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HOW TO SPEED UP YOUR REGRESSION MODEL.(U)
MAY 79 T M BEATTY, K P JAMES

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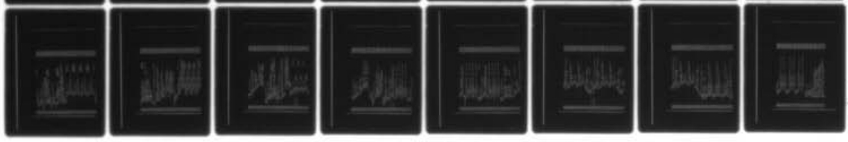

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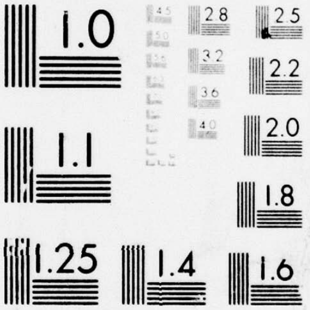

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Air Force personnel managers must be able to accurately forecast the force size. This need is explicit in meeting statutory budget limitations. Further, officer losses drive accessions, training, and promotion; thus the need for accuracy in forecasting losses cannot be over-emphasized. To accomplish this objective, loss rates have been generated using Ordinary Least Squares (OLS) stepwise regression run on what are locally dubbed the "binary files". The purpose of this paper is to report a front-end processor to OLS which has reduced computer run time by 85 percent for this organization.

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HOW TO SPEED UP YOUR REGRESSION MODEL

TECHNICAL MEMORANDUM

BY

T.M. BEATTY

K.P. JAMES

MAY 1979

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HOW TO SPEED UP YOUR REGRESSION MODEL

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MAY 1979

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While the contents of this report are considered to be correct, they are subject to modification upon further study. This report does not promulgate official Air Force policies or positions. The technical conclusions are solely those of the authors.

FOREWORD

This report and the associated software were prepared by the Modeling Section of the Air Force Manpower and Personnel Center in response to the need to solve large multivariate regression problems (100 attributes with up to 30,000 observations) in the management of the one million plus personnel employed by the Air Force. The collaboration of the following people is acknowledged: LCDR C. Pennington, Lt D. Hemphill, CMS L. Staton, and TSG D. Francis.

EXECUTIVE SUMMARY

Problem

Air Force Personnel managers must be able to accurately forecast the force size. Taken in a more general context, managers must be able to forecast a system response to independent stimuli . Ordinary Least Squares (O.L.S.) multivariate regression has been used to meet this need. O.L.S. Regression consumes inordinate ADP resources.

Objective

Reduce ADP resource usage in regression studies.

Approach

Isolate the portion(s) of regression which account for the greatest resource consumption and optimize.

Results

The major portion (75-95 percent) of the ADP resource was found to be expended in the computation of intercorrelation matrices. Since many regression problems are sparse due to the use of dummy variables, the introduction of logic to omit zeroe attribute values within an observation has provided ADP resource savings as high as 90 percent.

Conclusions

1. Regression problems of less than 91.5% density will yield economies.
2. Data files should not be processed with general utility regression programs.
3. As a second choice process data files with stand-alone correlation matrix builders.
4. The greatest economies will be realized if no data file is created for regression analysis. Rather insert correlation matrix build logic in the ADP system at the point where regression file(s) would be created.
5. Any of several matrix input regression packages may then be used to perform the actual stepwise or multiple regression.

ABSTRACT

Air Force personnel managers must be able to accurately forecast the force size. This need is explicit in meeting statutory budget limitations. Further, officer losses drive accessions, training, and promotion; thus the need for accuracy in forecasting losses cannot be over-emphasized. To accomplish this objective, loss rates have been generated using Ordinary Least Squares (OLS) stepwise regression, run on what are locally dubbed the "binary files". The purpose of this paper is to report a front-end processor to OLS which has reduced computer run time by 85 percent for this organization.

INTRODUCTION

Numerous software packages are available to solve the multivariate regression problem. To wit ; SPSS Incorporated's statistical package for the social sciences, the Biomedical Division's BMD02R, Burroughs' Advanced Statistical Inquiry System (BASIS), and Greenberger & Ward's Iterative Method. These methods and presumably a host of others capitalize upon the ability to sequentially consume virtually an unlimited amount of data, reduce the data to a correlation matrix, and "solve the problem". This feature of sequential processing of data into a relatively small core-resident matrix is one of the main selling points for OLS regression. However, the run time of most regression packages is notorious. In fact, the literature, both proprietary and public, note that providing a correlation matrix as input to the regression program will significantly reduce the regression run time. In application this approach saves time only if the user wishes to run various "sub-problems" against the same data file. (For example one may wish to make individual runs with the same independent variables against two or more dependent variables.) The lack of savings observed in running the single problem results because the data file must still be sequentially processed to build the correlation matrix. This leads to the incontrovertible conclusion that in order to make any money in reducing regression run time, the correlation matrix generation logic must be attacked. This, then is our approach.

This paper reports three methods which have resulted in significant computer resource savings in our application of O.L.S. It is presumed that readers of this paper are generally conversant with O.L.S. methodology. Therefore the objective of this paper will be to provide techniques which may provide reductions in run time, and not a tutorial on regression or correlation derivation.

METHOD

General

A straight-forward method of doing regression is to sequentially read the observations into an array, say VAR_i where i varies from 1 to the number of attributes and then execute code similar to the following:

```
 SUM(I) = SUM(I) + VAR(I)
SSUM(I) = SSUM(I) + VAR(I) * VAR(I)
 XYSUM (I,J) = XYSUM (I,J) + VAR (I) * VAR (J)
 for I = 1 to number of attributes
     J = 1 to number of attributes
```

After processing all observations as above, then compute the means, standard deviations, and the intercorellation matrix as below: Where N = the number of observations.

$$XMEAN(I) = SUM(I)/N$$

$$STDEV(I) = \left(\frac{SSUM(I) - N*XMEAN(I)*XMEAN(I)}{N-1}\right) ** 0.5$$

$$R(I,J) = \frac{XYSUM(I,J) - SUM(I)*SUM(J)/N}{(N-1)*STDEV(I)*STDEV(J)}$$

The above produces the means and standard deviations for the attributes and the Pearson Product-Moment correlation coefficients which can be used as input to a properly designed regression program. But at what cost?

If the above logic were applied to a 100 attribute problem with 3 thousand observations, the SUM (I) and SSUM (I) computations would each be executed 300 thousand times taking approximately 15 seconds CPU time. The XYSUM (I,J) computation would be executed 30 million times at a cost of about 11 hundred seconds CPU time. All of this is in addition to the time required to read the file and handle various other statements required to complete the set of executable program logic. (all timing estimates are for a Burroughs B6700).

There are obvious savings in the XYSUM (I,J) computations since the XYSUM matrix is symetric to the diagonal. Automatically the cost can be reduced by 49.5% or to 556 seconds of CPU time. Additionally the diagonal of the correlation matrix contains only 1's; therefore that XYSUM on the diagonal is extraneous. This reduces the time required to 545 seconds CPU. These economies are recognized by most, but not all, statistical packages which provide O.L.S. regression. There are, however, potential problems with the approach above.

Computers are limited in the number of significant digits that can be represented in a real number. And in regression we frequently deal with big numbers. Specifically, on the AFMPC B6700 a real number contains 11 significant digits. Thus truncation errors may develop if the sums, sums of squares, or cross-product sums exceed 10 to the 11th power. Depending upon cirmcumstances, this could result in attempting to compute the square root of a negative number or simply erroneous standard deviations and correlation elements. Since many regression algorithms have not planned for this anomaly, the researcher is cautioned to consider this possibility when dealing with big numbers, particularly if the attempted regression run terminates with "INVALID ALOG ARGUMENT".

