0.33	-1.17	0.05	0.13	-0.62	-0.78
145	-0.50	-0.22	-0.62	-0.20	-0.03	-0.13	0.47	0.01
146	0.18	0.01	0.79	-0.33	0.20	-0.32	-0.16	-0.10
147	-0.05	-0.32	1.45	0.69	-0.32	0.18	0.80	0.36
148	0.50	0.16	-0.09	-0.42	0.34	-0.02	-0.85	0.38
149	-0.00	-0.69	0.22	0.10	-0.40	0.69	-0.31	-0.04
150	0.12	-0.00	-0.06	0.48	-0.12	0.44	0.22	-0.43

MEAN= 0.0

VARIANCE= 0.50

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
151	0.04	-0.42	0.61	-0.54	-0.39	0.32	0.04	0.72
152	0.44	-0.08	-0.72	-0.23	-0.28	-0.54	-0.05	-0.12
153	-0.51	0.38	-0.99	0.15	0.64	0.47	0.26	0.04
154	0.37	0.83	-0.15	0.35	0.78	-0.05	-0.74	0.20
155	0.26	0.63	-0.66	0.59	-0.43	0.53	0.26	0.84
156	-1.18	0.15	-0.96	-0.87	0.45	-0.68	0.05	0.96
157	0.24	0.74	0.50	0.19	0.33	-0.57	0.44	0.03
158	0.19	-0.73	-0.23	0.51	0.14	0.47	0.23	0.54
159	0.34	0.60	-0.10	-0.16	0.31	-0.44	-0.28	-0.01
160	0.38	0.60	-0.06	-0.59	0.26	-0.69	0.20	0.37
161	0.48	0.63	-0.05	0.46	0.42	-0.66	0.48	-0.35
162	-0.19	-0.45	-0.54	0.23	1.22	0.25	0.87	-0.16
163	0.05	0.23	0.04	0.46	0.07	0.16	-0.35	0.41
164	0.38	-0.97	0.23	-0.62	-0.09	0.19	-0.86	-0.64
165	0.47	-0.19	0.59	-0.27	-0.33	0.44	-0.37	0.68
166	-0.51	0.44	0.16	0.26	-0.74	0.03	0.43	-0.15
167	-0.87	0.28	0.00	0.19	0.12	-0.42	-0.68	0.36
168	-0.94	0.18	-1.34	-0.23	-0.34	0.19	0.13	-0.31
169	0.45	0.03	0.18	0.24	-0.68	0.48	0.14	-0.15
170	-0.01	-0.83	1.13	0.33	0.52	0.57	-0.35	-0.19
171	-0.16	0.48	0.04	0.78	-0.31	-0.44	0.97	0.07
172	-0.82	0.31	0.47	0.34	0.75	0.57	-0.09	-0.39
173	-0.81	0.03	0.48	0.23	0.13	0.22	-0.25	-1.08
174	-0.46	0.50	0.61	-0.29	-0.75	0.61	-0.20	-0.01
175	-0.09	0.09	0.40	-0.01	0.04	-0.14	0.36	0.80
176	0.98	0.16	-0.07	0.33	0.43	0.09	0.23	0.35
177	-0.58	-0.43	0.72	0.47	-0.66	0.40	-0.79	0.13
178	-0.60	-0.31	0.35	1.13	-0.31	-0.59	-0.89	-0.38
179	0.11	0.37	-0.16	-0.43	-0.58	0.23	-0.78	-0.69
180	0.72	-0.51	0.27	-0.49	-0.55	-0.02	-0.65	0.68
181	-0.10	-0.10	-0.33	-0.81	-0.30	0.77	-0.71	0.24
182	0.33	-0.03	0.10	0.36	0.10	0.71	-0.15	0.46
183	-0.32	0.06	-0.39	-0.24	0.08	-1.08	-0.18	0.33
184	-0.36	-0.46	0.25	0.11	0.56	-0.50	-0.49	-0.15
185	-0.13	0.26	0.07	0.66	0.47	0.58	0.22	-0.01
186	-0.44	0.10	0.12	-0.35	0.23	-0.23	-0.25	-0.24
187	-0.12	-1.09	0.45	-0.19	-0.73	0.17	-1.60	0.63
188	0.50	0.56	0.12	0.39	-0.49	-0.09	-0.03	0.60
189	0.60	0.91	0.66	0.61	-0.61	1.09	-0.74	-0.35
190	0.86	-0.17	0.65	-0.27	-0.18	-0.17	0.07	-0.23
191	-0.06	1.17	-0.38	-0.02	-0.27	-0.26	0.71	-0.55
192	0.54	0.31	-0.38	0.59	0.56	0.44	0.47	0.68
193	0.32	0.10	-0.79	-0.69	-0.29	0.04	0.15	0.94
194	-0.04	0.40	0.44	-0.13	-0.37	0.15	0.57	-0.77
195	0.63	-0.41	0.86	-0.49	-0.27	-0.11	0.00	-0.46
196	-0.98	0.03	0.52	0.47	0.44	-0.64	-0.73	-0.16
197	-0.21	-0.43	-0.54	-0.51	0.19	-0.32	0.66	0.14
198	0.12	0.58	-0.75	-0.19	-0.60	0.97	-0.02	-0.09
199	-0.31	-0.07	0.43	1.16	-0.50	0.34	0.53	-0.35
200	0.68	0.97	-0.45	-0.22	0.42	0.40	-0.39	0.84

MEAN= 0.0

VARIANCE= 0.50

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	**********	**********	**********	**********	**********	**********	**********	**********
201	-0.24	-0.42	-0.34	-0.08	0.07	0.27	0.52	-0.03
202	0.10	0.11	-0.18	-0.70	-0.11	0.05	0.56	0.54
203	-0.12	-0.08	-0.43	-0.83	0.31	-0.13	0.03	0.03
204	0.28	-0.11	-0.03	-0.23	0.24	0.33	0.74	-0.08
205	0.47	-0.63	0.06	-1.17	0.11	0.05	0.48	-0.79
206	-0.37	0.23	-0.60	-0.40	0.35	0.64	-0.44	-0.12
207	0.44	0.33	0.54	-0.70	-0.11	-0.29	0.27	-0.57
208	0.06	0.54	-0.47	-0.82	-0.35	-0.11	-0.08	-0.17
209	-0.32	0.71	0.41	-1.01	0.55	-0.23	0.31	0.09
210	-0.03	-0.79	-0.25	-0.06	0.53	0.48	0.23	-0.32
211	-0.38	-0.60	0.08	-0.21	-0.50	-0.87	-0.01	-0.40
212	-0.22	0.15	-0.03	0.28	1.40	-0.68	-0.11	-0.17
213	0.64	-0.17	-0.54	0.13	0.14	-0.31	-0.26	0.37
214	0.38	0.28	0.11	-0.91	0.17	-0.17	-0.68	-0.31
215	-0.33	0.38	-0.04	1.40	0.39	0.36	-0.56	0.29
216	0.18	-0.00	-0.94	-0.21	-0.26	-0.61	-0.09	0.16
217	0.10	0.48	-1.03	0.01	0.14	0.04	0.52	-0.71
218	0.59	0.20	-0.27	0.79	0.52	-0.57	0.08	-0.84
219	-0.66	-0.47	-0.60	0.37	0.81	0.15	0.38	-0.24
220	0.02	-0.19	0.53	0.49	-0.08	0.34	-0.28	0.08
221	0.30	-1.58	0.67	0.39	-0.21	-0.41	0.42	-0.39
222	-1.13	-0.77	-0.13	0.30	-0.65	0.53	-0.24	-0.17
223	-0.11	-0.42	-0.33	-0.04	0.00	-0.23	-0.46	0.24
224	0.54	0.85	-0.36	0.11	0.20	0.92	0.08	-0.17
225	0.51	-0.10	0.32	-0.00	-0.65	0.59	0.17	0.57
226	0.45	0.60	-0.23	0.35	0.38	-0.60	1.11	0.97
227	0.06	0.80	0.02	0.91	-0.27	-0.55	0.69	-0.50
228	-0.50	0.37	-0.86	0.41	0.31	-0.12	0.23	0.16
229	0.45	-0.33	-0.32	0.60	-0.44	-0.73	-0.47	-0.07
230	-0.40	-0.93	-0.32	-0.29	-0.11	0.26	0.37	0.31
231	0.10	-0.58	-0.81	0.48	-0.26	0.95	0.57	0.28
232	0.64	-0.40	-0.22	-0.36	0.02	-0.04	-0.07	-0.67
233	-0.60	-0.03	-0.02	-1.06	-0.83	-0.60	-0.26	-0.06
234	0.05	-0.11	0.35	0.62	0.11	0.39	-0.69	-0.89
235	0.27	0.21	-1.06	0.41	0.77	-0.48	0.94	-0.67
236	-0.28	0.32	-0.19	0.05	0.07	-0.57	0.42	-0.42
237	0.10	0.06	-0.01	0.27	0.44	-0.28	-0.44	-0.16
238	0.57	0.30	0.54	0.33	-0.20	0.51	-0.33	1.12
239	0.30	0.41	-0.48	0.95	-0.42	-0.59	0.53	-0.10
240	-0.51	-0.25	-0.53	-0.12	-0.29	-0.47	-0.55	-0.34
241	0.79	0.68	-0.56	1.35	0.61	0.99	0.24	-0.61
242	0.39	0.57	-1.01	-0.41	-0.30	-0.10	0.19	0.59
243	0.46	0.78	1.17	0.86	0.92	-0.13	0.11	-0.76
244	0.68	0.16	0.02	-0.11	-0.31	-0.49	0.28	-0.18
245	-0.77	0.10	-0.40	-0.09	0.43	-0.05	0.03	0.34
246	0.77	-0.06	-0.04	-0.34	0.07	0.29	0.64	-0.23
247	0.50	1.05	0.15	-0.11	0.54	0.14	-0.09	1.10
248	0.57	0.30	-0.29	-0.68	0.26	0.62	0.66	-0.18
249	-0.33	0.55	0.71	-0.29	-0.34	0.35	0.67	-0.07
250	0.97	0.65	0.19	-0.72	0.66	0.93	-0.25	0.40

MEAN= 0.0

VARIANCE= 2.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
1	-1.39	1.03	-1.39	-1.71	1.51	0.64	0.76	0.82
2	-1.82	0.52	-2.85	-2.35	-0.10	1.55	0.75	2.32
3	1.33	-0.02	-2.12	1.77	0.48	1.41	0.28	0.31
4	-1.24	-1.16	1.01	-0.39	-3.06	-1.35	0.55	-3.26
5	3.17	2.58	4.73	0.12	-3.02	-0.26	0.77	-0.44
6	3.27	0.64	1.26	2.25	-1.68	1.13	0.15	0.74
7	-0.23	2.47	-1.22	-1.04	0.64	-4.73	-0.12	-1.78
8	1.35	-0.47	-0.48	-0.81	-0.34	0.62	-2.84	1.95
9	2.73	-0.72	1.66	-0.09	1.08	3.62	-0.79	1.89
10	2.61	1.15	5.41	0.06	0.60	0.74	-2.78	1.99
11	1.69	-1.38	-1.02	0.60	-2.08	-3.59	-1.60	2.21
12	0.68	5.12	0.57	-1.51	-1.25	-0.89	-2.05	2.49
13	0.28	-1.88	-1.61	2.66	2.79	5.27	-0.92	-1.20
14	1.19	-0.94	-1.38	0.09	-0.26	-0.64	0.98	1.08
15	-1.89	-0.59	1.49	1.71	-0.69	-0.18	-1.14	3.29
16	1.75	0.60	1.18	-1.51	1.20	-0.88	-2.08	1.37
17	0.81	0.11	-0.08	1.37	-0.89	1.69	-0.63	-0.71
18	0.00	1.37	-0.11	-0.68	0.75	2.00	-1.59	-1.00
19	-1.98	1.84	1.29	1.28	1.82	2.50	2.24	-3.55
20	3.56	2.98	2.35	0.20	2.02	-2.35	0.07	3.59
21	1.34	2.24	-0.75	-0.96	1.05	3.88	1.10	0.37
22	2.06	3.07	2.20	-1.24	2.63	1.67	0.52	2.76
23	-1.59	2.93	-0.60	0.30	-3.56	-0.54	-0.44	0.69
24	-0.89	-0.74	1.07	-1.38	2.20	-0.30	5.40	0.13
25	-1.14	-0.48	-0.61	0.67	1.61	-3.15	1.25	-2.97
26	2.35	-0.83	-1.43	1.41	-1.63	1.36	-1.69	-0.65
27	-1.70	-0.34	-1.18	-0.22	-3.82	1.68	1.80	-2.98
28	1.40	-1.57	-1.67	-1.25	0.75	2.27	-3.10	-1.98
29	-1.63	2.95	1.32	-0.74	1.78	-0.42	0.83	4.28
30	1.89	0.67	1.99	2.27	-1.03	-3.93	-1.22	1.77
31	-1.32	1.03	0.53	0.72	2.03	4.18	-2.04	-1.56
32	-0.56	-2.50	-2.84	3.59	-1.34	-1.63	-0.42	0.23
33	-1.14	1.52	-3.93	-2.20	0.57	3.09	-1.17	1.11
34	1.67	-1.44	-6.54	2.33	-0.56	0.80	2.92	-2.97
35	0.55	0.05	-0.45	2.12	1.00	-0.05	3.06	1.93
36	0.21	-0.53	-1.47	0.13	0.94	0.98	2.44	-0.22
37	-0.65	-3.75	-1.39	-0.69	-1.03	0.37	-1.74	-3.47
38	0.68	3.85	-2.01	-1.39	-1.22	0.55	-0.26	4.12
39	-3.09	-0.28	2.87	-1.02	0.08	-0.02	4.08	2.51
40	-1.28	-0.67	1.46	-2.61	2.58	-0.88	4.47	1.66
41	-3.17	4.11	-2.04	-3.23	1.98	2.42	-3.87	3.52
42	1.94	-0.47	2.57	0.09	1.98	2.32	-1.76	0.04
43	0.75	-2.96	-0.51	0.30	0.28	3.29	-1.97	-0.82
44	-0.03	-1.91	-1.06	0.35	2.59	1.78	-1.31	-1.12
45	-1.70	2.13	-0.89	1.20	-1.39	0.24	1.41	-0.89
46	2.44	2.61	0.20	-2.21	0.05	1.12	-0.58	1.80
47	3.09	1.00	0.42	1.08	-1.40	0.88	-0.09	2.93
48	-3.04	0.74	-0.03	-1.97	-0.03	1.96	0.08	2.43
49	-1.24	-0.71	1.06	1.58	-2.14	0.83	-0.87	0.27
50	1.18	0.09	-0.12	-1.31	1.98	1.94	-1.72	0.40