Thus far we've reduced the computation of XYSUM by over one-half for those statistical packages which do not recognize the symmetry of the matrix. The next area and the most important is the database itself. The data files we utilize daily are files created from raw data, the Master Personnel File (MPF). The raw data is converted to what we call "binary files". Each observation contains upwards of 100 variables or attributes. Most, but not all, attributes are "1" or "0", e.g., either the individual has a regular commission or he does not. Our new composite binary file contains on/off state variables and continuous variables, such as age. No statistical packages yet observed recognize the economics of checking for a value of "0" for an attribute before doing the SUM (I), SSUM (I), md XYSUM (I,J) computations. Our point is; a "0" added to a value of SUM (I) is the original SUM (I) and that squared, is the original SSUM (I), so why do them? By inclusion of 2 lines of code (in most cases), we check to see if the value is "0", increment the counter by one, and step back to process the next value instead of going thru all the calculations to end up eith the same results. We use the same logic for XYSUM (I,J). The following is a sample of the code from our local regression package. The starred lines are the added code.

```
    DO  80  J=1, KK
    *IF(VAR(J).EQ.O) GO TO 80
    SUM (J) = SUM (J) + VAR(J)
    SSUM (J) = SSUM (J) + VAR (J) * VAR (J)

    DO 110 K=1, J-1
    *IF (VAR(K).EQ.0) GO TO 110
    XYSUM (J,K)=XYSUM (J,K) + VAR (J) * VAR (K)
110 CONTINUE
80 CONTINUE
```

The added lines of code will cost us some CPU time. The overall CPU runtime reduction is clearly a function of the file density A test problem was constructed to see at what point would the modifications to the regression break even with the regression run time. To accomplish this the inner and outer DO statements were timed in a variety of computer mixes on the B6700. To process a 10,000 observation problem with 100 variables; the average run time was:

outer computations = 56 seconds
inner computations = 2200 seconds
Total 2256 seconds

The worst case with the new regression code and an 80% dense file was:

outer computations 45 seconds
inner computations 2216 seconds
Total 2261 seconds

If a file is 80% or less dense then the inclusion of the extra lines of code is cost effective.

To be able to reduce CPU time enables drastic reductions in clock time. Clock time represents a tie up of computer resources and personnel. Two actual files with 28% density are presented below:

a. File size: 2374 observations
   Attributes: 92 variables
   File Density: 28%
   File Format: Formatted
   CPU run time: 1375 seconds versus 230 seconds
   Clock time: 1 hr, 9 min, 57 sec versus 6 min 58 sec

b. File size: 4197
   Attributes: 94
   File Density: 28%
   File Format: Formatted
   CPU run time: 2676 sec versus 322 sec.
   Clock time: 2 hrs, 15 min 55 sec versus 10 min 46 sec

In example a., the CPU run time was reduced 83% while the clock time was reduced 90%. In example b. the CPU run time was reduced 87% while the clock time was reduced 96%. This is significant savings as the density of our average files is 28%. To restate the objectives we had; we needed to run regressions with matrix input and needed to speed up the matrix build process. The savings in CPU and clock time is geometric. Once a parent binary file is created capturing data at given points in time numerous regressions can be run on the file utilizing subsets of variables to answer a variety of questions in the same or less amount of time it took to run only one regression.

Application

First and foremost, the user must avoid processing the raw data with off-the-shelf, generalized software. And, if reading the data file can be avoided all together, even better. Locally we have modified production regression applications in both of the manners indicated.

In the first case our regression program was modified at the point where the data file would be sequentially consumed. At this point a procedure is invoked which processes all of the raw data and returns the intercorrelation matrix, the means, and the standard deviations to the regression program. Using the procedure shown below in figure #1, we have realized savings of 75-85 percent in CPU and in excess of 90 percent in elapsed time processing data files which average 28 percent density. This specific application has been generalized to produce a utility procedure which may be invoked by any calling program requiring the means, standard deviations, and a correlation matrix. Appendix A presents the utility procedure in ALGOL. As can be readily seen from the program documentation, this procedure may be included in a calling program to process observations as sequentially read, or introduced earlier in a system. It is this latter application which provides the greatest efficiency.

FIG 1

```
            BURROUGHS B6700 ALGOL COMPILER, VERSION 2.9.190,     FRIDAY, 02/02/79, 12:16 PM.

                               O B J E C T / L O S S 1 / L D A T A
                               = = = = = = = = = = = = = = = = = = =

 $SET LINEINFO LIST                                                        00000100  000:0000:0
%                                                                          00000200  000:0000:0
% PROCEDURE TO READ DATA FOR REGRFUN                                       00000300  000:0000:0
%                                                                          00000400  000:0000:0
%                                                                          00000500  000:0000:0
%      INSERT INTO MAIN PROG :  $SET AUTOBIND                              00000600  000:0000:0
%                               IWIND=0                                    00000700  000:0000:0
%                               IF (WIND.EQ.YES) IWIND=1                   00000800  000:0000:0
%                               CALL LOADATA(IWIND,ISKIP,IREC,IPROB,       00000900  000:0000:0
%                                      N,IP,X,STDEV,XMEAN,A)               00001000  000:0000:0
%                                                                          00001100  000:0000:0
%                                                                          00001200  000:0000:0
%                                                                          00001300  000:0000:0
[FILE FILE3,FILE6;]                                                        00001400  000:0000:0
%                                                                          00001500  000:0000:0
PROCEDURE LDATA(IWIND,ISKIP,IREC,IPROB,N,IP,X,STDEV,XMEAN,AA);             00001600  000:0000:0
     VALUE IWIND,ISKIP,N,IP;                                               00001700  000:0000:0
     INTEGER IWIND,ISKIP,IREC,IPROB,N,IP;                                  00001800  000:0000:0
     ARRAY X[*], XMEAN[*], AA[*], STDEV[*];                                00001900  000:0000:0
BEGIN                                                                      00002000  000:0000:0
                                                                           LDATA IS SEGMENT 00002
DEFINE BINSIZE=132#;                                                       00002100  002:0000:1
FILE FILE3A(KIND=DISKPACK,PACKNAME="PRODATA.",FILETYPE=7,                  00002200  002:0000:1
            TITLE="BIN/LOSS75.");                                          00002300  002:0000:1
                                                                                DATA IS 0009 LONG
FILE FILE3B(KIND=DISKPACK,PACKNAME="PRODATA.",FILETYPE=7,                  00002400  002:0000:1
            TITLE="BIN/LOSS76.");                                          00002500  002:0000:1
                                                                                DATA IS 0009 LONG
FILE LINE(KIND=PRINTER);                                                   00002510  002:0000:1
                                                                                DATA IS 0005 LONG
INTEGER I,I1,J,K,L,M,C2,C3,XI,CNT;                                         00002600  002:0000:1
REAL T,T1,T2;                                                              00002610  002:0000:1
EBCDIC ARRAY BRECD[0:BINSIZE-1];                                           00002700  002:0000:1
ARRAY TAG[0:0],SUM,SSUM[0:100];                                            00002800  002:0000:1
LABEL PAR,EOF,EXIT;                                                        00002900  002:0002:4
DEFINE LDX(COL,LEN)=X[XI:=*+1]:=INTEGER(BRECD[COL],LEN)#,                  00003000  002:0002:4
       A[I,J]=AA[I+99*J]#,                                                 00003100  002:0002:4
       YRGRP=[38:7]#,                                                      00003200  002:0002:4
       FILNR=[31:2]#,                                                      00003300  002:0002:4
       RECNR=[29:30]#;                                                     00003400  002:0002:4
T2 := TIME(12);                                                            00003410  002:0002:4
IF NOT FILE3.OPEN THEN FILE3.OPEN:=TRUE;                                   00003500  002:0004:1
%                                                                          00003600  002:0008:0
%                                                                          00003700  002:0008:0
%                                                                          00003800  002:0008:0
IF IWIND GEQ 1 THEN BEGIN                                                  00003900  002:0008:0
     REWIND(FILE3);  WRITE(FILE6,<//"INPUT FILE REWOUND."//>);  END;    2  00004000  002:0009:1
%                                                                       2  00004100  002:000F:2
%                                                                          00004200  002:000F:2
IF ISKIP GTR 0 THEN BEGIN                                                  00004300  002:000F:2
     SPACE(FILE3,ISKIP);  IREC:=*+ISKIP;  IPROB:=*+ISKIP;               2  00004400  002:0010:5
     WRITE(FILE6,<//I6," RECORDS SKIPPED."//>,ISKIP);  END;                00004500  002:0019:2
```

```
%                                                                            2   00004600  002:0020:2
%                                                                                00004700  002:0020:2
J:=N-1;      M:=IP-1;                                                            00004800  002:0020:2
F)R I:=0 STEP 1 UNTIL J DO BEGIN                                                 00004900  002:0023:0
     READ(FILE3,1,TAG) [EOF:PAR],                                            2   00005000  002:0027:3
     IF TAG[0].FILNR = 0                                                         00005100  002:0031:0
        THEN READ(FILE3A[TAG[0].RECNR],BINSIZE,BRECD)[EOF:PAR]                   00005200  002:0032:0
        ELSE READ(FILE3B[TAG[0].RECNR],BINSIZE,BRECD)[EOF:PAR];                  00005300  002:003C:3
     XI:=-1;                                                                     00005400  002:004A:0
     FOR K:= 16 STEP 1 UNTIL  24,                                                00005500  002:004A:5
             31 STEP 1 UNTIL  39,129,                                            00005600  002:004F:5
             45 STEP 1 UNTIL  57,130,63,64,                                      00005700  002:0057:0
             77 STEP 1 UNTIL  80,                                                00005800  002:0063:0
             127                                                                 00005900  002:0057:2
            DO LDX(K,1);                                                         00006100  002:0057:2
     LDX(65,2);  LDX(82,2),                                                      00006200  002:006F:3
     IREC:=*+1;    IPROB:=*+1;                                                   00006300  002:0077:3
     CNT := * + 1;                                                               00006310  002:007A:3
```

Accumulate data after each observation read.

```
     FOR K:=0 STEP 1 UNTIL M DO                                                  00006400  002:007B:5
         IF T:=X[K] NEQ 0 THEN                                                   00006500  002:0080:2
            BEGIN                                                                00006600  002:0082:2
               SUM[K] := * + T;                                              3   00006700  002:0082:5
               SSUM[K] := * + T*T;                                               00006710  002:0084:4
               FOR L:=0 STEP 1 UNTIL K-1 DO                                      00006720  002:0086:5
                   IF X[L] NEQ 0 THEN                                            00006730  002:008B:4
                      A[K,L] := * + T * X[L];                                    00006740  002:008D:1
            END;                                                                 00006750  002:0092:5
     END READ LOOP;                                                          3   00006900  002:0093:2
   C2 := CNT -1;                                                             2   00006905  002:0093:5
  FOR K := 0 STEP 1 UNTIL M DO                                                   00006910  002:0095:1
```

Compute mean, standard deviation, and correlation matrix after all data read.

```
     BEGIN                                                                       00006920  002:0099:4
      T := XMEAN[K] := SUM[K]/CNT;                                           2   00006930  002:0099:4
       T1 :=  STDEV[K] := ((SSUM[K]-CNT*T*T)/C2)**0.5;                           00006940  002:009C:5
       A[K,K] := 1;                                                              00006950  002:00A3:1
       IF T1 NEQ 0 THEN                                                          00006955  002:00A5:5
          FOR L := 0 STEP 1 UNTIL K-1 DO                                         00006960  002:00A6:3
             IF T := T1*STDEV[L] NEQ 0 THEN                                      00006965  002:00AB:5
                A[K,L] := A[L,K] := ((A[K,L]-SUM[K]*SUM[L]/CNT)/C2)/T            00006970  002:00AE:2
             ELSE  A[K,L] := A[L,K] :=  .0019                                    00006975  002:00B8:2
        ELSE FOR L := 0 STEP 1 UNTIL K-1 DO                                      00006980  002:00BD:5
             A[K,L] := A[L,K] := .0019;                                          00006985  002:00C5:1
     END;                                                                        00006990  002:00CC:5
T2 := TIME(12)-T2;                                                           2   00007000  002:00CD:2
WRITE(LINE,*//,T2,CNT,M,K,L);                                                    00007010  002:00CF:2
GO EXIT;                                                                         00007050  002:00DD:2
%                                                                                00007100  002:00DD:5
%                                                                                00007200  002:00DD:5
%                                                                                00007300  002:00DD:5
PAR:  WRITE(FILE6,<"PARITY ERROR ON INPUT AT RECD NR ",I8,                       00007400  002:00DD:5
                     " THIS PROBLEM ",I6>,IREC,IPROB),                           00007500  002:00DF:4
                                                                                      DATA IS 0012 LONG
       MYSELF STATUS:=-1;                                                        00007600  002:00E6:2
%                                                                                00007700  002:00E8:2
%                                                                                00007800  002:00E8:2
EOF.  WRITE(FILE6,<"UNEXPECTED END OF INPUT AT RECD NR ",I8,                     00007900  002:00E8:2
                     " THIS PROBLEM ",I6>,IREC,IPROB),                           00008000  002:00EA:1
                                                                                      DATA IS 000F LONG
       MYSELF STATUS:=-1;                                                        00008100  002:00F0:2
%                                                                                00008200  002:00F2:2
%                                                                                00008300  002:00F2:2
```

```
          EXIT:   END OF LOADATA;                                             00008400  002:00F2:2  [illegible]
                                                                                    DATA IS 000F LONG
                                                                                    DATA IS 000A LONG
                                                                              LDATA(002) IS 010B LONG
**** WARNING : THIS PROCEDURE VALID FOR BINDING ONLY  -  FOR OTHER USE RECOMPILE AT LEVEL 2  ****
                                                                                 BLOCK IS SEGMENT 000A
                                                                              BLOCK(00A) IS 000C LONG
=======================================================================================================
NUMBER OF ERRORS DETECTED = 0.
NUMBER OF SEGMENTS = 9.  TOTAL SEGMENT SIZE = 360 WORDS.  CORE ESTIMATE = 1438 WORDS.  STACK ESTIMATE = 45
PROGRAM SIZE = 107 CARDS, 782 SYNTACTIC ITEMS, 37 DISK SEGMENTS.
PROGRAM FILE NAME:  OBJECT/LOSS1/LDATA.
COMPILATION TIME = 13.966 SECONDS ELAPSED;  2.727 SECONDS PROCESSING;  1.203 SECONDS I/O.
=======================================================================================================
```

Our second application of these enhancements to regression has been accomplished by early introduction into an existing system of software similar to that above, in figure #1. In this case a system in which two files were merged produced a "binary" file for subsequent processing in a stand-alone regression package. In the system as it previously operated, the two files were merged and written to diskpack for later regression analysis. At this point program logic was added to the "merge" program to compute the necessary data for producing the means, standard deviations, and correlation matrix. This, thus saves the ADP time to write and read a file plus the storage medium to store data between processing steps. Resource usage was markedly reduced.