MEAN= 0.0

VARIANCE= 2.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
51	-3.08	0.61	-1.35	2.32	-1.97	1.73	-3.29	-3.24
52	2.70	0.29	-2.44	-2.59	-0.29	-1.33	-0.35	-2.68
53	-0.79	-3.41	0.81	-1.08	-1.28	1.20	0.28	-1.98
54	1.15	0.97	-3.38	1.80	-1.22	1.77	-2.19	-1.18
55	-2.76	-1.14	1.18	1.01	-0.43	-1.15	1.45	-0.32
56	2.17	-2.26	0.70	-2.50	-1.19	-3.11	0.39	-1.46
57	-1.35	-0.95	1.37	0.22	2.20	0.33	-2.15	-0.64
58	1.37	0.24	-2.59	0.13	1.44	-0.37	1.02	0.09
59	3.05	-3.23	-2.99	-1.83	0.23	3.25	-2.89	0.68
60	0.38	2.08	-1.61	-2.70	0.28	1.63	-2.68	3.09
61	4.08	-0.35	-2.27	0.48	-2.71	1.24	0.85	-2.73
62	-1.17	0.90	3.25	-3.34	-1.03	2.52	2.91	1.18
63	1.35	-0.69	-0.85	0.78	-2.99	-2.08	-3.30	2.77
64	0.34	4.32	1.63	-0.19	1.12	-2.10	-2.58	3.98
65	0.50	-0.61	-3.10	-1.30	-1.00	0.92	2.28	-1.22
66	0.53	-2.03	1.15	2.40	-1.64	-0.58	0.47	-0.89
67	1.14	-0.49	-1.41	-0.15	-1.10	-0.14	1.21	-1.07
68	-0.97	1.46	-0.57	-3.97	0.32	-1.31	1.70	-7.80
69	-1.09	3.28	-0.14	1.88	0.32	-1.63	1.13	0.86
70	1.47	2.43	2.10	4.34	-3.38	1.34	2.72	0.87
71	1.42	2.35	2.33	4.39	-1.10	2.07	-2.34	0.19
72	1.46	4.50	2.78	-1.04	-1.12	-1.00	3.16	0.76
73	0.31	0.32	3.63	-0.99	2.26	-3.41	-1.59	2.53
74	0.65	-2.71	1.10	-0.50	-1.26	3.29	2.64	-2.53
75	-0.81	-1.16	1.38	-0.62	0.02	-2.45	-0.97	-0.48
76	-1.36	-1.57	-1.32	1.59	1.81	-0.17	-1.21	0.65
77	-2.30	-0.49	-0.80	5.11	-0.19	0.58	1.13	0.79
78	3.07	1.54	3.15	-1.13	1.73	4.25	1.24	-0.10
79	-0.55	1.97	0.73	-0.17	-2.74	-0.70	0.33	-0.05
80	-2.45	-1.75	0.13	-3.06	2.11	-1.82	-0.40	-3.13
81	2.08	-2.16	1.58	-0.84	-2.02	1.35	0.26	4.63
82	3.73	0.19	5.26	-0.56	0.58	-0.76	1.51	-0.83
83	3.20	-3.25	1.38	0.74	1.61	0.33	-1.44	2.45
84	-0.79	-1.02	2.14	2.00	-3.23	-0.94	0.59	-1.57
85	-1.55	0.32	1.75	-1.83	-0.23	-2.12	-1.17	1.05
86	1.63	0.24	0.42	2.23	4.30	-0.75	0.47	0.27
87	-0.56	0.18	0.33	1.10	0.08	-0.37	2.71	4.04
88	2.60	-0.40	-0.30	-0.24	-1.20	-0.55	2.76	0.32
89	-0.19	1.95	2.73	1.15	-1.83	-0.81	-0.18	-0.95
90	-0.23	0.68	1.63	4.22	-2.12	-0.72	3.10	0.20
91	-2.83	-0.75	0.59	-0.07	1.66	0.19	-0.21	-0.29
92	-1.26	1.11	-0.19	3.23	5.19	0.37	1.11	1.54
93	-2.84	-0.28	-0.48	-0.92	-1.82	4.27	-1.75	1.64
94	-0.85	-3.48	-0.11	2.42	-3.67	0.34	0.41	-0.03
95	1.40	-1.03	1.15	2.22	-2.64	-0.97	0.81	0.47
96	0.61	-1.48	-2.52	-0.59	2.95	-1.19	0.63	-0.90
97	-0.50	0.63	-6.90	0.97	-3.19	0.12	1.10	-0.18
98	0.77	0.75	2.21	-0.17	2.65	1.41	-2.60	2.57
99	-2.89	-1.66	1.01	0.96	-1.83	1.15	-1.26	1.31
100	-2.77	-1.17	3.70	-0.70	1.07	-0.23	2.33	-2.01

MEAN= 0.0

VARIANCE= 2.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****								
101	-2.17	1.70	-1.51	-2.18	-0.95	-0.26	1.37	-3.42
102	1.63	0.39	-2.42	-0.55	1.83	-0.49	-2.94	1.00
103	1.31	0.35	-2.83	-2.84	7.09	1.53	2.61	-2.76
104	1.58	-0.96	-0.53	1.90	-1.44	-1.75	-2.79	1.22
105	1.16	-0.09	-1.32	0.62	-0.09	-1.87	2.08	0.92
106	0.73	-1.58	1.00	-3.72	-1.13	-0.37	0.41	-1.73
107	1.00	-1.99	2.64	1.83	1.14	-0.82	1.40	1.24
108	-1.32	0.14	-0.21	0.21	-3.59	-0.74	2.27	-2.22
109	0.47	-1.73	0.67	2.39	2.39	-1.70	-1.79	1.84
110	-2.93	-0.16	1.48	-0.68	0.78	0.76	-1.57	1.38
111	3.18	0.31	-1.59	-0.05	1.29	1.11	0.13	6.34
112	-0.48	1.14	3.67	-0.77	1.63	-0.22	0.51	0.68
113	-1.23	-0.23	-0.53	0.12	1.48	1.23	0.77	0.35
114	-4.35	3.66	-2.00	-4.43	-3.44	3.93	2.13	3.31
115	0.86	0.27	-0.52	0.53	0.57	-1.70	1.78	-0.49
116	-0.91	-2.97	-1.90	1.96	3.21	0.83	-1.08	-1.09
117	5.06	1.42	0.07	0.80	-1.81	-2.06	0.76	-4.55
118	1.47	2.88	-0.42	0.02	-0.80	2.11	-1.50	-0.91
119	3.02	0.86	-3.14	0.57	-2.04	-2.23	3.35	1.78
120	0.41	0.83	0.08	-0.61	2.16	1.39	-1.49	-0.53
121	0.35	-3.78	-0.53	5.45	1.51	-0.58	-0.82	0.12
122	1.53	-1.50	-0.78	3.69	1.71	0.31	0.56	-0.31
123	-5.33	-0.89	1.53	-2.93	0.46	0.51	1.86	-1.88
124	0.47	-0.49	-3.38	-1.46	1.47	0.48	2.28	-2.63
125	3.62	1.16	-1.33	1.05	-3.56	-1.33	-0.98	-4.61
126	2.84	-0.49	1.90	-2.44	1.08	-0.46	-0.71	0.13
127	-1.18	0.00	-1.49	1.02	-2.92	-2.48	-1.71	-0.45
128	2.26	0.10	-1.29	0.39	0.15	1.09	3.22	1.60
129	1.88	3.25	-3.32	-1.39	-0.01	0.69	-0.71	0.23
130	-1.62	-3.08	0.64	-3.36	0.31	0.78	-0.30	-0.60
131	-3.55	0.54	-1.20	-0.56	0.81	-0.19	1.65	-2.94
132	-1.20	1.58	1.35	1.95	3.19	2.23	0.35	-2.84
133	0.14	-0.51	0.49	1.13	-0.84	-1.51	-3.01	-0.34
134	-0.84	-4.28	0.44	-0.06	0.42	1.05	-1.21	-1.49
135	-3.43	1.72	-2.62	-0.69	-1.34	-1.64	2.94	-0.34
136	-0.92	-1.04	-0.46	0.22	-2.40	-1.12	2.65	-0.94
137	-4.62	-1.13	-2.90	1.61	0.94	-0.95	-0.88	4.68
138	-1.82	-1.08	0.28	-1.56	2.38	-2.66	-2.45	2.45
139	-1.81	2.56	-0.73	-2.35	-0.37	-1.81	3.15	-1.66
140	0.10	3.23	-1.72	-1.80	-1.62	-1.95	1.13	0.30
141	-1.38	2.40	1.52	1.05	2.34	-0.61	0.67	2.27
142	-3.55	-2.48	1.18	-0.85	3.21	0.65	1.00	2.23
143	-1.71	2.03	-0.54	1.44	-1.29	0.29	-0.70	0.10
144	0.86	-0.60	0.58	0.89	-1.48	2.75	0.78	1.86
145	0.84	-0.92	-1.26	-3.55	0.35	0.50	0.65	-2.54
146	-3.05	2.51	0.13	-2.93	-2.09	-0.02	2.12	0.83
147	-6.11	-0.84	-1.04	-0.30	-1.10	1.65	2.37	-0.05
148	-1.65	-1.53	3.43	-2.71	1.02	-0.03	0.62	-3.24
149	-0.94	-0.10	-2.24	-1.19	-2.02	-0.62	2.06	-2.78
150	2.69	0.90	0.13	-0.81	3.47	-1.66	-0.09	1.28

MEAN= 0.0

VARIANCE= 2.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
151	-4.03	-1.07	-1.24	3.41	1.21	-0.70	-0.63	2.89
152	1.59	1.43	-0.16	2.40	-1.11	-1.29	-0.37	-2.00
153	2.26	-2.13	-0.42	1.12	2.22	-0.97	-2.10	2.57
154	0.68	-2.31	2.19	-1.47	-1.10	-1.29	-0.61	0.55
155	3.55	0.34	-4.14	-0.42	-1.36	-1.79	3.29	-0.10
156	-0.43	1.29	0.80	1.21	3.13	-0.03	0.82	-3.43
157	1.46	-2.02	-2.79	2.40	-1.92	-1.55	-0.83	-1.49
158	-2.10	-0.13	-0.71	0.09	1.20	-3.89	-0.46	1.67
159	-2.39	2.41	1.26	-2.79	2.18	3.39	-0.85	2.00
160	3.29	-0.95	1.30	0.74	-3.27	2.75	-2.81	-2.53
161	-0.36	-0.75	-2.36	1.63	-3.45	0.65	0.86	2.02
162	1.37	-1.55	-1.55	2.83	-0.65	-0.47	-0.62	-0.39
163	1.17	0.12	1.96	1.29	-1.17	-4.15	-4.07	-1.81
164	-0.25	1.70	-1.63	-2.03	2.69	-1.94	-2.27	1.71
165	-2.18	-1.35	-2.13	-2.18	-1.36	0.61	1.98	-1.88
166	-1.93	-1.57	4.67	-0.21	0.38	-0.03	1.88	1.39
167	-0.79	-1.53	-1.03	0.84	-0.40	-1.43	0.64	1.46
168	-4.05	0.25	0.98	3.92	4.03	-1.12	1.46	2.28
169	-1.02	3.21	-1.10	-4.03	3.35	-0.65	-2.47	-2.19
170	-0.99	-1.20	-1.07	-0.03	1.27	-1.57	4.07	-2.00
171	0.75	-1.52	1.28	-1.15	-0.51	-3.43	2.28	-1.19
172	0.89	1.70	0.15	-0.43	1.72	0.23	-0.64	2.18
173	0.14	-2.09	-0.26	-2.91	-2.34	-0.14	0.51	2.08
174	3.20	0.57	2.25	0.35	7.02	1.91	2.94	2.45
175	2.78	1.13	-2.10	0.31	-4.51	0.84	1.84	3.25
176	1.57	1.04	0.87	-2.07	2.78	1.10	2.44	-1.58
177	0.28	-0.24	1.38	2.16	-1.40	-0.86	1.91	1.93
178	-0.38	0.73	1.62	-2.06	2.64	1.41	-2.52	1.73
179	-1.71	-0.58	-2.19	0.24	-3.39	2.38	0.34	-0.23
180	-3.01	3.28	0.14	0.00	0.21	0.49	1.69	-0.00
181	2.42	-0.25	-1.18	4.18	1.15	2.19	0.74	0.37
182	-0.71	0.30	2.05	-4.26	-0.88	-2.06	-1.30	-3.15
183	2.30	-1.63	0.03	3.62	3.84	2.19	-1.24	-0.63
184	0.15	3.41	0.97	-1.22	-1.00	-2.60	0.13	1.90
185	-0.45	2.89	1.07	2.17	0.31	-1.99	2.00	2.39
186	-0.80	-1.75	0.53	0.75	3.47	-1.51	-0.40	-1.21
187	1.80	-1.05	-2.45	-0.54	0.19	-0.72	-1.89	-0.94
188	2.05	0.45	0.35	-4.73	2.16	2.83	2.74	-0.86
189	0.67	2.18	-0.89	1.12	-2.91	-0.39	0.69	-1.00
190	-1.66	-4.39	0.06	-2.03	2.69	4.06	-0.83	0.58
191	-2.22	0.19	1.38	-1.24	-1.35	-1.37	-0.62	5.83
192	-2.31	3.37	-2.72	0.47	2.68	1.79	-1.47	4.72
193	0.77	0.61	-0.03	-1.98	-1.51	-0.03	1.81	3.19
194	-0.27	-0.64	1.64	-1.61	-0.23	-0.35	-1.57	-0.81
195	-0.74	-2.93	0.50	0.52	2.23	-0.74	-0.41	2.69
196	0.07	-0.80	2.76	3.37	1.57	-2.74	0.49	-0.37
197	0.87	7.19	0.62	-0.11	-2.50	-1.89	2.35	-0.04
198	0.35	2.51	0.28	1.03	-0.29	4.26	0.36	1.65
199	1.23	-1.40	5.93	-2.26	1.92	2.16	-2.28	0.63
200	0.19	-3.08	-0.20	-1.01	-2.18	2.26	-0.36	0.87

MEAN= 0.0

VARIANCE= 2.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****								
201	1.96	0.92	4.08	-2.29	1.12	-0.98	-4.68	-1.68
202	-0.78	-1.95	4.96	-1.13	1.52	-5.11	-0.03	-1.07
203	2.69	-0.22	2.67	1.42	-3.27	0.33	-3.22	-1.35
204	-0.94	-2.46	-0.61	-1.69	0.44	-0.22	-5.04	1.45
205	1.04	-1.21	-0.67	-5.50	0.36	-0.30	-0.28	-0.74
206	-0.67	-1.01	0.70	0.93	0.20	0.55	4.25	0.05
207	0.63	1.60	-0.30	-1.44	-0.35	-1.23	-2.23	1.76
208	-0.34	-1.95	-1.47	-3.66	2.43	0.82	1.46	0.36
209	-0.90	1.81	-0.60	-0.76	-1.78	-0.85	-1.45	1.79
210	3.67	0.33	0.50	-1.81	2.74	-1.78	-1.78	0.00
211	0.07	-0.94	0.04	2.15	-0.31	-1.52	-0.32	2.96
212	1.00	-0.54	0.23	0.09	-1.23	2.38	0.14	-1.40
213	-2.84	-3.02	-0.74	-3.06	1.69	0.38	-1.20	-3.10
214	-0.74	3.07	1.34	-4.34	2.15	-1.03	-1.14	1.79
215	0.00	-0.82	-1.32	1.21	-0.15	2.46	1.52	-0.77
216	0.08	0.77	1.47	0.54	0.49	-0.54	-0.00	1.18
217	2.21	1.29	3.93	0.60	-0.22	0.37	-0.52	-2.41
218	1.09	2.20	2.24	0.34	1.42	-2.36	1.18	2.41
219	-0.58	-1.06	-1.38	0.72	-0.89	-0.28	2.29	1.59
220	3.91	-1.03	-4.72	-1.30	-3.43	1.07	0.03	-0.91
221	-2.75	-0.25	2.40	-0.78	1.48	2.14	3.59	-1.13
222	0.16	0.72	0.20	-0.77	-0.44	-0.62	0.18	2.86
223	-0.67	-2.65	0.87	1.70	0.50	1.25	0.99	-0.96
224	1.47	-0.93	-1.37	-2.43	0.01	0.19	-4.76	1.34
225	1.28	-0.64	3.67	-2.21	-0.20	-1.33	2.13	-0.27
226	1.46	-2.35	2.20	-0.67	1.56	-0.86	0.85	0.15
227	-1.27	-0.60	0.42	-0.87	1.00	0.05	2.62	-1.43
228	3.77	2.07	0.53	0.14	1.82	-2.16	0.63	-3.08
229	1.30	1.11	-3.25	-0.67	-0.27	0.98	0.09	1.17
230	-1.99	-2.03	1.26	1.64	2.43	3.92	0.20	-0.72
231	0.62	2.10	-1.73	-3.98	-0.39	-2.88	0.17	-2.82
232	-0.19	-1.04	1.99	-2.57	1.00	1.01	1.20	0.84
233	0.31	0.01	-1.38	0.83	-1.72	0.06	-1.52	0.20
234	-3.20	-3.32	0.37	-0.85	-0.84	-1.27	1.24	-0.77
235	-2.00	2.45	-0.57	-0.63	-0.66	1.46	-1.35	1.88
236	-1.40	-5.25	-2.00	2.43	0.54	0.70	-0.06	-1.91
237	1.31	1.05	0.30	3.28	0.44	-1.08	0.30	-0.18
238	0.83	0.80	-1.47	4.88	-1.24	4.56	-1.06	-0.98
239	-0.13	-2.56	-1.12	0.18	1.19	-1.93	-0.94	-0.34
240	1.12	-3.56	1.57	2.13	1.44	1.91	-2.14	-0.33
241	3.30	1.24	0.79	-0.31	-0.78	-1.46	-1.45	-0.99
242	1.10	1.31	-3.25	-0.19	-1.78	2.40	0.33	-0.35
243	1.23	0.08	3.64	-2.55	2.15	1.95	0.40	1.52
244	2.39	-0.98	-2.31	1.55	2.71	3.65	-4.03	-1.41
245	-0.72	-4.42	-0.93	3.07	-2.39	-2.06	0.23	-1.20
246	-1.39	-0.79	0.01	0.96	0.55	3.27	0.39	-1.89
247	1.08	-0.63	0.71	2.17	1.23	0.11	-2.34	0.47
248	3.39	3.50	-0.64	-0.33	3.35	-1.10	1.24	1.84
249	-1.75	-0.94	0.16	-1.60	-1.38	0.10	-3.67	-1.84
250	0.36	-0.49	3.34	-2.69	2.74	2.16	-1.86	-2.60

MEAN= 0.0

VARIANCE=20.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
1	-15.82	2.99	-9.28	-6.40	-5.84	-4.62	-1.43	15.01
2	11.35	28.76	55.78	-4.98	43.49	26.80	6.98	4.20
3	12.10	26.95	10.56	-13.12	12.43	0.41	-1.37	1.11
4	13.47	32.12	-2.91	-1.29	-2.01	0.76	-14.45	-14.75
5	-37.51	-1.22	-42.60	0.05	-2.77	-7.63	19.77	-23.83
6	-13.80	1.48	-26.47	20.43	7.16	19.78	33.32	13.39
7	-28.39	-5.27	-12.50	-10.63	4.82	27.51	-1.78	36.44
8	25.77	-6.93	21.35	-3.58	7.23	-19.90	6.52	-55.14
9	-4.29	-28.96	17.11	-28.91	11.44	-17.92	-9.75	-1.83
10	-31.55	3.16	-3.19	-17.07	-25.53	-2.02	-18.57	15.92
11	-8.98	-16.03	-17.52	-18.54	33.36	-27.68	-7.91	17.62
12	10.47	27.99	-3.85	-3.79	5.13	9.65	-5.73	-17.19
13	33.82	-10.24	39.85	-3.28	26.81	-5.50	-40.00	-28.98
14	-11.90	23.81	-24.38	-7.48	15.44	-8.61	-38.69	-38.22
15	-59.66	24.67	25.48	-6.87	-11.95	-35.15	-9.76	-5.37
16	-2.42	26.87	-8.53	8.09	-18.33	19.42	38.80	-10.91
17	26.84	24.95	-4.39	-33.06	13.33	19.63	-40.96	-15.30
18	-24.85	-6.57	19.95	-0.80	0.06	30.01	2.98	-19.01
19	-10.44	6.84	6.51	14.39	-1.10	-24.91	2.66	-2.52
20	-2.92	19.72	-2.69	2.07	6.87	-0.59	-9.90	13.72
21	4.75	6.60	-25.59	31.75	-19.00	-12.52	-2.65	-50.78
22	-0.39	-18.00	19.81	-7.04	-1.67	3.85	-3.58	3.53
23	8.68	0.47	15.56	15.25	-4.11	-6.95	19.36	-3.82
24	18.99	16.53	3.69	8.13	30.71	19.60	-21.82	6.68
25	17.58	-15.29	6.22	21.15	19.83	-11.95	24.94	-5.41
26	-8.53	-0.45	5.20	-16.18	-19.74	-57.09	11.64	19.42
27	-32.30	15.57	22.64	-14.31	-10.96	28.72	30.33	20.71
28	13.30	7.31	-19.41	-3.71	3.22	-9.98	-26.96	-2.01
29	15.30	9.29	1.07	-34.86	19.80	11.33	51.80	10.79
30	0.73	-3.94	46.11	21.77	15.84	-22.82	-1.36	-21.36
31	-3.38	2.13	-2.25	-4.27	-31.65	12.11	-34.41	1.08
32	10.01	2.05	18.02	-23.47	-5.63	-19.35	24.68	-22.37
33	7.92	30.34	-11.06	-26.29	-9.07	-32.68	27.94	7.83
34	17.39	-18.47	-7.44	-3.19	15.07	-3.33	7.41	-48.79
35	5.45	10.16	10.89	-4.65	23.80	13.21	15.12	7.29
36	-20.87	10.76	5.98	-1.14	-5.83	1.49	23.09	-4.38
37	5.45	17.85	-0.16	16.88	3.21	26.03	23.36	15.72
38	-8.54	-14.03	-25.47	18.94	-12.05	11.37	-12.04	-12.89
39	24.18	29.65	-7.95	-5.44	-14.59	-17.97	28.93	-10.65
40	-9.36	3.43	14.46	13.29	-7.37	2.55	-1.72	-18.06
41	-2.12	1.82	23.77	24.64	6.65	-2.55	-11.94	4.44
42	-7.07	-20.62	2.02	-21.84	4.48	31.28	-9.71	-3.64
43	2.81	10.61	11.25	-16.63	3.17	28.56	-2.99	-2.76
44	-25.44	10.06	-6.53	-30.20	19.74	-6.18	0.25	46.61
45	-24.78	-27.74	30.73	-13.01	-8.77	11.59	12.03	4.00
46	-8.20	-8.26	5.05	-15.54	-5.33	6.41	-15.60	-11.06
47	-28.66	-16.97	58.47	11.76	-32.92	-17.20	29.38	-19.03
48	40.88	0.67	13.01	18.40	-14.49	5.31	-1.01	-0.39
49	-32.55	-20.83	30.71	13.93	26.97	-21.55	5.29	-15.60
50	-21.93	-46.92	-26.40	-12.14	28.51	26.76	0.28	-5.13

MEAN= 0.0

VARIANCE=20.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****								
51	-0.22	16.92	3.71	-30.26	-32.85	14.77	-23.98	30.54
52	19.61	5.23	23.07	9.09	19.92	7.01	4.52	30.96
53	-15.41	-27.46	13.72	15.45	3.86	8.01	-2.18	-24.36
54	-18.25	13.38	17.68	-21.65	16.00	2.31	-32.06	-15.87
55	18.12	-37.73	-43.01	27.31	33.36	14.44	-33.07	-4.04
56	-19.26	13.76	13.67	11.88	-7.01	-11.07	6.82	10.64
57	-23.37	2.37	9.76	41.57	-8.10	-29.70	-0.30	7.73
58	12.83	2.64	7.29	25.93	7.14	-16.91	-2.62	6.74
59	-3.64	-10.91	-11.71	-25.52	35.73	-8.17	-7.87	-12.79
60	-5.74	-3.74	14.79	-3.25	-25.29	1.06	-24.11	-11.33
61	-6.43	-21.33	-11.18	2.28	21.10	-4.70	-19.29	10.65
62	1.31	-9.13	12.42	0.59	11.94	-0.92	-41.40	12.68
63	24.50	7.37	7.62	21.23	4.25	16.94	21.60	-25.70
64	-9.80	-17.28	-3.56	13.71	-4.92	-6.60	-18.25	35.03
65	5.41	-48.56	-19.08	7.58	1.45	13.01	11.07	-5.59
66	-22.81	8.06	3.08	-7.65	20.39	40.28	-18.41	11.97
67	32.55	-12.88	4.97	-22.43	-11.07	19.76	25.35	7.23
68	-21.47	3.14	-31.39	12.76	-35.89	15.97	-5.62	-0.27
69	22.16	-9.33	-23.97	-12.54	22.95	33.44	20.71	-10.99
70	10.47	-15.78	-10.73	-8.80	-17.51	16.70	36.36	14.59
71	-9.50	-21.67	-9.65	13.50	-0.24	-29.71	-6.62	16.00
72	29.27	-12.47	1.31	3.90	11.78	-1.26	3.79	-7.22
73	13.81	26.36	-15.82	11.94	-24.40	26.58	-0.38	-35.55
74	-8.84	-10.66	0.99	7.13	28.24	-1.66	12.91	-9.45
75	-11.65	-8.99	13.77	19.02	6.73	18.54	-24.32	-9.39
76	-7.60	5.89	4.54	17.14	-11.89	11.73	-20.03	-15.84
77	10.36	-11.48	-24.64	-8.99	9.41	2.44	17.81	-29.27
78	-10.75	-26.57	28.23	-9.84	7.65	15.18	1.23	9.86
79	16.10	35.15	-14.80	4.14	19.86	-25.49	2.27	21.06
80	-62.06	28.21	8.30	22.46	3.09	-15.06	-7.06	43.89
81	21.81	7.14	39.56	-5.34	14.36	-8.99	45.29	17.85
82	14.74	-13.52	21.00	-9.72	-29.30	17.25	-8.66	22.50
83	3.75	0.75	-5.33	18.84	-30.85	-31.81	3.12	-2.65
84	-4.11	4.49	2.59	-10.13	6.73	8.36	12.68	1.95
85	-1.83	-7.77	26.79	-27.09	20.47	22.30	12.03	15.81
86	-2.36	18.50	9.30	17.48	27.41	-5.47	-6.78	18.48
87	-18.69	17.82	32.16	-6.87	24.58	-10.42	-11.74	9.48
88	-3.77	44.74	-42.60	29.37	29.01	32.00	-30.80	28.35
89	-10.57	13.78	47.04	15.74	-42.27	6.30	-11.94	-5.38
90	-12.07	-0.52	23.13	1.78	-12.22	-2.98	-3.13	-32.19
91	-21.23	16.36	7.68	-22.99	16.17	-31.31	-32.32	7.45
92	-11.02	-1.04	-37.26	-29.04	-40.05	5.85	32.49	-26.91
93	5.59	1.80	10.33	53.17	16.15	13.01	-16.64	4.26
94	15.63	-20.57	-27.52	-6.83	1.79	-25.27	12.31	-19.53
95	6.13	6.36	-8.77	40.48	-26.09	-4.48	31.37	1.27
96	-15.87	-2.86	28.60	44.64	-30.46	-0.09	12.57	26.18
97	-3.35	-33.72	6.64	15.19	-14.29	-7.55	-12.06	-25.26
98	-29.27	-11.66	7.36	-18.36	-20.54	17.65	-10.48	-13.53
99	-6.60	-2.17	-27.20	13.54	27.80	20.05	-10.66	-19.08
100	-8.32	-10.72	5.00	40.41	27.79	4.19	39.42	-2.40