The implementation in the second case realized the preatest reduction in computer resources. Regression problems which had run in 1400 CPU seconds are now processed in 120 CPU seconds. In addition DASD storage can be reduced.

Appendix B presents the HOL source code illustrating one way to insert the time consuming portion of regression into a extant ADP application.

CONCLUSION/RECOMMENDATION

- OLS regression requires high CPU resources.
- Applied regression typically produces low density files. That is, introduction of dummy variables to accomodate non-linearity results in lots of zeros.
- Files of less than 80% density can be processed more rapidly by improved logic.
- Don't use off-the-shelf generalized regression packages to build correlation matrices.
- As a second choice use stand-alone correlation matrix generator.
- As a first choice hardwire correlation matrix logic into existing systems at the point where the data files for regression analyses are now produced.

Appendix A

```
WORKFILE: HEMPHILL/SRC/BOUND/MATRIX (04/27/79)                    4:41 PM FRIDAY, APRIL 27, 1979

     0    $ SET ERRLIST LINEINFO                                                 00000000
   100    % W A R N I N G !   T H I S   P R O C E D U R E   M U S T   B E   B O U N D !   00000100
   200    % =================================================================   00000200
   300    %  THIS PROCEDURE PRODUCES THE MEAN, STANDARD DEVIATION AND PEARSON'S    00000300
   400    % PRODUCT-MOMENT INTERCORRELATION MATRIX FOR ANY NUMBER OF VARIABLES,   00000400
   500    % AND ANY NUMBER OF OBSERVATIONS. THE MEAN, STANDARD DEVIATION AND      00000500
   600    % INTERCORRELATION MATRIX ARE STORED IN A DISKPACK FILE WITH A TITLE    00000600
   700    % COMPOSED OF A DIRECTORY OF "MATRIX/DATA/" AND A FILENAME SPECIFIED    00000700
   800    % BY THE USER OR IN IT'S ABSENCE A FILENAME REFLECTING THE MONTH, DAY,  00000800
   900    % YEAR, HOUR, MINUTE, AND SECOND THE FILE WAS CREATED                   00000900
  1000    % (I.E. 01JAN99H00M01S01). ADDITIONALLY, THE PROCEDURE IS ABLE TO       00001000
  1100    % MINIMIZE THE IMPACT ON THE DEPENDENT VARIABLE OF TWO OR MORE HIGHLY   00001100
  1200    % CORRELATED VARIABLES. THE HIGH CORRELATION THRESHOLD CAN BE SET       00001200
  1300    % ANYWHERE FROM 0.0000 TO 1.0000 BASED ON A PARAMETER PASSED TO THE     00001300
  1400    % PROCEDURE AT EXECUTION.                                               00001400
  1500    %  THE USER'S PROGRAM SHOULD CONTAIN A DECLARATION LIKE THIS:           00001500
  1600    % PROCEDURE MATRIX(A,B); VALUE B; REAL B; ARRAY A[0]; EXTERNAL;         00001600
  1700    % FOR EACH OBSERVATION (I.E. RECORD READ), MATRIX SHOULD BE CALLED      00001700
  1800    % PASSING THE VALUES OF THE VARIABLES IN THE A ARRAY AND THE NUMBER OF  00001800
  1900    % VARIABLES (I.E. THE SIZE OF THE ARRAY) ONE-RELATIVE IN B. AFTER THE   00001900
  2000    % LAST OBSERVATION, MATRIX SHOULD BE CALLED ONE MORE TIME WITH THE HIGH 00002000
  2100    % CORRELATION THRESHOLD IN THE FIRST WORD OF THE A ARRAY AND THE        00002100
  2200    % FILENAME BEGINNING IN THE SECOND WORD OF THE A ARRAY. B SHOULD        00002200
  2300    % CONTAIN THE NUMBER OF THE DEPENDENT VARIABLE ZERO-RELATIVE.           00002300
  2400    %  ONE RESTRICTION IS THAT THE NUMBER OF VARIABLES WILL REMAIN THE      00002400
  2500    % SAME FOR EVERY OBSERVATION IN EACH GROUP OR SET OF OBSERVATIONS       00002500
  2600    % (I.E. EACH RECORD IN A FILE CONTAINS THE SAME NUMBER OF VARIABLES)    00002600
  2700    % THE FIRST TIME AND EACH SUBSEQUENT TIME THRU THE PROCEDURE WHILE B    00002700
  2800    % REMAINS THE SAME THE USER IS ACCUMULATING DATA. WHEN B CHANGES IT     00002800
  2900    % INDICATES THAT THE USER WANTS TO FINISH THE CALCULATIONS AND          00002900
  3000    % PRODUCE THE FILE CONTAINING THE MEAN, STANDARD DEVIATION AND THE      00003000
  3100    % INTERCORRELATION MATRIX.                                              00003100
  3200    %  THE FILE IS CREATED AS A FRONT END TO SPSS AND THEREFORE IS IN A     00003200
  3300    % FORMAT WHICH IT IS EXPECTING (I.E. EACH RECORD IS A CARD IMAGE. THE   00003300
  3400    % FIRST SET OF RECORDS CONTAINS THE MEANS OF THE VARIABLES, THE SECOND  00003400
  3500    % SET OF RECORDS CONTAINS THE STANDARD DEVIATIONS OF THE VARIABLES AND  00003500
  3600    % THE REST OF THE RECORDS CONTAIN THE INTERCORRELATION MATRIX. THE DATA 00003600
  3700    % IS WRITTEN WITH AN F10.5 FORMAT EIGHT WORDS PER RECORD. THUS IF THERE 00003700
  3800    % ARE MORE THAN EIGHT VARIABLES THE MEANS AND STANDARD DEVIATIONS WILL  00003800
  3900    % BE WRITTEN ON MORE THAN ONE RECORD. AND IF THERE ARE MORE THAN TWO    00003900
  4000    % VARIABLES THE INTERCORRELATION MATRIX WILL ALSO BE WRITTEN ON MORE    00004000
  4100    % THAN ONE RECORD. THIS IS USER INFORMATION ONLY.)                      00004100
  4200    %  IN ORDER TO BIND THIS ROUTINE YOU MUST FIRST CREATE A COPY OF THE    00004200
  4300    % OBJECT CODE UTILITY/OBJ/MATRIX UNDER YOUR DIRECTORY. ADDITIONALLY YOU 00004300
  4400    % MUST SET AUTOBIND IN YOUR SOURCE CODE. FOR MORE COMPLETE INSTRUCTIONS 00004400
  4500    % READ EITHER GREGORY VOLUME II OR BURROUGHS BINDER MANUAL.             00004500
  4600    %  THIS IS A PRODUCT OF THE MODELING AND RESEARCH SECTION OF THE SYSTEM 00004600