MEAN= 0.0

VARIANCE=20.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
101	-7.38	-2.77	5.98	-8.21	16.43	-5.41	11.80	-3.94
102	3.24	-3.79	-2.23	-2.79	-9.22	35.79	18.51	-4.19
103	10.56	0.76	2.40	26.19	-32.15	12.31	-28.42	36.41
104	21.64	-14.61	1.92	8.27	-15.32	-11.31	3.05	-2.64
105	3.49	4.64	-1.66	-7.01	-1.70	29.45	4.93	-1.78
106	23.14	13.06	-26.30	9.86	25.75	19.14	-10.72	-1.50
107	7.63	-34.85	10.03	-11.57	24.05	2.28	48.10	17.74
108	-16.01	-24.54	9.37	-21.78	-9.77	3.40	13.45	-4.54
109	-40.74	-41.48	13.73	28.77	1.33	7.03	-2.65	11.22
110	20.45	8.86	-14.84	-10.39	-5.63	-2.29	-8.18	24.52
111	34.60	-18.99	-14.31	10.26	-13.60	-40.04	-11.09	14.91
112	-11.25	9.50	17.34	40.26	-45.57	-41.68	20.63	1.91
113	9.93	-51.14	-17.85	-10.85	15.50	17.32	-20.97	-14.94
114	5.16	13.63	42.15	-33.56	-33.35	21.49	-3.86	3.88
115	41.48	18.34	-0.63	-18.32	4.90	-4.64	3.98	-2.09
116	-14.08	17.50	15.85	-15.60	-12.72	3.46	-25.41	-13.31
117	-34.50	5.67	13.60	-15.89	30.83	-9.67	0.00	-30.27
118	7.27	-2.63	14.67	-9.63	12.58	-19.51	12.24	-53.42
119	-21.75	7.12	21.09	12.69	29.55	18.47	3.34	-23.24
120	5.48	9.47	14.88	20.62	-21.21	8.82	-14.67	-20.19
121	-44.02	18.94	-1.92	3.67	17.31	-23.95	30.25	-4.75
122	16.79	50.07	32.72	-8.62	22.16	-35.30	-9.88	2.62
123	-25.07	-2.62	20.82	33.29	-9.64	-20.70	-3.03	1.45
124	17.45	-4.59	-15.56	-1.08	-1.05	4.39	2.84	11.27
125	-8.64	-1.32	5.58	-22.19	4.95	24.48	-20.23	11.61
126	23.71	1.73	6.29	-20.51	5.39	4.13	19.77	22.01
127	21.51	-20.90	8.59	-6.52	-2.68	27.84	14.88	-18.02
128	-8.18	5.30	-5.48	9.32	-2.25	20.17	17.14	31.07
129	41.64	-5.12	6.11	-3.45	-16.27	-14.37	-21.43	-11.19
130	-41.97	-17.64	-14.61	24.68	12.28	-31.23	-8.80	-25.27
131	-32.00	-17.72	-5.62	-36.74	0.43	-25.90	47.07	-11.65
132	-21.41	9.17	15.13	1.81	-14.78	6.17	18.21	29.22
133	-23.17	-22.45	-10.33	-50.13	3.67	9.50	16.64	-23.15
134	29.75	1.96	0.01	16.97	-7.18	28.62	34.41	10.79
135	44.38	16.93	8.20	-7.37	-30.31	-11.93	23.53	30.56
136	7.76	16.99	-3.73	6.39	-8.67	12.38	-23.95	-24.30
137	-13.09	-23.32	6.25	-12.21	14.76	6.08	3.99	5.73
138	-11.13	30.52	0.17	-13.66	-22.99	-26.30	-0.61	0.19
139	20.67	-26.95	20.05	-8.41	15.11	19.76	-5.72	-21.39
140	49.34	-1.21	-12.06	33.06	-13.90	-31.19	0.68	20.52
141	1.90	2.28	5.86	0.29	7.00	-14.63	-9.37	-14.55
142	5.40	-41.95	15.85	-17.19	-25.15	-6.02	16.15	-7.07
143	6.86	0.62	-0.07	-9.86	26.68	19.16	-10.71	42.50
144	13.31	-15.46	0.14	11.82	19.52	5.45	-17.92	13.68
145	-28.21	24.34	18.50	-2.62	10.40	-42.62	-13.47	-13.99
146	9.33	-25.47	-2.94	-3.64	36.35	-0.52	14.69	-20.99
147	12.95	9.67	-2.17	-21.72	-5.60	-23.72	-1.41	12.23
148	-10.31	-15.73	2.86	-27.33	21.59	-27.69	-9.74	-14.82
149	6.59	32.86	14.17	-10.93	-5.06	-7.89	1.72	17.40
150	10.66	9.99	13.79	-23.00	31.49	-19.80	5.01	-11.57

MEAN= 0.0

VARIANCE=20.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
151	28.95	-9.82	3.76	-13.99	8.27	21.11	-7.83	-2.21
152	-31.52	-12.05	6.11	-14.39	-17.69	-0.61	15.21	-14.98
153	36.28	-2.15	2.86	-14.66	10.64	-0.45	-33.82	9.64
154	19.39	-25.59	36.05	14.74	-29.71	6.13	-22.99	-28.81
155	4.84	12.15	-12.28	3.33	18.30	-16.34	-19.98	29.20
156	19.66	5.61	19.88	0.64	11.69	-23.33	-13.05	3.20
157	10.88	-10.69	-25.42	-3.79	27.49	9.70	-30.08	-7.28
158	-34.47	-2.21	-6.16	-0.44	22.75	-32.73	20.98	-2.71
159	-9.36	25.59	19.70	20.23	14.48	13.92	12.15	-23.55
160	13.25	7.22	14.19	7.76	-0.28	-5.82	35.46	9.72
161	-19.62	-22.77	19.33	11.66	-4.50	12.57	-37.06	-23.36
162	-0.93	-9.86	-22.84	21.47	18.85	13.63	6.63	16.73
163	-3.65	0.49	9.71	-33.27	-13.19	21.90	-1.45	-30.46
164	-0.76	2.80	19.02	-3.04	-23.60	21.90	30.74	34.58
165	14.78	11.62	-12.89	41.70	-15.35	38.16	15.23	11.40
166	-29.99	1.46	-43.99	10.48	8.61	55.21	-15.95	19.51
167	-8.05	6.86	27.75	12.82	5.29	17.59	-10.76	18.46
168	-12.37	-17.65	4.38	-21.74	11.73	9.83	-37.19	7.78
169	-15.91	22.47	27.91	-3.66	-15.04	16.45	-23.19	26.99
170	-11.65	1.73	20.38	-23.43	2.02	-18.00	3.26	-24.37
171	7.46	14.69	-16.18	-31.50	-0.08	-9.00	-25.80	13.23
172	-11.57	-24.14	40.26	1.65	-4.28	7.98	1.65	19.32
173	-1.70	-20.22	-8.26	5.56	-33.58	-2.53	17.66	13.43
174	-15.90	20.98	-19.72	-10.25	-10.92	-16.00	-5.76	-4.91
175	-27.14	13.99	7.92	-16.23	-19.29	12.12	-16.57	43.84
176	-8.38	-6.66	-23.32	17.13	18.35	6.34	-2.73	39.20
177	-12.59	-6.44	-31.40	59.37	-0.96	11.20	-32.22	-19.29
178	-12.75	9.19	5.71	-19.97	19.79	-8.78	-53.00	7.89
179	-1.82	14.75	-49.96	-11.38	37.65	-9.05	6.95	20.29
180	7.22	24.78	3.62	-5.30	9.64	14.91	-0.33	-2.58
181	-18.58	-6.20	28.48	-12.23	12.80	7.64	-2.81	-1.18
182	-12.20	16.36	-33.34	17.39	-15.84	-6.34	-28.47	4.03
183	-6.61	-13.02	20.19	-26.93	-19.26	-2.50	14.74	12.57
184	-14.78	0.18	11.09	-15.65	-20.41	3.71	-1.16	3.98
185	10.33	-9.49	-18.60	40.77	17.72	-3.20	15.87	-22.22
186	-4.25	12.50	-6.86	-28.16	32.18	1.31	-2.15	13.51
187	8.51	0.67	8.36	-32.89	19.99	1.77	16.31	-29.30
188	35.63	29.55	29.08	-3.90	18.18	-17.29	4.80	8.88
189	24.15	13.69	-2.67	28.35	23.79	8.67	-6.17	27.58
190	-18.89	-12.40	35.15	-6.62	-6.15	4.17	15.94	-13.67
191	13.52	25.83	24.57	20.74	-14.62	33.75	23.16	-35.33
192	-31.57	-17.11	-12.40	19.94	15.43	21.94	-32.47	22.12
193	-27.13	13.33	-13.70	0.52	-18.99	33.26	21.06	38.21
194	13.86	-8.33	22.69	12.02	19.17	52.25	-44.19	52.49
195	18.44	-7.55	-21.20	23.95	26.93	-16.55	23.79	24.47
196	13.64	-9.81	-3.35	25.86	21.33	31.37	-2.97	33.70
197	-13.51	-0.57	18.30	7.28	-20.61	-19.44	-32.42	-20.31
198	24.02	34.70	25.75	17.74	-41.85	-4.45	-52.55	1.99
199	-6.73	10.53	-18.95	26.76	14.63	0.86	8.69	-19.88
200	1.25	1.46	26.23	3.88	5.88	1.02	-16.68	13.61

MEAN= 0.0

VARIANCE=20.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
201	-4.98	2.00	3.32	18.63	48.92	-19.42	-16.63	-17.99
202	1.59	-13.30	14.34	40.55	40.78	4.05	-19.13	4.83
203	-12.01	-29.92	-18.66	-0.84	-1.51	-4.02	-12.13	41.60
204	-18.73	26.69	-13.66	3.99	-0.92	0.89	-3.62	31.87
205	-11.56	31.03	-8.63	-15.42	-0.40	3.31	-1.56	15.16
206	-3.45	-2.34	18.46	10.45	17.06	27.78	6.07	-8.99
207	32.62	-38.90	9.65	-28.86	-11.51	-1.18	-28.68	-41.07
208	23.68	35.88	-13.03	-3.81	30.94	20.97	6.22	-41.53
209	-23.23	16.53	12.44	-4.89	1.43	-21.24	-37.22	-10.84
210	-21.08	-2.41	-31.89	17.44	-3.01	-23.28	33.05	10.52
211	17.15	-26.42	-4.01	12.72	-25.35	19.38	-10.94	42.10
212	-1.50	-0.96	-1.87	30.47	-8.55	-8.73	-17.17	-16.59
213	-10.00	-31.50	-3.45	60.23	24.41	16.92	-13.60	-6.01
214	-21.31	-23.52	-26.72	11.52	10.57	20.87	11.81	13.38
215	-8.42	-22.47	-9.64	33.89	-13.04	-12.36	11.07	1.10
216	-4.28	6.16	9.82	-3.15	10.61	1.78	16.23	-3.31
217	-21.86	36.92	13.68	-30.06	-21.45	7.80	-0.70	-20.33
218	5.86	4.34	3.98	-17.31	27.81	10.24	-7.66	29.58
219	-14.08	-17.06	2.76	-15.36	-4.57	13.63	7.36	-14.05
220	5.34	7.25	12.03	5.31	38.42	22.50	-3.60	-11.69
221	11.17	-8.18	33.84	14.24	-6.16	1.39	-8.52	-43.81
222	-9.57	11.16	10.21	20.96	18.70	-5.18	4.65	29.12
223	10.15	39.81	43.18	14.99	30.04	7.33	27.93	6.63
224	-2.63	12.31	-25.23	25.87	-15.11	43.44	33.34	8.26
225	-20.89	23.18	7.02	3.13	0.28	7.70	-7.06	-6.45
226	2.41	-13.05	21.97	-3.69	-26.76	4.62	18.74	2.00
227	14.29	-1.85	1.63	-5.08	0.81	18.74	-17.23	-6.84
228	-18.20	11.33	8.04	28.52	0.01	14.60	17.07	26.55
229	31.95	1.00	3.24	26.61	-12.12	-3.28	13.67	-18.26
230	-28.21	21.70	9.25	-1.25	-18.56	9.63	-35.40	-1.79
231	-11.67	-12.04	8.10	-5.55	-22.27	-22.13	41.89	-24.48
232	-11.37	14.31	-38.16	-16.75	13.78	25.97	-2.43	13.20
233	-0.31	-24.71	-7.52	14.68	6.62	-1.55	3.68	10.77
234	8.57	-14.59	42.06	18.28	33.28	-0.14	12.24	7.77
235	-37.72	-0.77	12.61	3.56	10.80	14.72	-44.71	23.73
236	-12.14	-8.74	26.16	-19.92	-23.80	-12.45	-15.15	38.18
237	12.34	-23.96	-15.25	17.34	-13.48	22.91	12.97	10.65
238	22.75	8.10	10.39	4.90	-1.22	5.30	-8.34	0.67
239	6.12	1.96	5.14	-7.73	-9.97	39.27	-7.04	7.77
240	-10.51	32.17	-28.99	8.99	17.28	-10.65	8.91	11.49
241	-40.11	-6.74	30.04	-15.41	37.57	-19.93	11.53	11.36
242	4.34	-40.26	-15.74	28.61	-32.06	-4.04	32.86	-13.10
243	29.87	6.16	15.70	-29.43	5.40	1.55	-15.08	-22.34
244	3.53	7.05	-13.61	-20.00	-12.99	-18.63	19.75	23.15
245	-7.66	-3.06	18.36	-13.57	-30.23	-20.05	9.37	2.91
246	3.32	10.35	-26.35	-0.59	-9.26	-18.17	5.83	-3.52
247	3.52	1.83	-25.71	28.45	46.93	-8.46	-18.85	3.38
248	-0.03	25.90	2.30	3.09	35.39	13.60	-12.64	3.15
249	-0.31	-42.92	-0.29	12.86	-6.87	-7.45	-23.51	15.31
250	-10.29	-10.07	-11.43	7.30	-2.80	-7.08	0.58	-40.60

MEAN= 0.0

VARIANCE=50.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****								
1	-35.00	-51.33	19.72	-72.31	-30.86	-51.99	20.29	73.19
2	-61.44	-9.19	29.03	-56.28	67.65	11.30	-17.48	-59.30
3	35.16	78.09	1.71	-50.08	4.23	-105.85	41.91	41.54
4	22.36	-53.15	-107.17	-29.89	-28.55	-42.10	-21.47	24.55
5	17.76	-16.58	7.47	-21.86	111.91	-36.13	22.46	-11.45
6	-111.08	-75.88	-49.29	-2.18	-31.83	23.39	53.78	-17.64
7	-46.58	55.29	77.62	-47.02	-167.19	-2.21	102.56	-45.17
8	-21.16	113.24	-6.71	17.45	-101.59	-1.61	-1.12	4.77
9	32.77	-65.68	52.79	65.06	7.55	-13.48	72.83	-68.99
10	-17.23	54.85	11.20	19.64	2.81	23.52	4.47	-67.62
11	-3.57	-38.85	123.60	55.02	-23.23	20.71	73.89	7.71
12	41.33	-10.45	-4.94	-54.99	22.00	39.41	-88.83	55.83
13	-14.96	26.39	30.67	13.46	-18.92	40.96	-3.61	-24.43
14	-4.87	-42.02	85.51	-15.81	46.59	-13.31	-90.39	15.75
15	-10.80	20.67	14.64	-18.97	61.11	37.91	30.93	25.20
16	-15.18	0.77	73.16	27.80	67.21	5.97	90.41	-47.25
17	-0.44	84.62	-83.87	-51.67	-92.52	52.19	-81.86	-2.77
18	-49.00	58.53	-1.36	16.46	-75.50	37.89	44.19	57.46
19	56.73	-91.15	75.76	-43.99	10.83	24.41	48.65	32.28
20	134.31	21.90	102.57	-9.19	-40.94	23.07	-38.41	-29.49
21	1.34	-15.99	-65.85	-5.32	61.77	-4.80	63.08	70.99
22	25.38	-18.50	25.58	91.46	11.54	52.13	133.22	-67.47
23	-25.99	100.70	-18.06	-45.03	-49.07	105.19	2.07	3.97
24	14.82	-72.05	-141.70	9.04	-27.46	15.70	49.71	34.13
25	65.37	-0.44	59.74	-22.49	-31.06	-155.00	106.22	-28.16
26	-6.74	51.87	-58.65	-15.82	-17.29	54.41	-48.31	-34.06
27	16.05	-28.79	-41.81	-47.09	-43.58	55.26	16.18	-34.75
28	-48.68	-56.10	-84.65	-92.49	32.65	-41.13	-20.22	-31.41
29	16.66	-43.72	67.90	71.80	-46.01	76.59	22.56	-75.20
30	-70.36	94.66	-79.07	-30.37	-36.99	69.72	24.60	-67.29
31	7.84	45.38	-70.49	-25.18	-47.72	-50.39	15.98	41.13
32	18.84	-55.23	-1.28	61.19	-35.61	27.58	26.78	48.91
33	-19.79	29.15	-16.37	52.58	-8.08	64.96	-12.92	54.86
34	59.53	-15.14	-60.67	22.80	27.44	-76.93	-23.04	7.82
35	-25.61	48.21	-29.10	45.70	-36.47	13.25	-23.52	56.61
36	42.36	5.55	33.40	-4.90	42.77	-53.17	15.74	-99.93
37	81.01	-6.81	81.93	-55.18	7.73	-14.88	24.80	-12.98
38	7.93	-2.53	71.55	-81.30	1.00	39.46	33.75	-83.72
39	-59.30	-45.29	57.35	-9.44	65.15	71.18	-27.33	-13.30
40	-3.12	1.24	44.41	-15.77	-57.23	-8.39	-28.37	147.08
41	-5.93	-26.61	-62.21	-26.46	-73.58	12.07	-39.29	-3.72
42	49.83	7.49	42.59	32.32	-141.31	-56.11	-30.00	-16.90
43	131.76	39.87	13.88	34.40	-17.84	48.40	29.56	56.38
44	-42.59	56.85	6.73	53.59	-60.60	86.93	19.47	64.95
45	-5.62	44.76	26.23	13.74	-27.01	20.80	-30.18	-42.37
46	10.24	-60.07	27.45	-11.33	-74.48	-38.65	60.68	33.26
47	-77.43	28.69	65.47	-47.80	-10.45	19.91	22.13	-9.34
48	-51.05	-2.64	-4.63	28.17	-42.33	7.79	-15.75	-71.34
49	6.95	-67.72	22.23	40.41	72.45	-13.67	-22.88	-3.91
50	-35.84	-80.23	-48.88	-37.26	-23.53	16.85	-69.19	-8.23

MEAN= 0.0

VARIANCE=50.00

INDEX	GROUPS OF (1X8) DATA VECTORS						
51	-11.85	-3.83	-62.87	18.99	12.32	-39.30	-24.59	64.54
52	46.49	-2.21	35.33	-67.02	22.56	-20.82	-59.02	-36.78
53	-43.22	10.97	-49.20	28.56	-50.22	33.64	7.61	-13.35
54	-13.42	72.03	-11.38	-20.47	-63.44	35.39	5.38	83.64
55	53.48	67.31	-46.14	-90.26	-24.53	-54.23	-35.63	3.02
56	-24.96	-16.87	-48.39	-56.99	9.09	26.11	114.65	-6.36
57	-81.14	5.82	-13.06	-46.82	-70.00	87.73	-13.70	-45.70
58	-47.49	-28.29	14.93	14.05	-19.23	-8.03	-90.60	83.85
59	43.56	17.12	-59.34	-50.52	4.00	-49.86	64.03	31.10
60	9.60	-71.62	-30.80	33.27	-57.76	73.58	-19.74	-5.10
61	18.20	141.83	5.65	-10.73	138.09	-26.38	-11.82	24.06
62	36.94	-6.21	5.06	41.30	-15.88	11.58	67.86	-32.59
63	33.40	20.59	22.52	13.18	72.91	-101.21	-50.62	-26.22
64	25.16	58.55	13.12	28.75	47.03	-53.41	-37.18	-7.99
65	-70.21	44.01	-18.08	-38.16	-50.93	-83.71	-11.75	20.91
66	64.88	13.29	-15.99	-13.73	-28.40	-30.77	5.76	9.32
67	-52.00	-47.28	74.46	-24.14	57.20	16.73	45.42	56.06
68	-53.28	-1.37	-91.65	-45.54	-1.55	-29.87	-12.68	9.97
69	78.64	-12.66	-59.24	-4.12	37.93	40.75	-38.48	19.87
70	-38.68	5.19	26.78	23.96	68.21	39.91	-1.89	-15.42
71	12.35	38.51	-78.54	62.52	81.87	28.96	-22.84	-47.06
72	49.30	73.61	-78.10	-14.61	-78.50	-80.79	28.76	-26.22
73	89.75	46.84	-42.82	-83.60	-70.33	-28.01	-17.02	45.92
74	1.27	44.51	-41.64	29.38	48.95	-51.36	69.90	-31.81
75	1.46	2.96	-11.47	-1.85	21.93	10.47	-130.41	-10.58
76	57.88	8.52	-47.23	-53.45	141.18	-31.18	12.15	58.44
77	-61.89	-2.50	6.16	48.39	-0.71	35.02	77.63	-25.93
78	9.73	56.25	-96.24	-22.48	-11.18	-29.60	46.13	-14.85
79	40.32	21.08	-49.33	7.76	-47.64	36.27	47.72	-59.50
80	47.46	28.33	1.96	12.93	-17.51	-6.02	62.47	-61.05
81	-1.28	14.32	-87.29	16.86	71.79	-45.16	-29.52	-20.67
82	-38.31	-34.61	-12.01	-56.61	12.82	30.19	1.81	10.46
83	-46.06	-32.14	32.88	16.33	48.18	-18.64	-13.46	81.18
84	93.05	58.05	52.47	-40.47	20.43	19.67	4.75	40.31
85	96.60	72.31	51.82	46.80	-127.83	56.45	36.52	36.68
86	-17.84	-3.05	-63.97	-48.02	45.96	3.03	-38.08	19.12
87	-82.68	68.30	-39.84	48.89	-65.62	20.74	11.05	-13.54
88	-30.35	22.69	-70.71	-38.64	30.01	20.90	13.96	37.52
89	-43.28	-3.55	-1.49	13.22	-24.57	64.84	100.75	71.13
90	-3.87	25.92	22.89	28.30	13.22	63.90	1.49	86.13
91	5.45	47.40	-42.50	30.42	-64.05	-70.60	-153.75	31.33
92	2.25	-2.76	57.43	-56.59	-63.79	22.66	-34.88	55.58
93	104.11	111.76	27.76	-8.89	-93.43	55.02	-11.82	-42.32
94	28.61	77.30	73.56	-2.66	89.61	-12.19	-54.51	-13.51
95	43.33	-69.83	49.91	-64.08	-72.09	-17.65	67.15	-9.19
96	15.85	-43.30	61.90	-19.31	-35.95	-50.04	33.23	69.48
97	63.75	-6.77	64.58	5.48	-9.40	-48.01	23.80	-28.66
98	-45.40	-73.91	-86.94	34.10	0.14	-50.25	-31.06	45.19
99	-94.02	-8.41	12.40	-9.60	-64.75	-145.42	-1.26	-10.11
100	-64.53	26.08	17.68	-1.80	-61.49	-72.20	-6.73	4.24

MEAN= 0.0

VARIANCE=50.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
101	10.65	15.87	-66.02	-18.68	152.50	-19.25	-17.39	-112.91
102	-0.91	-2.71	-83.63	-36.41	19.79	24.74	46.84	87.25
103	-31.62	56.68	-30.05	-81.15	32.97	-28.89	16.03	3.56
104	-63.91	30.36	-50.23	20.92	84.61	31.18	20.26	-15.15
105	-30.20	54.66	60.93	-106.37	67.29	-83.71	-10.58	-20.06
106	37.09	-34.09	108.51	60.81	-26.42	37.76	54.17	37.66
107	55.53	50.43	-2.44	-53.72	-53.93	6.92	44.00	-43.16
108	-57.29	-55.44	-16.81	-26.12	-72.66	-14.91	-60.81	36.31
109	-33.79	34.62	-29.54	-82.58	59.95	33.62	69.87	74.89
110	-6.41	56.94	-135.54	50.75	-13.50	-36.19	-34.05	71.42
111	42.44	-2.15	70.25	-52.32	-50.45	87.01	7.68	-75.29
112	30.34	-56.33	92.93	-67.95	41.69	-35.45	-24.93	-16.39
113	24.87	-19.26	-12.44	-22.31	5.50	7.73	48.21	96.94
114	-56.40	-4.62	9.22	-41.59	-66.45	77.91	7.17	-86.48
115	-45.89	-26.08	-36.99	-51.94	68.42	-13.60	-67.96	-17.81
116	-76.02	2.69	53.98	70.45	2.68	44.53	-97.11	-48.23
117	-79.21	18.02	-12.78	-100.58	78.93	63.64	-0.20	-78.91
118	12.11	56.23	-82.19	58.80	-10.27	5.04	102.84	-61.02
119	-84.47	53.66	-99.17	22.41	-22.34	30.07	-57.90	-145.74
120	-1.38	46.63	-58.65	-35.92	85.30	-49.94	-52.35	15.77
121	-21.04	71.46	-55.55	7.64	5.24	26.33	49.58	22.34
122	24.13	14.50	65.22	-23.09	30.04	70.21	77.95	22.78
123	-48.29	62.06	58.72	-54.26	-47.72	43.03	-37.15	15.94
124	29.27	0.47	30.04	87.93	14.55	-43.88	84.36	0.63
125	24.39	16.07	-15.75	27.33	59.43	70.81	22.55	-24.31
126	4.66	-4.82	-23.56	37.75	29.48	-51.59	57.50	-10.06
127	37.64	24.12	11.68	-56.96	17.29	0.28	19.30	-107.79
128	-59.07	39.23	-4.95	-82.99	15.44	37.72	-61.99	81.33
129	82.08	-23.16	31.62	-66.51	66.50	-77.93	-6.28	6.14
130	28.69	-76.73	126.48	66.32	-36.95	64.66	16.50	115.44
131	-1.67	14.85	-15.29	39.31	-2.32	-73.19	36.43	-41.92
132	8.59	87.90	-88.63	-73.69	12.95	-30.14	33.60	82.89
133	-172.98	128.77	11.56	51.13	1.45	5.12	38.98	38.68
134	-28.77	-26.23	40.35	-12.40	-94.25	-6.06	-20.06	74.30
135	8.78	-40.77	2.81	9.56	18.44	47.63	-10.73	-11.44
136	-42.75	-28.51	-45.98	90.83	32.09	-22.47	96.14	30.29
137	-15.78	46.86	-0.93	5.24	-10.72	-55.04	-19.37	-1.67
138	7.27	21.68	-56.98	26.61	32.59	-88.75	-127.18	-58.50
139	43.98	-17.72	-109.03	28.79	-45.41	-12.26	52.79	8.63
140	61.92	14.98	47.98	-14.42	97.87	35.74	0.62	48.55
141	-21.32	6.11	69.14	-29.17	4.99	-33.41	46.38	10.08
142	-38.18	-57.99	-40.48	108.35	68.55	41.61	70.15	-7.94
143	-71.06	108.99	-25.80	21.98	-18.88	22.13	52.01	-56.70
144	-52.40	-6.61	68.26	-64.45	-14.73	-30.51	-27.96	-37.35
145	-14.61	-18.47	-3.22	22.89	-26.41	-5.00	110.32	-101.07
146	59.88	-40.25	14.84	7.81	-61.35	10.00	-3.08	100.96
147	-11.35	-35.64	27.51	14.16	-26.97	-74.19	11.92	17.57
148	-60.71	-68.29	-60.14	-34.25	-130.69	3.77	85.41	47.60
149	-20.64	-51.89	6.99	36.42	20.06	-44.80	-2.55	-60.13
150	-73.56	-50.10	33.97	-100.00	17.87	-8.57	78.13	-6.79