  4700    % SOFTWARE AND DEVELOPMENT BRANCH AT THE AIR FORCE MANPOWER AND         00004700
  4800    % PERSONNEL CENTER (AFMPC/MPCDDP7). THE ORIGINAL CONCEPT WAS DEVELOPED  00004800
  4900    % BY MISTER THOMAS BEATTY, CHIEF MODELING AND RESEARCH SECTION. THE     00004900
  5000    % PROCEDURE WAS DESIGNED AND WRITTEN BY FIRST LIEUTENANT DAVID HEMPHILL, 00005000
  5100    % USAF. THE DESIGN AND PROGRAMING EFFORT WERE ACCOMPLISHED OVER A PERIOD 00005100
  5200    % FROM NOVEMBER 1978 THRU APRIL 1979. ANY INQUIRIES MAY BE DIRECTED TO  00005200
  5300    % EITHER MR BEATTY OR LT HEMPHILL AT AFMPC/MPCDDP7, RANDOLPH AFB TEX    00005300
  5400    % 78148 OR AT (COMM (512) 652- OR AUTO 487- & EXT 2233 OR 5684).        00005400
  5500    PROCEDURE MATRIX(VARIABLESARRAY,NUMBERVARIABLES);                       00005500
  5600      VALUE NUMBERVARIABLES; REAL NUMBERVARIABLES;                          00005600
```

```
5700      ARRAY VARIABLESARRAY[0];                                            00005700
5800    BEGIN                                                                 00005800
5900      OWN ARRAY XYSUM[0:0],SUM,SSUM[0:0];                                 00005900
6000      OWN BOOLEAN NOTFIRST;                                               00006000
6100      OWN REAL ARRAYSIZE,OBSERVATIONS;                                    00006100
6200      REAL I1,I2,T1,T2,T3;                                                00006200
6300      IF NOTFIRST THEN                          %I N I T I A L I Z A T I O N II 00006300
6400      ELSE                                      %THIS PIECE OF CODE IS EXECUTED 00006400
6500      BEGIN                                     %THE FIRST TIME AND ONLY THE    00006500
6600        NOTFIRST:=TRUE;                         %FIRST TIME THROUGH FOR ANY ONE 00006600
6700        ARRAYSIZE:=NUMBERVARIABLES;             %SET OF DATA. UPON COMPLETING   00006700
6800        RESIZE(XYSUM[*],ARRAYSIZE*ARRAYSIZE);%WITH ONE SET OF DATA ALL THE     00006800
6900        RESIZE(SUM[*],ARRAYSIZE);               %OWN VARIABLES ARE DEALLOCATED  00006900
7000        RESIZE(SSUM[*],ARRAYSIZE);              %THUS ALLOWING THIS PROCEDURE   00007000
7100        OBSERVATIONS:=0;                        %TO BE CALLED AGAIN FOR A NEW   00007100
7200      END;                                      %SET OF DATA.                   00007200
7300      IF ARRAYSIZE=NUMBERVARIABLES THEN                  %  M A I N  L I N E    00007300
7400      BEGIN                                              %THIS PIECE OF CODE IS 00007400
7500        OBSERVATIONS:=*+1;                               %EXECUTED EVERY TIME   00007500
7600        FOR I1:=0 STEP 1 UNTIL ARRAYSIZE-1 DO            %THE PROCEDURE IS CALLED 00007600
7700          IF T1:=VARIABLESARRAY[I1] NEQ 0 THEN           %FOR A PARTICULAR SET OF 00007700
7800          BEGIN                                          %DATA EXCEPT THE LAST  00007800
7900            SUM[I1]:=*+T1;                               %TIME. EXECUTING THIS  00007900
8000            SSUM[I1]:=*+T1*T1;                           %SMALL PIECE OF CODE   00008000
8100            FOR I2:=0 STEP 1 UNTIL I1-1 DO               %FOR EVERY OBSERVATION 00008100
8200              IF T2:=VARIABLESARRAY[I2] NEQ 0 THEN %RATHER THAN ALL THE         00008200
8300                XYSUM[I1*ARRAYSIZE+I2]:=*+T1*T2;         %CALCULATIONS WHICH ARE 00008300
8400          END;                                           %NOW DONE AS A FINAL STEP 00008400
8500      END                                                %SAVES CONSIDERABLE TIME. 00008500
8510                                                         %ADDITIONAL ECONOMIES ARE 00008510
8520                                                         %REALIZED IN CHECKING FOR 00008520
8530                                                         %ZERO VALUES IN VARIABLES 00008530
8540                                                         %WHEN SPARSE ARRAYS ARE 00008540
8550                                                         %INVOLVED.             00008550
8600      ELSE                                                                00008600
8700      BEGIN                                                               00008700
8710    % THE PROCEDURE IS CALLED ONE MORE TIME AFTER THE LAST OBSERVATION AND   00008710
8720    % THIS PIECE OF CODE IS EXECUTED TO PRODUCE THE FILE CONTAINING THE      00008720
8730    % MEAN, STANDARD DEVIATION, AND PEARSONS INTERCORRELATION MATRIX. IN     00008730
8740    % ADDITION HIGH CORRELATION VARIABLES ARE IDENTIFIED AND ELIMINATED      00008740
8750    % FROM THE EQUATION BASED ON A USER SUPPLIED TOLERANCE. THE USER MAY     00008750
8760    % SUPPLY A FILE NAME VIA THE REAL ARRAY BEGINNING IN THE SECOND WORD.    00008760
8770    % THE TOLERANCE IS IN THE FIRST WORD AND THE DEPENDENT VARIABLE ZERO     00008770
8780    % RELATIVE IS SUPPLIED IN THE SECOND PARAMETER.                         00008780
8800        FILE OUTFILE(KIND=PACK,MAXRECSIZE=14,BLOCKSIZE=420,AREASIZE=120);  00008800
8900        FILE LINEOUT(KIND=PRINTER);                                       00008900
9000        ARRAY MEAN,STANDARDDEVIATION,HI1,HI2[0:ARRAYSIZE-1],WORK[0:15];   00009000
9100        REAL I3,I4,I5,T4;                                                 00009100
9200        POINTER P;                                                        00009200
9300        BOOLEAN HIT;                                                      00009300
9400        EBCDIC VALUE ARRAY MON("JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC");   00009400
9500        TRUTHSET VLDCHRCTRS("0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ/");     00009500
9600        DEFINE                                                            00009600
9700          DEPENDENT=NUMBERVARIABLES#,                                     00009700
9800          TOLERANCE=VARIABLESARRAY[0]#;                                   00009800
9900        SCAN P:VARIABLESARRAY[1] FOR T2:95 UNTIL IN VLDCHRCTRS;           00009900
10000       IF T2 NEQ 0 THEN                                                  00010000
10100         REPLACE WORK BY "MATRIX/DATA/",P FOR T2 WHILE IN VLDCHRCTRS,"." 00010100
10200       ELSE                                                              00010200
10300       BEGIN                                                             00010300
```

```
  T1:=TIME(7);
  REPLACE WORK BY "MATRIX/DATA/",T1.[29:6] FOR 2 DIGITS,
    MON[(INTEGER(T1.[35:6])-1)*3] FOR 3,T1.[47:12] FOR 2 DIGITS,
    "H",T1.[23:6] FOR 2 DIGITS,"M",T1.[17:6] FOR 2 DIGITS,"S",
    T1.[11:6] FOR 2 DIGITS,".";
END;
REPLACE OUTFILE.TITLE BY WORK;
T3:=OBSERVATIONS-1;
FOR I1:=0 STEP 1 UNTIL ARRAYSIZE-1 DO
BEGIN
  T1:=MEAN[I1]:=SUM[I1]/OBSERVATIONS;
  T2:=STANDARDDEVIATION[I1]:=((SSUM[I1]-OBSERVATIONS*T1*T1)/T3)
                             **0.5;
  WRITE(LINEOUT,<I15,2E10.5>,I1,T1,T2);
  XYSUM[I1*ARRAYSIZE+I1]:=1;
  IF T2 NEQ 0 THEN
    FOR I2:=0 STEP 1 UNTIL I1-1 DO
      IF T1:=T2*STANDARDDEVIATION[I2] NEQ 0 THEN
      BEGIN
        T4:=XYSUM[I1*ARRAYSIZE+I2]:=XYSUM[I2*ARRAYSIZE+I1]:=
          ((XYSUM[I1*ARRAYSIZE+I2]-SUM[I1]*SUM[I2]/OBSERVATIONS)
            /T3)/T1;
        IF ABS(T4) >= TOLERANCE AND I1 NEQ DEPENDENT AND I2 NEQ
          DEPENDENT THEN
        BEGIN
          FOR I3:=0 STEP 1 UNTIL I5-1 DO
            IF HI1[I3] = I1 THEN
              HIT:=TRUE;
          IF NOT HIT THEN
          BEGIN
            HI1[I5]:=I1;
            I5:=*+1;
          END;
          HIT:=FALSE;
          FOR I3:=0 STEP 1 UNTIL I5-1 DO
            IF HI1[I3] = I2 THEN
              HIT:=TRUE;
          IF NOT HIT THEN
          BEGIN
            HI1[I5]:=I2;
            I5:=*+1;
          END;
          HIT:=FALSE;
        END;
      END
      ELSE
        XYSUM[I1*ARRAYSIZE+I2]:=XYSUM[I2*ARRAYSIZE+I1]:=0.0019
  ELSE
    FOR I2:=0 STEP 1 UNTIL I1-1 DO
      XYSUM[I1*ARRAYSIZE+I2]:=XYSUM[I2*ARRAYSIZE+I1]:=0.0019;
END;
FOR I1:=0 STEP 1 UNTIL I5-1 DO
BEGIN
  HI2[I1]:=XYSUM[DEPENDENT*ARRAYSIZE+HI1[I1]];
END;
FOR I1:=0 STEP 1 UNTIL I5-1 DO
BEGIN
  T1:=ABS(HI2[I1]);
  FOR I2:=0 STEP 1 UNTIL I5-1 DO
    IF T2:=ABS(HI2[I2]) > T1 THEN
```

```
16300           BEGIN                                                               00016300
16400             T1:=T2;                                                           00016400
16500             I3:=I2;                                                           00016500
16600           END;                                                                00016600
16700         HI2[I3]:=0;                                                           00016700
16800         FOR I2:=0 STEP 1 UNTIL I3-1,I3+1 STEP 1 UNTIL I5-1 DO                 00016800
16900           IF ABS(XYSUM[HI1[I3]*ARRAYSIZE+HI1[I2]]) >= TOLERANCE THEN          00016900
17000           BEGIN                                                               00017000
17100             WRITE(LINEOUT,<I6," REMOVED DUE TO HIGH CORRELATION WITH ",       00017100
17200               I4>,HI1[I2],HI1[I3]);                                           00017200
17300             FOR I4:=0 STEP 1 UNTIL HI1[I2]-1,HI1[I2]+1 STEP 1 UNTIL           00017300
17400               ARRAYSIZE-1 DO                                                  00017400
17500               XYSUM[I4*ARRAYSIZE+HI1[I2]]:=XYSUM[HI1[I2]*ARRAYSIZE+I4]:=      00017500
17600                 0.0017;                                                       00017600
17700           END;                                                                00017700
17800       END;                                                                    00017800
17900       WRITE(LINEOUT,*//,OBSERVATIONS);                                        00017900
18000       WRITE(OUTFILE,<8F10.5>,MEAN);                                           00018000
18100       WRITE(OUTFILE,<8F10.5>,STANDARDDEVIATION);                              00018100
18200       FOR I1:=0 STEP 1 UNTIL ARRAYSIZE-1 DO                                   00018200
18300         WRITE(OUTFILE,<8F10.5>,FOR I2:=0 STEP 1 UNTIL ARRAYSIZE-1 DO          00018300
18400           XYSUM[I1*ARRAYSIZE+I2]);                                            00018400
18500       LOCK(OUTFILE);                                                          00018500
18600       DEALLOCATE(XYSUM);                                                      00018600
18700       DEALLOCATE(SSUM);                                                       00018700
18800       DEALLOCATE(SUM);                                                        00018800
18900       NOTFIRST:=FALSE;                                                        00018900
19000     END;                                                                      00019000
19100   END;                                                                        00019100
```