MEAN= 0.0

VARIANCE=50.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****								
151	48.12	23.40	25.88	80.31	-94.68	23.78	-42.47	-43.55
152	-38.03	-45.06	-112.22	101.17	-25.03	-36.41	65.72	-21.59
153	-14.42	-69.15	-75.23	86.43	119.42	-77.81	-17.22	57.92
154	36.51	37.46	41.92	59.91	81.23	10.89	38.79	43.81
155	-17.65	-38.91	-5.69	-54.57	2.99	-8.96	-36.17	34.92
156	-9.33	-61.92	37.02	16.82	27.27	73.95	37.97	-19.94
157	29.06	4.75	-24.88	47.92	-3.34	20.96	-108.70	128.07
158	65.08	-2.57	13.70	-37.46	-46.28	-6.60	3.89	77.77
159	-33.67	2.45	-42.18	84.53	-8.96	-47.42	105.82	-22.01
160	-49.63	6.14	-37.42	-12.31	1.20	-40.15	27.17	27.56
161	-65.21	94.82	-16.96	95.83	-23.23	26.52	-51.99	25.31
162	-12.84	-45.18	-25.72	-17.10	10.34	63.93	-1.57	20.07
163	-24.93	-77.53	91.40	-77.40	-55.53	-16.59	58.50	10.66
164	16.08	-15.90	-10.55	-61.21	-28.24	-53.72	58.31	-4.09
165	-72.22	-23.96	23.52	55.31	-65.23	-136.13	-22.08	-25.34
166	-22.25	-15.38	-51.31	-54.01	-23.91	-2.49	-2.58	-4.28
167	33.56	46.16	20.04	34.64	-11.71	8.53	-3.12	7.93
168	-37.21	46.98	-7.36	45.11	-36.05	-91.75	6.39	-39.39
169	-66.97	23.43	-28.43	-48.78	145.65	8.01	6.02	-48.90
170	11.84	11.83	-88.06	26.79	25.97	-30.87	25.85	-20.28
171	-33.19	-51.50	-81.25	-104.33	-2.52	52.93	-54.05	44.80
172	65.51	19.78	47.15	-18.34	2.77	20.76	96.42	-4.84
173	25.53	11.98	-97.80	-91.40	-15.59	33.93	7.31	-170.36
174	14.43	-88.55	-11.04	-49.67	-15.02	53.78	58.72	47.07
175	-50.19	104.51	-37.47	-19.34	-2.94	-108.38	-19.28	-53.73
176	-50.77	-22.52	-22.02	-76.57	13.22	-91.20	-46.61	-23.94
177	-19.72	-33.30	-59.62	-97.54	-23.95	-83.36	6.80	35.29
178	60.54	108.49	-95.17	-58.41	-71.88	26.46	-28.96	72.77
179	7.57	-60.82	76.38	14.63	12.02	-50.40	-23.82	37.34
180	-11.03	-4.90	10.13	45.42	20.31	-2.62	52.30	-72.19
181	72.30	62.57	11.14	57.79	-54.43	-118.86	79.48	-56.97
182	-24.85	-22.07	-15.49	-24.43	-19.60	-37.81	-62.20	-68.18
183	15.09	-22.49	85.30	72.58	-32.65	51.87	-42.67	-107.00
184	9.70	-2.38	-31.41	-27.36	-0.98	11.50	68.16	-24.59
185	-23.43	-75.39	-10.53	99.60	17.98	52.42	-49.65	27.88
186	-16.74	-55.21	3.01	77.28	66.80	35.95	34.00	-0.78
187	-52.64	-55.50	14.28	-70.50	38.07	-126.58	-0.83	38.27
188	-63.56	110.06	-21.62	30.09	-75.64	26.16	25.96	-6.14
189	68.09	27.81	0.36	102.88	-31.74	105.49	94.42	-85.18
190	-90.12	34.06	-64.68	121.71	112.34	-77.25	84.65	-0.03
191	79.39	65.16	-61.66	10.39	-0.83	39.26	-23.29	-1.86
192	-5.81	-42.58	64.48	-57.24	-78.66	16.35	-49.30	8.16
193	21.87	-2.83	-31.17	42.64	21.42	65.35	36.68	28.86
194	80.01	20.75	6.46	-66.14	42.00	47.59	64.74	9.07
195	-13.83	-35.53	-17.54	-59.74	-74.35	-25.61	14.95	47.61
196	7.95	-85.32	51.90	-14.35	14.95	57.08	17.39	43.31
197	-37.09	7.69	19.86	-56.13	2.47	57.00	52.13	45.00
198	18.64	-20.16	-8.59	-111.25	80.80	35.46	49.27	51.51
199	-7.29	-32.55	-128.35	44.10	-7.49	3.80	-11.13	-38.33
200	52.71	6.86	15.64	33.77	80.18	23.35	1.02	-25.69

MEAN= 0.0

VARIANCE=50.00

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	******	******	******	******	******	******	******	******
201	-33.80	34.38	-21.54	-18.42	-13.60	-44.57	-34.22	38.24
202	0.78	-13.65	15.19	11.35	53.73	61.37	-86.75	-47.69
203	24.01	-0.90	-19.09	-3.08	-25.25	2.50	-26.51	-34.66
204	-46.53	-91.05	30.69	62.11	-107.95	40.15	-23.41	-123.85
205	106.75	2.23	19.62	30.76	-51.80	-14.35	-47.38	-16.41
206	1.42	115.27	-47.22	26.68	-64.22	0.32	-18.33	-13.54
207	5.06	-65.60	-14.77	23.71	-102.63	95.49	-106.20	-16.39
208	85.24	-4.05	22.07	45.68	125.55	-117.51	69.11	23.85
209	-40.45	-63.76	-31.64	-33.59	62.89	-27.34	-12.34	106.03
210	-54.43	41.60	79.19	59.74	1.97	-122.70	-70.47	-21.04
211	10.86	48.37	9.63	99.48	-114.62	57.77	-75.19	-8.53
212	23.02	-7.14	-35.24	9.47	55.68	25.37	3.57	-7.60
213	-50.39	11.41	49.67	63.54	5.46	-8.55	-54.12	-69.43
214	-41.78	-9.65	-30.58	-64.48	-22.71	17.33	-18.16	4.80
215	116.43	-34.01	29.09	-50.78	-86.24	14.33	-8.49	-36.06
216	41.80	-75.31	83.77	-71.51	-42.56	-6.21	-45.03	6.80
217	1.93	-97.26	38.54	-2.85	-99.09	67.03	2.30	32.21
218	64.39	-13.50	98.46	29.02	36.74	-4.61	-86.41	-11.00
219	46.75	-37.72	18.63	-102.06	57.53	-9.82	-81.10	-74.00
220	16.59	66.42	-95.89	-22.27	5.83	-37.26	-1.68	92.04
221	41.50	-14.76	59.98	92.22	74.24	-25.60	31.92	35.95
222	-60.95	55.07	41.33	65.25	55.33	36.48	49.78	-43.45
223	26.82	62.24	53.23	120.63	-58.33	60.32	-18.02	2.67
224	-77.61	-6.93	0.75	32.20	-24.15	107.23	8.61	-26.86
225	43.33	-16.10	-61.01	-26.22	50.45	38.55	9.73	-33.21
226	57.23	21.05	23.01	-130.80	8.04	-34.39	15.42	82.44
227	-18.35	90.85	-42.10	-7.71	-8.80	49.74	55.76	-81.07
228	34.19	-20.37	-1.28	-33.11	42.51	2.26	10.84	75.08
229	-17.59	73.72	-49.43	16.81	-45.46	84.50	10.73	-50.28
230	-6.10	-90.56	-31.49	65.88	19.88	-42.21	35.50	-58.31
231	-13.76	23.13	57.63	37.94	-68.89	-16.55	-84.76	49.79
232	27.00	101.11	23.01	56.80	30.79	-27.18	30.02	72.88
233	83.75	129.70	-30.29	-3.69	-38.48	137.23	59.92	9.76
234	-75.91	45.25	2.83	80.28	15.86	37.99	35.02	-40.72
235	-34.42	34.07	27.44	32.55	-63.61	86.45	-64.60	70.26
236	75.81	32.49	-51.39	26.94	-34.29	-106.08	91.14	-8.48
237	-77.65	26.85	-28.57	37.29	-53.63	21.74	-17.69	21.90
238	-27.22	3.46	50.97	-12.59	70.96	-18.76	38.99	10.22
239	-105.32	-1.33	-107.69	1.14	82.06	33.73	41.26	55.32
240	5.63	-51.21	100.53	2.31	22.25	-9.44	-80.80	6.02
241	-26.80	40.15	-169.29	-35.26	134.10	13.05	2.89	11.14
242	14.98	-40.91	-62.07	62.26	60.20	12.52	22.40	-30.48
243	-51.47	-58.07	77.25	-31.30	43.11	50.31	-42.19	-120.02
244	41.45	-125.00	-96.23	-92.10	-74.57	-12.26	-10.79	41.36
245	61.31	-55.38	22.56	3.66	49.72	-63.86	-3.34	-47.52
246	-74.32	37.13	-11.30	29.84	-91.43	6.84	-39.75	62.16
247	2.14	-61.14	7.27	-39.76	-5.45	61.17	-39.94	-30.76
248	-41.72	-13.88	-66.67	18.71	0.24	10.45	-23.84	-27.45
249	111.67	-34.75	-78.02	-20.94	18.22	-33.98	88.63	-79.09
250	29.89	12.59	-21.71	115.14	-58.94	-60.81	27.55	13.15

APPENDIX II

DATA RELATED TO EXAMPLE 2.4-2, TABLE 2.4-5.

MEAN= 5.45

VARIANCE=16.37

INDEX	GROUPS OF (1X8) DATA VECTORS							
1	-0.99	-5.94	-13.86	-17.82	-15.84	-9.57	-0.99	5.94
2	11.55	16.50	17.49	15.18	11.55	7.92	4.62	0.66
3	-4.62	-10.56	-13.86	-11.22	-4.29	1.98	6.60	10.23
4	13.53	16.17	16.50	11.55	5.94	1.65	-1.65	-5.23
5	-8.91	-13.86	-15.51	-12.21	-6.93	0.99	8.58	14.85
6	21.45	23.76	20.13	14.52	7.59	0.66	-5.94	-13.20
7	-17.49	-19.47	-17.49	-10.56	-1.98	6.60	15.51	23.43
8	28.05	26.73	20.13	10.23	0.66	-6.60	-11.88	-13.20
9	-14.19	-13.86	-10.89	-6.93	-0.99	5.28	11.22	15.84
10	18.15	17.49	13.20	7.59	0.99	-6.27	-12.21	-13.20
11	-11.88	-8.58	-3.63	0.99	4.62	11.88	18.15	20.79
12	20.13	15.84	7.26	-1.98	-11.55	-16.17	-16.83	-14.52
13	-9.57	-4.95	1.65	6.60	13.20	19.80	19.80	16.83
14	11.88	3.30	-4.29	-10.56	-12.87	-10.89	-8.58	-4.29
15	1.32	3.96	8.25	14.19	17.16	16.50	12.54	5.28
16	-1.65	-8.91	-13.53	-14.19	-11.88	-8.58	-3.30	1.98
17	8.25	12.87	18.15	19.47	16.50	12.21	3.63	-5.28
18	-13.20	-19.47	-20.79	-16.50	-9.24	-0.33	7.92	16.83
19	19.47	18.81	16.17	11.22	7.26	1.65	-4.95	-10.23
20	-14.85	-16.17	-13.86	-11.55	-6.60	-0.33	5.61	14.19
21	18.15	17.82	15.18	11.88	7.92	2.64	-4.29	-13.20
22	-17.16	-18.81	-16.83	-9.24	0.0	10.89	22.11	29.04
23	28.71	21.45	11.55	0.99	-8.91	-16.50	-22.11	-24.42
24	-21.45	-15.84	-8.58	0.66	11.88	23.43	30.36	30.03
25	23.76	13.53	2.97	-4.95	-10.89	-15.51	-18.48	-17.49
26	-11.88	-4.95	0.99	8.91	16.50	21.12	22.11	19.14
27	11.55	0.99	-8.25	-14.85	-19.14	-20.13	-17.49	-9.57
28	0.33	10.89	21.45	26.40	26.40	21.45	11.55	3.63
29	-2.64	-9.90	-15.18	-19.47	-19.47	-14.52	-8.91	-0.33
30	9.57	18.15	23.10	20.46	14.52	8.25	3.96	2.31
31	-0.33	-7.92	-14.19	-15.84	-13.53	-5.94	3.96	13.86
32	23.43	26.40	22.77	13.53	0.66	-6.93	-12.54	-15.84
33	-17.82	-19.14	-15.51	-8.58	0.99	14.19	25.74	32.67
34	32.01	24.09	12.21	-0.99	-11.55	-18.81	-22.77	-22.77
35	-21.12	-15.18	-6.93	3.30	17.16	26.73	29.04	25.08
36	15.18	6.93	-1.98	-11.88	-20.13	-25.41	-25.08	-18.81
37	-11.22	-0.99	11.22	23.43	30.36	30.03	21.12	10.23
38	1.98	-6.60	-14.85	-22.11	-26.40	-26.40	-20.13	-8.58
39	3.63	14.85	23.43	25.08	20.79	14.85	7.59	1.65
40	-3.30	-10.23	-17.16	-21.45	-21.78	-15.84	-1.65	12.54
41	22.11	25.74	22.11	16.17	10.23	2.97	-4.62	-12.87
42	-20.13	-22.11	-19.80	-13.20	-1.98	11.22	22.44	27.39
43	22.77	10.89	-0.33	-8.58	-13.86	-17.82	-20.46	-16.83
44	-10.56	-1.65	9.57	21.45	30.03	30.36	24.09	12.54
45	-1.98	-11.88	-18.15	-21.78	-22.44	-19.80	-14.85	-7.92
46	0.66	12.87	25.74	35.64	36.63	27.72	13.53	-1.98
47	-13.86	-23.76	-30.03	-29.37	-25.41	-16.83	-6.93	4.62
48	20.79	33.33	39.93	37.95	25.41	13.20	3.30	-10.56
49	-22.77	-31.02	-34.98	-32.67	-22.77	-7.26	8.58	23.43
50	34.65	36.96	32.34	22.11	10.89	0.99	-9.24	-19.47