Appendix B

```
 $ RESET LIST                                                                  00000100
 $ SET ERRLIST LINEINFO                                                        00000200
%*****************TSGT FRANCIS DPMODA EXT 2233                                 00000300
%**********CARDIN FORMAT                                                       00000400
%    CC 1-5  BOARD NAME                                                        00000500
%    CC 1-2    CY                                                              00000600
%    CC   3    TYPE BOARD                                                      00000700
%                 R=REG APPT                                                   00000800
%                 N=NOM                                                        00000900
%                 P=PERM                                                       00001000
%                 T=TEMP                                                       00001100
%    CC 4-5    GRADE BOARD OR TENURE OF APPT                                   00001200
%    CC 70-72  TERT ZONE CUTOFF                                                00001300
%    CC 74-76  SEC ZONE CUTOFF                                                 00001400
%    CC 78-80  PRI ZONE CUTOFF                                                 00001500
BEGIN                                                                          00001600
FILE BINARY (KIND=DISKPACK,PACKNAME="MPCDATA.",TITLE="BIN.",MYUSE=10,          00001700
            UNITS=CHARACTERS,FILETYPE=7);                                      00001800
FILE BOARDFILE (KIND=TAPE,BLOCKSIZE=6400,MAXRECSIZE=640,TITLE="BF.",           00001900
                UNITS=CHARACTERS,FILETYPE=7);                                  00002000
FILE LINE (KIND=PRINTER);                                                      00002100
FILE CRD (KIND=READER,TITLE="CARDIN.");                                        00002200
FILE PRI(KIND=DISKPACK,PACKNAME="MPCDATA.",MAXRECSIZE=14,                      00002300
        TITLE="TMB/MAT/TOGP.",BLOCKSIZE=2100,PROTECTION=SAVE,AREAS=10,         00002400
        AREASIZE=14),                                                          00002500
     SEC(KIND=DISKPACK,PACKNAME="MPCDATA.",MAXRECSIZE=14,                      00002600
        TITLE="TMB/MAT/TOGS.",BLOCKSIZE=2100,PROTECTION=SAVE,AREAS=10,         00002700
        AREASIZE=14),                                                          00002800
     TER(KIND=DISKPACK,PACKNAME="MPCDATA.",MAXRECSIZE=14,                      00002900
        TITLE="TMB/MAT/TOGT.",BLOCKSIZE=2100,PROTECTION=SAVE,AREAS=10,         00003000
        AREASIZE=14);                                                          00003100
DIRECT ARRAY SUMS,SUMSS,SUMP,SUMPS,SUMT,SUMTT[0:100];                          00003200
DIRECT ARRAY XYSUMS,XYSUMP,XYSUMT[0:10000];                                    00003300
ARRAY RECHOLD,MEANT,MEANS,MEANP,STDVT,STDVS,STDVP,IAPRI[0:100];                00003400
ARRAY IASEC,IATER[0:100];                                                      00003500
EBCDIC ARRAY BIN[0:161],                                                       00003600
             BF[0:639];                                                        00003700
ARRAY DIST[0:3,0:100,0:2],                                                     00003800
      CUTSCORE[0:3],                           %CUT OFF SCORE                  00003900
      ZNCNT[0:3],                                                              00004000
      ZONECNT[0:3],                                                            00004100
      STATDIST1[0:3,0:200,0:1],              %ZONE,SCORE;SEL,NON-SEL;          00004200
      STATDIST2[0:3,0:1,0:2];                 %ZONE;SEL,NON-SEL;>=<            00004300
BOOLEAN BOO; INTEGER PARCNT; LABEL PARR;                                       00004400
EBCDIC VALUE ARRAY TITL  ("      ","      ",                                   00004500
                          "PRIMAR","Y     ",                                   00004600
                          "SECOND","ARY   ",                                   00004700
                          "TERTIA","RY    ");                                  00004800
FORMAT CARDIN(X2,A1,A3,X63,A3,X1,A3,X1,A3);                                    00004900
FORMAT HDR1N("PREDICTED",X12,"PRIMARY ZONE");                                  00005000
FORMAT HDR1T("PREDICTED",X12,"PRIMARY ZONE",X13,"SECONDARY ZONE");             00005100
FORMAT HDR1R("PREDICTED",X12,"PRIMARY ZONE",X12,"SECONDARY ZONE",              00005200
             X11,"TERTIARY ZONE");                                             00005300
FORMAT HDR2N("  SCORE",X12,"TOTAL   SELECTED");                                00005400
FORMAT HDR2T("  SCORE",X12,2("TOTAL   SELECTED",X10));                         00005500
FORMAT HDR2R("  SCORE",X12,3("TOTAL   SELECTED",X10));                         00005600
FORMAT HDR3(X14,"SELECT   > CUT   = CUT   < CUT      NON-SELECT   > CUT",      00005700
```

```
5800              "   = CUT   < CUT   PREDICTED CORRECTLY      PREDICTION RATIO");     00005800
5900      FORMAT HDR4(A6,A6,"ZONE    PANEL",X11,"MEAN",X8,"STN DEV",X9,"SAMPLE");     00005900
6000      FORMAT DET1(X24,3(I4,X4),X15,3(I4,X4),X8,I4,X19,F5.3);                        00006000
6100      FORMAT DET4(X23,I2,X10,F5.1,X10,F5.1,X10,I5);                                  00006100
6200      ALPHA BOARD,ORBD;                                                              00006200
6300      REAL TVAP,TVAS,TVAT,VAP,VAS,VAT,VARAMT;                                        00006300
6310      REAL TEMP,TEMS,TEMT;                                                           00006310
6400      INTEGER BDCNT,                                                                 00006400
6500              BDSCR,                                                                 00006500
6600              B,                         %BINARY MAXRECSIZE                          00006600
6700              BDSCRSQ,                   %BOARD SCORE SQUARED                        00006700
6800              BINCNT,                                                                00006800
6900              BINCNT1,                                                               00006900
7000              CUT,                                                                   00007000
7100              HOLD1,                                                                 00007100
7200              HOLD2,                                                                 00007200
7300              I,M,K,J,L,                   %NEW                                      00007300
7400              NRVARS,XX,XY,M1,M2,M3,          %NEW                                   00007400
7500              ISW,MRPRI,MRSEC,MRTER,          %NEW                                   00007500
7600              LSPRI,LSSEC,LSTER,                                                     00007600
7700              IX1,                                                                   00007700
7800              PANEL,                                                                 00007800
7900              SAMPL,                                                                 00007900
8000              SCORE,                                                                 00008000
8100              SUMM,                                                                  00008100
8200              VAR,                                                                   00008200
8300              ZONE,                                                                  00008300
8400              X;                                                                     00008400
8500      DEFINE ZONEDEF = INTEGER(BIN[141],1)#,       %BINZONE                          00008500
8600             BINSEL = BIN[142]#,                   %BINSELECT                        00008600
8700             BINPAN = BIN[143]#;                   %BINPANEL                         00008700
8800      LABEL READBIN,READBD,ENDRD,COMPARE,PASS1,ENDSTAT,                              00008800
8900            ENDLOOP,READAGAIN,ENDAGAIN,ENDLOOP2,CKSCORE;                             00008900
9000       $ PAGE                                                                        00009000
9100      PROCEDURE HICOR(WCHARRY,WCHIA,WCHLS);                                          00009100
9200      ARRAY WCHARRY[*],WCHIA[*];                                                     00009200
9300      INTEGER WCHLS;                                                                 00009300
9400        BEGIN                                                                        00009400
9500          LABEL OUTHI,ENDM;                                                          00009500
9600          ARRAY R[0:100];                                                            00009600
9700          REAL V;                                                                    00009700
9800          INTEGER MC,VALIA,LL,L,M,J,N;                                               00009800
9900          MC := 0;                                                                   00009900
10000         LL := (87-1)*NRVARS;                               %DEP VARIABLE           00010000
10100         FOR I := 1 STEP 1 UNTIL NRVARS DO                                          00010100
10200              R[I] := WCHARRY[LL+I];                                                00010200
10300         FOR M1 := 1 STEP 1 UNTIL WCHLS DO                                          00010300
10400           BEGIN                                                                    00010400
10500             IF MC = WCHLS THEN GO TO OUTHI;                                        00010500
10600             V := 0;                                                                00010600
10700             FOR I := 1 STEP 1 UNTIL WCHLS DO                                       00010700
10800               BEGIN                                                                00010800
10900                 VALIA := WCHIA[I];                                                 00010900
11000                 IF ABS(WCHARRY[LL+VALIA]) < V THEN ELSE                            00011000
11100                   BEGIN                                                            00011100
11200                     V := ABS(WCHARRY[LL+VALIA]);                                   00011200
11300                     L := WCHIA[I];                                                 00011300
11400                   END;                                                             00011400
11500               END;                                                                 00011500