MEAN= 5.45

VARIANCE=16.37

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
51	-26.73	-27.39	-21.78	-12.87	0.66	14.19	23.76	27.06
52	24.42	16.17	6.93	-1.32	-10.56	-17.82	-22.77	-25.08
53	-22.11	-12.87	0.0	14.52	27.39	33.00	29.37	21.78
54	10.23	0.33	-6.93	-13.20	-17.82	-21.45	-23.10	-19.80
55	-10.56	1.32	14.52	24.42	26.40	21.45	14.52	7.26
56	-0.33	-9.24	-16.17	-18.48	-17.82	-12.54	-1.98	8.58
57	20.46	27.06	24.75	19.14	10.56	0.99	-7.92	-15.84
58	-21.45	-23.43	-21.12	-14.19	-3.96	7.26	17.49	24.42
59	25.74	21.78	15.18	7.59	-0.66	-11.55	-17.16	-19.14
60	-17.82	-12.54	-3.63	5.28	13.86	16.17	13.53	9.24
61	4.29	0.66	-1.65	-6.93	-13.53	-19.80	-21.12	-16.50
62	-6.93	3.96	15.84	23.43	23.76	19.47	11.55	3.96
63	-0.66	-7.26	-11.55	-14.85	-17.16	-15.84	-10.89	-0.99
64	10.89	16.83	16.83	11.88	2.64	-3.63	-7.92	-11.55
65	-14.52	-14.85	-12.21	-7.26	-1.65	2.97	9.90	17.16
66	21.12	19.80	14.52	8.91	3.63	-2.31	-9.57	-16.17
67	-20.13	-19.14	-15.18	-6.93	1.65	7.26	12.21	14.19
68	11.55	6.60	3.30	0.0	-4.95	-9.24	-12.21	-12.21
69	-8.25	0.66	12.54	21.45	24.42	19.14	10.23	2.31
70	-4.62	-11.88	-17.49	-21.12	-21.45	-20.13	-14.52	-5.61
71	4.62	16.50	24.75	25.08	19.14	9.57	0.99	-6.27
72	-13.20	-18.15	-19.14	-16.17	-10.89	-1.65	9.57	19.14
73	25.41	23.76	16.50	6.93	-1.65	-12.87	-21.78	-24.42
74	-23.10	-18.48	-11.22	-1.32	9.24	19.47	25.74	24.42
75	16.17	9.57	-0.99	-10.23	-18.81	-26.40	-27.39	-22.11
76	-12.54	0.0	11.55	22.77	30.36	31.02	25.74	15.84
77	3.96	-8.25	-21.12	-28.71	-31.35	-29.70	-21.78	-9.90
78	0.99	11.22	17.49	19.80	20.46	18.81	13.86	6.27
79	-0.66	-8.91	-14.19	-15.84	-14.52	-9.24	0.0	8.91
80	14.85	15.84	12.21	6.60	0.33	-7.92	-16.17	-21.45
81	-20.79	-17.82	-12.54	-2.31	4.62	12.21	19.14	21.12
82	21.45	18.81	10.89	1.32	-7.59	-14.85	-18.48	-16.17
83	-9.90	-2.97	4.29	11.88	14.19	13.20	11.55	7.92
84	2.31	-4.95	-12.87	-18.15	-20.13	-18.15	-12.87	-4.29
85	3.96	11.55	16.83	19.80	19.80	16.83	11.22	4.29
86	-2.97	-8.58	-11.55	-9.90	-5.28	-0.66	5.61	8.58
87	6.93	3.30	0.99	-1.98	-7.26	-11.88	-14.85	-16.17
88	-13.86	-8.25	0.99	8.91	16.50	20.46	21.12	18.81
89	14.85	9.57	4.29	-1.65	-6.60	-11.55	-13.20	-9.57
90	-4.29	1.65	6.27	7.26	5.61	0.33	-2.97	-5.94
91	-8.91	-9.90	-10.23	-8.91	-4.95	-0.33	8.58	18.48
92	25.08	27.72	24.75	20.13	11.88	0.66	-10.23	-18.81
93	-24.75	-24.75	-21.12	-14.52	-2.97	7.92	16.17	20.79
94	19.80	15.51	9.24	2.31	-2.31	-10.23	-15.51	-16.83
95	-16.17	-8.91	2.31	14.85	25.08	28.38	25.41	18.48
96	7.26	-3.30	-10.56	-13.20	-14.85	-14.19	-9.24	-2.97
97	6.60	14.52	17.49	18.81	15.84	8.91	-0.33	-10.23
98	-17.49	-22.11	-20.46	-11.88	-1.65	9.57	20.79	27.06
99	27.72	25.74	20.46	11.88	2.31	-7.59	-15.51	-20.13
100	-20.13	-15.84	-8.91	2.64	11.88	17.16	19.80	17.49

MEAN= 5.45

VARIANCE=16.37

INDEX	GROUPS OF (1X8) DATA VECTORS							
101	13.20	7.59	-1.98	-7.92	-9.24	-8.91	-6.27	-2.31
102	2.97	10.89	18.15	22.77	22.11	18.81	12.54	3.63
103	-3.63	-10.56	-15.18	-14.52	-8.25	-1.32	2.97	6.60
104	7.92	10.23	15.18	16.83	12.87	6.93	0.66	-3.63
105	-3.63	-0.99	0.99	5.28	8.91	10.23	10.89	11.55
106	13.86	14.19	9.57	2.97	-5.28	-7.92	-5.94	-3.30
107	0.99	4.95	10.56	15.18	16.83	15.84	11.55	5.61
108	-0.66	-4.95	-7.59	-7.26	-2.31	3.30	7.92	13.86
109	18.48	21.45	21.45	17.82	11.88	1.65	-7.92	-14.52
110	-17.82	-11.22	-0.33	8.58	18.15	22.77	24.42	24.09
111	21.78	17.16	7.92	-1.65	-11.55	-19.14	-18.81	-10.89
112	0.33	11.55	21.12	24.75	24.42	22.11	18.81	13.53
113	4.95	-5.61	-12.21	-11.88	-5.61	1.32	6.93	12.87
114	17.16	20.13	22.11	21.12	15.51	6.27	-2.64	-11.55
115	-15.18	-10.23	-0.99	10.23	17.49	19.80	22.44	24.75
116	25.41	22.11	13.86	3.30	-7.92	-17.49	-19.80	-13.86
117	-1.32	9.90	21.12	30.03	33.99	34.65	29.04	18.81
118	6.60	-4.62	-13.53	-19.14	-18.48	-10.23	0.0	10.56
119	19.80	28.38	35.64	36.63	30.69	18.81	5.28	-6.60
120	-13.86	-14.19	-6.60	3.96	12.54	21.78	29.37	33.33
121	33.00	26.07	15.18	3.30	-10.56	-19.47	-22.44	-18.48
122	-5.94	7.92	21.45	33.66	41.58	44.22	41.25	30.03
123	13.53	0.0	-6.60	-9.57	-12.21	-9.90	-1.32	7.92
124	16.17	25.08	32.34	34.65	30.36	19.80	8.58	-1.98
125	-8.58	-10.56	-9.57	-2.97	4.95	10.89	21.78	33.33
126	41.25	42.90	35.97	20.13	3.96	-6.27	-10.89	-13.20
127	-11.22	-4.29	3.30	11.22	21.12	31.02	36.96	36.96
128	28.71	16.83	7.26	-0.99	7.92	2.31	-3.96	-5.94
129	-3.63	2.31	9.90	15.51	19.47	24.09	26.40	26.07
130	23.43	19.47	14.19	8.25	1.98	-3.30	-5.61	-1.65
131	6.60	13.20	18.15	19.47	20.46	23.76	25.08	21.78
132	17.49	13.20	10.23	5.28	0.0	-5.61	-6.60	-1.98
133	5.61	14.52	22.11	26.07	29.37	30.69	29.70	26.73
134	20.46	14.52	6.60	-2.97	-9.24	-11.88	-7.92	0.99
135	11.22	21.12	29.04	33.99	35.64	33.99	28.71	21.45
136	13.53	7.59	1.65	-1.98	-4.62	-5.61	-2.31	4.62
137	12.21	19.14	25.41	27.06	26.40	26.07	22.11	18.81
138	29.70	7.26	1.65	-0.66	-1.65	0.0	5.28	12.21
139	18.15	25.74	31.68	32.34	30.03	24.09	15.18	7.92
140	0.66	-2.97	-3.30	-1.65	1.32	4.95	11.22	17.16
141	24.75	32.01	33.66	30.03	23.10	14.19	7.26	1.32
142	-1.32	1.98	5.28	8.25	12.87	14.85	19.14	25.74
143	29.04	30.36	27.39	18.48	10.56	3.30	-1.65	-2.64
144	-1.32	3.96	9.57	8.91	20.13	24.75	29.04	30.69
145	29.04	25.41	17.16	7.59	0.0	-5.94	-7.26	-3.63
146	3.63	12.21	20.79	29.70	32.34	32.01	29.37	24.09
147	20.13	16.17	7.59	1.65	-1.98	-2.64	-0.33	2.31
148	5.94	11.22	17.49	25.08	29.04	30.69	29.37	25.08
149	20.13	14.85	6.60	-2.97	-6.93	-6.93	-2.97	3.96
150	12.21	22.11	32.01	38.94	39.60	33.00	24.42	14.52

MEAN= 5.45

VARIANCE=16.37

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****	********	********	********	********	********	********	********	********
151	3.96	-3.96	-11.22	-15.84	-12.54	-4.62	4.95	14.52
152	26.40	35.97	40.59	39.27	33.33	24.75	16.50	10.56
153	4.29	-1.98	-7.59	-9.57	-3.96	5.28	13.86	23.10
154	30.36	33.99	32.67	27.39	19.14	10.89	4.62	0.33
155	-3.30	-5.94	-6.27	-0.66	8.58	21.45	34.32	40.26
156	41.25	34.65	22.44	12.87	4.62	-0.99	-3.30	-5.94
157	-4.62	-1.32	2.64	8.58	16.83	26.73	33.33	33.33
158	29.37	22.44	14.52	10.23	6.27	-0.99	-3.96	-2.97
159	0.33	8.25	14.85	22.44	31.35	34.32	32.67	25.41
160	14.52	6.27	-0.99	-6.60	-10.23	-10.23	-5.28	3.96
161	15.84	28.71	38.28	42.90	40.59	33.00	22.77	12.54
162	3.96	-3.96	-9.57	-11.22	-10.23	-5.28	3.30	16.17
163	31.35	41.58	42.24	35.31	24.42	16.50	8.91	0.66
164	-6.27	-11.22	-11.55	-6.27	0.0	9.90	22.77	34.98
165	43.23	44.22	34.32	22.44	12.87	5.28	-2.64	-10.23
166	-13.86	-13.20	-7.59	3.63	15.51	27.06	35.64	37.29
167	33.33	28.05	19.80	12.87	8.25	0.66	-6.27	-10.23
168	-10.89	-3.63	10.23	23.43	34.65	37.29	33.99	28.38
169	21.45	15.18	7.59	-0.66	-6.27	-8.58	-6.93	-1.65
170	8.58	21.78	33.66	39.27	34.65	23.43	2.64	3.96
171	-2.64	-7.59	-10.56	-6.27	1.65	12.21	23.76	34.32
172	41.91	41.58	34.98	23.43	9.24	0.33	-4.95	-9.90
173	-11.88	-11.22	-7.26	1.32	12.21	25.41	38.61	48.18
174	47.19	36.30	20.46	5.94	-4.29	-12.21	-16.83	-17.82
175	-15.18	-7.92	0.0	12.54	30.36	44.55	52.14	49.50
176	36.96	22.77	9.90	-1.65	-11.88	-19.47	-22.44	-20.13
177	-11.88	0.99	14.85	31.02	43.23	47.52	43.89	34.65
178	21.78	10.23	-1.32	-11.55	-17.49	-16.17	-9.90	-0.66
179	12.21	24.42	32.34	35.31	32.01	25.74	18.81	11.22
180	1.98	-7.59	-15.18	-17.16	-14.19	-3.96	10.89	26.07
181	39.27	43.89	37.95	29.04	18.15	9.24	2.97	-2.64
182	-7.26	-11.88	-14.19	-11.22	-3.63	8.91	24.09	34.32
183	36.96	32.01	22.77	13.20	5.61	-2.97	-8.25	-9.90
184	-9.24	-2.97	6.60	16.50	27.39	32.67	31.68	27.72
185	20.13	11.38	1.65	-8.58	-14.85	-17.49	-14.52	-6.93
186	3.96	17.16	27.72	33.00	32.67	27.39	21.45	15.84
187	8.58	0.0	-5.28	-8.91	-8.58	-4.29	2.97	13.20
188	22.77	27.39	26.07	20.13	12.87	8.25	5.61	0.33
189	-5.61	-8.91	-9.24	-6.27	1.98	10.56	20.13	27.72
190	30.69	29.04	22.11	14.52	6.93	-1.32	-6.27	-9.57
191	-9.90	-6.60	0.66	10.89	20.46	24.42	22.77	15.84
192	8.25	3.96	1.65	-1.65	-5.94	-7.92	-6.60	-2.64
193	2.64	9.24	19.47	27.72	30.69	26.73	20.13	13.86
194	8.58	5.61	0.33	-6.27	-9.57	-9.90	-6.93	-0.99
195	6.93	14.85	22.77	25.41	21.12	15.18	10.23	4.95
196	0.99	-1.65	-2.97	-2.64	0.99	10.23	20.46	27.72
197	31.68	26.73	19.14	11.88	4.29	-2.97	-9.90	-14.52
198	-14.85	-12.54	-5.94	3.96	14.52	26.40	33.00	31.68
199	25.74	17.82	9.90	3.30	-3.96	-9.57	-11.22	-9.90
200	-4.62	6.27	17.49	27.06	33.00	31.35	24.09	13.86

MEAN= 5.45

VARIANCE=16.37

INDEX	GROUPS OF (1X8) DATA VECTORS							
*****								
201	5.61	-5.28	-13.53	-15.84	-15.18	-10.56	-2.64	7.26
202	17.82	27.72	33.99	32.34	23.76	17.49	6.93	-2.31
203	-10.89	-18.15	-18.15	-13.86	-4.95	7.59	20.13	32.01
204	39.60	39.60	33.33	22.77	10.23	-1.65	-13.53	-20.79
205	-23.10	-21.12	-13.20	-2.31	7.59	17.82	24.42	27.72
206	30.03	27.72	23.10	14.52	5.28	-2.64	-8.25	-9.57
207	-6.60	-0.99	8.58	16.83	20.46	20.79	17.82	13.86
208	8.58	1.65	-6.93	-13.86	-14.85	-13.20	-6.93	4.62
209	13.20	22.44	28.71	28.71	27.06	22.77	15.18	6.60
210	-1.98	-7.92	-10.23	-9.90	-5.61	-0.66	5.94	14.52
211	19.80	20.79	19.47	13.86	5.94	-1.98	-10.23	-14.52
212	-14.85	-11.88	-4.95	1.98	8.25	14.19	19.14	23.10
213	25.08	23.76	19.14	9.90	0.99	-6.27	-9.90	-7.92
214	-1.98	5.28	11.88	13.86	11.55	5.61	1.65	-1.65
215	-5.28	-7.26	-8.25	-8.91	-8.91	-4.95	2.64	11.22
216	20.13	25.41	27.39	25.74	19.80	13.53	6.93	0.33
217	-4.29	-7.26	-7.59	-4.95	-1.32	1.65	4.29	5.28
218	3.63	1.32	-1.65	-5.94	-8.58	-11.88	-13.86	-13.20
219	-9.90	-0.99	8.58	18.48	25.41	27.06	22.44	16.17
220	8.25	-0.66	-10.23	-18.15	-23.76	-24.75	-21.78	-16.50
221	-4.95	8.91	19.80	25.41	24.09	18.48	10.23	3.63
222	-1.32	-9.24	-13.86	-14.85	-13.20	-6.27	3.96	14.85
223	23.43	27.06	25.08	18.81	9.24	-0.33	-8.58	-13.53
224	-16.17	-15.51	-11.88	-3.63	6.60	13.53	17.16	16.83
225	14.19	8.91	-0.33	-10.56	-16.83	-17.82	-11.88	-2.97
226	5.61	16.83	26.40	31.02	33.00	32.01	26.40	16.50
227	5.28	-5.28	-13.53	-19.14	-19.14	-14.19	-7.26	3.63
228	12.54	18.81	21.45	18.48	14.85	9.57	1.98	-3.63
229	-6.60	-7.92	-5.94	-2.31	2.64	11.55	20.46	26.73
230	28.38	24.09	16.50	7.26	-0.66	-6.60	-8.91	-7.59
231	-2.31	2.97	7.26	10.23	11.22	14.85	20.46	22.77
232	18.81	12.21	4.29	-1.98	-1.32	1.32	4.29	-1.32
233	11.22	12.21	10.89	10.56	11.88	10.56	7.26	0.99
234	-8.25	-11.55	-10.89	-7.92	-3.63	0.33	6.93	12.87
235	16.83	18.81	12.87	3.63	-3.63	-9.90	-12.21	-10.23
236	-5.94	-0.33	5.28	13.20	17.82	18.15	16.50	12.54
237	6.60	-3.30	-13.20	-20.13	-24.09	-18.81	-8.25	1.32
238	10.89	16.83	19.14	18.81	15.51	10.23	0.33	-9.24
239	-16.17	-20.13	-17.82	-8.58	0.99	8.91	16.83	18.48
240	18.48	17.16	15.18	11.22	1.65	-10.23	-19.14	-20.79
241	-12.87	-3.96	3.63	10.89	15.18	16.83	16.50	12.54
242	6.60	-0.66	-7.92	-15.18	-18.81	-15.51	-8.58	-0.66
243	6.60	11.55	15.18	19.47	21.12	15.51	4.62	-8.58
244	-22.11	-29.70	-29.04	-21.78	-8.91	1.65	11.22	18.15
245	22.77	24.42	21.45	13.20	1.98	-9.24	-21.78	-30.03
246	-30.36	-22.77	-10.23	1.32	10.89	20.13	26.73	25.41
247	18.48	5.28	-7.59	-16.83	-22.11	-20.13	-13.20	-5.61
248	1.65	9.90	16.83	22.77	22.11	14.52	3.30	-10.56
249	-24.75	-33.33	-34.65	-27.39	-13.86	0.66	12.87	21.12
250	28.05	30.03	27.06	17.82	2.64	-9.57	-16.83	-22.77

APPENDIX III

THIS APPENDIX PROVIDES A LISTING OF FORTRAN PROGRAMS USED TO OBTAIN SOLUTIONS TO EXAMPLES IN CHAPTER II AND III, RESPECTIVELY.

```
0001          DIMENSION P(8,8),CV(8,8),R(8,8),Q(8,8),CO(8,8)
0002          DIMENSION A(2000),B(8),C(8),D(8),H(8),RMS(75),AEPS(10)
0003       21 FORMAT (6E13.4)
0004       22 FORMAT('1',///////////////////////////////////////////////////
             C,' INDEX',25X,'GROUPS OF (1X8) DATA VECTORS')
0005       23 FORMAT ('******',3X,'************************************'
             C,'**************************************')
0006       24 FORMAT (3X,I3,2X,8(F7.2,2X))
0007       32 FORMAT('1',15X,'VARIANCE=',F7.2,10X,'MEAN=',F6.2,/,16X,
             C'****************',10X,'*************',/)
0008       33 FORMAT(2X,3(5X,4HEPS=F9.6,10X),/,2X,3(5X,'*************'
             C,10X),//)
0009       34 FORMAT(1X,3('# OF VECT.',2X,'RMS DEVIATION',3X),/,1X,
             C3('**********',2X,'*************',3X))
0010       35 FORMAT(/,1X,3(3X,I3,9X,F6.3,7X))
0011          M=2000
0012          K=8
0013          L=10
0014          JJ=M/K
0015          NUM=K*K
        C*********************************************************************
        C     FOR EX. 2.4-1 THE FOLLOWING BLOCK CAN BE USED TO GENERATE
        C     GAUSSIAN RANDOM NUMBERS WITH MEAN=0 AND VARIANCE=0.5.
        C           IX=999
        C           AMN=0.0
        C           STA=0.5
        C           DO 30 I=1,M
        C           CALL GAUSS (IX,STA,AMN,V)
        C        30 A(I)=V
        C     AND THE SUBROUTINE TO BE USED FOR THIS PURPOSE IS
        C           SUBROUTINE GAUSS (IX,S,AM,V)
        C           A=0.0
        C           DO 50 I=1,12
        C           CALL RANDU(IX,IY,Y)
        C           IX=IY
        C        50 A=A+Y
        C           V=(A-6.0)*S+AM
        C           RETURN
        C           END
        C*********************************************************************
0016          READ (5,21) (A(I),I=1,M)
0017          PRINT 22
0018          PRINT 23
0019          II=0
0020          DO 9 J=1,JJ
0021          WRITE(6,24) J,(A(I+II),I=1,K)
0022        9 II=II+K
0023          EPS=0.0001
0024          INDEX=0
0025          DO 101 NN=1,3
0026          N=0
        C*********************************************************************
        C     INITIALIZATIONS NECESSARY FOR THE COMPUTATION OF
        C     AUTOCORRELATION AND INVERCE-AUTOCORRELATION MATRICES.
0027          DO 10 I=1,K
0028          DO 11 J=1,K
0029          CV(I,J)=0
0030       11 P(I,J)=0
```

```
   10 P(I,I)=1/EPS
C*****************************************************************
      II=0
  100 NO=0
   99 N=N+1
      NO=NO+1
      DO 12 I=1,K
   12 H(I)=A(I+II)
      II=II+K
C*****************************************************************
C     COMPUTATION OF AUTOCORRELATION MATRIX.
      DO 13 I=1,K
      DO 14 J=1,K
      CV(I,J)=H(I)*H(J)+CV(I,J)
   14 CO(I,J)=CV(I,J)/N
   13 CONTINUE
C*****************************************************************
C*****************************************************************
C     COMPUTATION OF INVERSE-AUTOCORRELATION.
      SCALAR=0
      DO 15 J=1,K
      C(J)=0
      DO 16 I=1,K
      B(I)=H(I)*P(I,J)
   16 C(J)=C(J)+B(I)
   15 SCALAR=C(J)*H(J)+SCALAR
      SCALAR=SCALAR+1
      DO 17 J=1,K
      D(J)=0
      DO 18 I=1,K
      B(I)=P(J,I)*H(I)
   18 D(J)=D(J)+B(I)
   17 CONTINUE
      DO 19 J=1,K
      DO 20 I=1,K
      R(J,I)=D(J)*C(I)/SCALAR
      P(J,I)=P(J,I)-R(J,I)
   20 Q(J,I)=P(J,I)*N
   19 CONTINUE
C*****************************************************************
      IF(NO.NE.L) GO TO 99
      CALL INVERS (CO,K)
C*****************************************************************
C     THIS BLOCK COMPUTES THE RMS ERROR.
      SUM=0
      DO 41 J=1,K
      DO 42 I=1,K
      CO(I,J)=(CO(I,J)-Q(I,J))**2
   42 SUM=SUM+CO(I,J)
   41 CONTINUE
      AVG=SUM/NUM
      INDEX=INDEX+1
      RMS(INDEX)=SQRT(AVG)
C*****************************************************************
      IF(JJ.NE.N) GO TO 100
      AEPS(NN)=EPS
  101 EPS=EPS*100
C*****************************************************************
```

```
C      COMPUTATION OF MEAN AND VARIANCE FOR THE 2000 DATA POINTS.
       AVG=0
       DO 103 I=1,M
   103 AVG=AVG+A(I)
       AMN=AVG/M
       SUM=0
       DO 104 I=1,M
   104 SUM=SUM+(AMN-A(I))**2
       VAR=SUM/2000
       STA=SQRT(VAR)
C*********************************************************************
       PRINT 32,STA,AMN
       WRITE(6,33) (AEPS(I),I=1,3)
       PRINT 34
       DO 130 I=1,25
       J=L*I
   130 WRITE(6,35) J,RMS(I),J,RMS(I+25),J,RMS(I+50)
       STOP
       END
```

```
FORTRAN IV G LEVEL  21                 INVERS                 DATE = 77067

              SUBROUTINE INVERS (C,N)
              DIMENSION C(N,N),A(1024)
              K=0
              DO 10 J=1,N
              DO 10 I=1,J
              K=K+1
              A(K)=C(I,J)
           10 CONTINUE
              EPS=1. E-7
              CALL SINV(A,N,EPS,IER)
              IF (IER.EQ.-1) STOP
              K=0
              DO 20 J=1,N
              DO 20 I=1,J
              K=K+1
              C(I,J)=A(K)
              IF (I.EQ.J) GO TO 20
              C(J,I)=C(I,J)
           20 CONTINUE
              RETURN
              END
```

```
0001        DIMENSION P(3,3),Q(3,3),R(3,3),CV(3,3),CO(3,3),A(3,3)
0002        DIMENSION B(3),C(3),D(3),H(3),V(3),SVZ(3,3),VZ(3,3)
0003     21 FORMAT(4X,I2)
0004     22 FORMAT('1',//,' # OF VECT.',8X,'AUTOCORRELATION MATRIX',7X,
           C'INVERSE OF AUTOCORRELATION',9X,'CROSSCORRELATION MATRIX',5X
           C,'TRANSFORMATION MATRIX',/,'************',8X,'*************'
           C,'*********',7X,'**************************',9X,
           C'***********************',5X,'*********************')
0005     23 FORMAT(/,16X,3(F9.3),5X,3(F8.3),9X,3(F8.3),3X,3(F8.3))
0006     24 FORMAT(4F2.0)
0007        K=3
0008        EPS=.01
0009        NN=48
0010        DO 102 JJ=1,3
0011        N=0
0012        DO 11 I=1,K
0013        DO 12 J=1,K
0014        CV(I,J)=0
0015        VZ(I,J)=0
0016     12 P(I,J)=0
0017        P(I,I)=1/EPS
0018        V(I)=0
0019     11 CONTINUE
0020    101 PRINT 22
0021        M=0
0022    100 READ(5,24) CLASS,(H(I),I=1,K)
0023        V(CLASS)=1
0024        N=N+1
0025        M=M+1
0026        DO 17 I=1,K
0027        DO 16 J=1,K
0028        CV(I,J)=H(I)*H(J)+CV(I,J)
0029        VZ(I,J)=V(I)*H(J)+VZ(I,J)
0030        SVZ(I,J)=VZ(I,J)/N
0031     16 CO(I,J)=CV(I,J)/N
0032     17 CONTINUE
0033        SCALAR=0
0034        DO 20 J=1,K
0035        C(J)=0
0036        DO 30 I=1,K
0037        B(I)=H(I)*P(I,J)
0038        C(J)=C(J)+B(I)
0039     30 CONTINUE
0040        SCALAR=C(J)*H(J)+SCALAR
0041     20 CONTINUE
0042        SCALAR=SCALAR+1
0043        DO 50 J=1,K
0044        D(J)=0
0045        DO 40 I=1,K
0046        B(I)=P(J,I)*H(I)
0047        D(J)=D(J)+B(I)
0048     40 CONTINUE
0049     50 CONTINUE
0050        DO 70 J=1,K
0051        DO 60 I=1,K
0052        R(J,I)=D(J)*C(I)/SCALAR
0053        P(J,I)=P(J,I)-R(J,I)
0054        Q(J,I)=P(J,I)*N
```

```
0055           60 CONTINUE
0056           70 CONTINUE
0057              DO 71 J=1,K
0058              DO 72 I=1,K
0059              SUM=0
0060              DO 73 L=1,K
0061           73 SUM=SUM+SVZ(J,L)*Q(L,I)
0062           72 A(J,I)=SUM
0063           71 CONTINUE
0064              PRINT 21,N
0065              DO 110 J=1,K
0066              WRITE(6,23) (CO(J,I),I=1,K),(Q(J,I),I=1,K),(SVZ(J,I),I=1,K)
                 C,(A(J,I),I=1,K)
0067              V(J)=0
0068          110 CONTINUE
0069              IF(N.EQ.NN)GO TO 888
0070              IF(M.EQ.8) GO TO 101
0071              GO TO 100
0072          888 NN=15
0073          102 CONTINUE
0074              STOP
0075              END
```

ACKNOWLEDGMENTS

The author wishes to express his deep gratitude and sincere appreciation to his major professor, Dr. Nasir Ahmed, for his advice and encouragement during the preparation of this report. Appreciation and thanks are also due to Mr. D. Parikh for his assistance. Furthermore, the author expresses his sincere gratitude to Drs. Donald Hummels and S. Thomas Parker who served as his committee members.

The author also expresses his sincere appreciation to Mrs. Deanna L. Nicodemus for typing this report.

STUDY OF A RECURSIVE METHOD FOR MATRIX INVERSION VIA SIGNAL PROCESSING EXPERIMENTS

by

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B.S., Kansas State University, 1975

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Electrical Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1977

This report discusses some aspects pertaining to a recursive method for inverting real symmetric matrices. The use of this method is explained in connection with two problems of interest in the following areas of communication and signal processing: (i) digital filtering via nonrecursive filters, and (ii) pattern classification via a least-squares minimum distance classifier.