11600             MC := * + 1;                                                           00011600
```

```
11700             WCHARRY[LL+L] := 0.0;                                                 00011700
11800             FOR M := 1 STEP 1 UNTIL WCHLS DO                                      00011800
11900               BEGIN                                                               00011900
12000                 J := WCHIA[M];                                                    00012000
12100                 IF J = L THEN GO TO ENDM;                                         00012100
12200                 IF ABS(WCHARRY[(L-1)*NRVARS+J]) < 0.80 THEN ELSE                  00012200
12300                    BEGIN                                                          00012300
12400                      MC := * + 1;                                                 00012400
12500                      WRITE(LINE,<"VAR "I2," REMOVED DUE TO HI CORRELATION",       00012500
12600                            " WITH VAR ",I2>,J,L);                                 00012600
12700                      FOR N := 1 STEP 1 UNTIL NRVARS DO                            00012700
12800                         IF N = J THEN ELSE                                        00012800
12900                             BEGIN                                                 00012900
13000                               R[J] := 0.0017;                                     00013000
13100                               WCHARRY[(N-1)*NRVARS+J] := 0.0017;                  00013100
13200                               WCHARRY[(J-1)*NRVARS+N] := 0.0017;                  00013200
13300                             END;                                                  00013300
13400                    END;                                                           00013400
13500      ENDM:       END;                                                             00013500
13600               END;                                                                00013600
13700      OUTHI:                                                                       00013700
13800         FOR I := 1 STEP 1 UNTIL NRVARS DO                                         00013800
13900            WCHARRY[LL+I] := R[I];                                                 00013900
14000        END HICOR;                                                                 00014000
14100       $ PAGE                                                                      00014100
14200      PROCEDURE CORPRINT(WCHARRY);                                                 00014200
14300      ARRAY WCHARRY[*];                                                            00014300
14400      BEGIN                                                                        00014400
14500        INTEGER J,L,LL,LINCNT;                                                     00014500
14600        LINCNT := 0;                                                               00014600
14700        FOR L := 1 STEP 12 UNTIL 85 DO                                             00014700
14800          BEGIN                                                                    00014800
14900            WRITE(LINE,<X9,12(X4,"VAR"I2,X1)//>,FOR LL := L STEP 1 UNTIL L+11      00014900
15000                 DO LL);                                                           00015000
15100            FOR J := 1 STEP 1 UNTIL NRVARS DO                                      00015100
15200               BEGIN                                                               00015200
15300                 WRITE(LINE,<X2,"VAR",I2,X1,12(F10.5)>,J,FOR LL := L STEP 1        00015300
15400                      UNTIL L+11 DO WCHARRY[(J-1)*NRVARS+LL]);                     00015400
15500                 LINCNT := * + 1;                                                  00015500
15600                 IF LINCNT > 50 THEN                                               00015600
15700                   BEGIN                                                           00015700
15800                     WRITE(LINE[SKIP 1]);                                          00015800
15900                     LINCNT := 0;                                                  00015900
16000                     WRITE(LINE,<X9,12(X4,"VAR"I2,X1)//>,FOR LL := L STEP 1        00015000
16100                        UNTIL L+11 DO LL);                                         00016100
16200                   END;                                                            00016200
16300               END;                                                                00016300
16400            WRITE(LINE[SPACE 2]);                                                  00016400
16500            LINCNT := * + 3;                                                       00016500
16600          END;                                                                     00016600
16700        WRITE(LINE[SKIP 1]);                                                       00016700
16800      END CORPRINT;                                                                00016800
16900      %****************START PROGRAM**********************                         00016900
17000            NRVARS := 96;                                                          00017000
17100            BINARY.OPEN := TRUE;                                                   00017100
17200            B := BINARY.MAXRECSIZE;                                                00017200
17300            READ(CRD,CARDIN,BOARD,GRBD,CUTSCORE[3],CUTSCORE[2],CUTSCORE[1]);       00017300
17400            VAR := IF BOARD = "R" THEN 1 ELSE            %REGULAR                  00017400
17500                   IF BOARD = "N" THEN 2 ELSE            %NOMINATION               00017500
17600                   IF BOARD = "P" THEN 3 ELSE            %PERMANENT                00017600
```

```
                    4;                                  %TEMPORARY
        READ(BOARDFILE,640,BF);
        BDCNT := * + 1;
    READBIN:
        READ(BINARY,B,BIN)[ENDRD];
        BINCNT := * + 1;
    %   IF BINCNT > 1200 THEN GO TO ENDRD;
    COMPARE:
        IF BF[1] > BIN[0] FOR 9 THEN GO TO READBIN;
        IF BF[1] < BIN[0] FOR 9 THEN GO TO READBD;
        IF BF[42] = "R" THEN GO TO READBIN;             %REPAT
        IF BF[581] > "99" OR BF[581] < "01" THEN GO TO READBIN;
        IF BF[593] = "000" THEN GO TO READBIN;      %BD SCORE
        ZONECNT[ZONEDEF] := * + 1;
        GO TO PASS1;
    READBD:
        READ(BOARDFILE,640,BF)[ENDRD:PARR];
        BDCNT := * + 1;
        GO TO COMPARE;
    PASS1:
        SCORE := INTEGER(BF[37],3) - 300;           %PRED SCORE
        BDSCR := INTEGER(BF[593],3);                %BOARD SCORE
        IF BF[37] > "500" OR BF[37] < "300"         %PRED SCORE
            THEN GO TO CKSCORE;
        CUT := IF BF[37] > POINTER(CUTSCORE[ZONEDEF]) + 3 FOR 3 THEN 0
           ELSE IF BF[37] = POINTER(CUTSCORE[ZONEDEF]) + 3 FOR 3 THEN 1
           ELSE 2;      %0=PRED>CUT,1=PRED=CUT,2=PRED<CUT
        STATDIST1[ZONEDEF,SCORE,0] := * + 1;
        CASE VAR OF
            BEGIN
              1:  IF BF[249] = "N" THEN                     %REG APPT
                      BEGIN                                   %REG SELECT
                         REPLACE BINSEL BY "X";
                         IX1 := 0;
                         STATDIST1[ZONEDEF,SCORE,1] := * + 1;
                      END ELSE
                         IX1 := 1;                            %NON SELECT
              2:  IF BF[158] = "3" THEN                     %NOMINATION
                      BEGIN                                   %NOM SELECT
                         REPLACE BINSEL BY "X";
                         IX1 := 0;
                         STATDIST1[ZONEDEF,SCORE,1] := * + 1;
                      END ELSE
                         IX1 := 1;                            %NON SELECT
              3:  IF BF[156] = "X" THEN                     %PERMANENT
                      BEGIN                                   %PERM SELECT
                         REPLACE BINSEL BY "X";
                         IX1 := 0;
                         STATDIST1[ZONEDEF,SCORE,1] := * + 1;
                      END ELSE
                         IX1 := 1;                            %NON SELECT
              4:  IF BF[157] = "X" THEN                     %TEMPORARY
                      BEGIN                                   %TEMP SELECT
                         REPLACE BINSEL BY "X";
                         IX1 := 0;
                         STATDIST1[ZONEDEF,SCORE,1] := * + 1;
                      END ELSE
                         IX1 := 1;                            %NON SELECT
            END;
        STATDIST2[ZONEDEF,IX1,CUT] := * + 1;
```

```
CKSCORE:
        REPLACE BINPAN BY BF[581] FOR 2;                    %BD PANEL
        REPLACE BIN[124] BY BF[593] FOR 3;                  %BD SCORE
        BDSCRSQ := BDSCR * BDSCR;
        DIST[ZONEDEF,INTEGER(BF[581],2),0] := * + BDSCR;    %BD SCORE
        DIST[ZONEDEF,100,0] := * + BDSCR;
        DIST[ZONEDEF,INTEGER(BF[581],2),1] := * + BDSCRSQ;
        DIST[ZONEDEF,100,1] := * + BDSCRSQ;
        DIST[ZONEDEF,INTEGER(BF[581],2),2] := * + 1;
        DIST[ZONEDEF,100,2] := * + 1;
        WRITE(BINARY,B,BIN);
        GO TO READBIN;
PARR:
    PARCNT := * + 1; BOO := READ(BOARDFILE,640,BF); GO TO READBIN;
ENDRD:
        REWIND(BINARY);
        WRITE(LINE[SPACE 2],<"PREPARED(MMDDYY): ",A6>,TIME(15));
        WRITE(LINE[SPACE 2],<"BOARD: ",A1,A3>,BOARD,GRBD);
        FOR X := 1 STEP 1 UNTIL 3 DO
          BEGIN
            IF ZONECNT[X] = 0 THEN GO TO ENDSTAT;
            WRITE(LINE,<A6,A6>,TITL[X*12],TITL[X*12+6]);
            WRITE(LINE[SPACE 2],HDR3);
            HOLD1 := HOLD2 := 0;
            FOR IX1 := 0,1 DO
                FOR CUT := 0 STEP 1 UNTIL 2 DO
                    HOLD2 := * + STATDIST2[X,IX1,CUT];
            HOLD1 := STATDIST2[X,0,0] + STATDIST2[X,1,2] +
                    STATDIST2[X,0,1];
            WRITE(LINE[SPACE 3],DET1,STATDIST2[X,0,0],
                  STATDIST2[X,0,1],STATDIST2[X,0,2],
                  STATDIST2[X,1,0],STATDIST2[X,1,1],
                  STATDIST2[X,1,2],HOLD1,HOLD1/HOLD2);
ENDSTAT: END;
        WRITE(LINE[SKIP 1]);
        CASE VAR OF
             BEGIN
               1:  WRITE(LINE,HDR1R);                        %REG APPT
                   WRITE(LINE[SPACE 2],HDR2R);
                   FOR SCORE := 0 STEP 1 UNTIL 200 DO
                       WRITE(LINE,<X4,I3,X9,3(X4,I4,X7,I4,X7)>,SCORE+300,
                           STATDIST1[1,SCORE,0],STATDIST1[1,SCORE,1],
                           STATDIST1[2,SCORE,0],STATDIST1[2,SCORE,1],
                           STATDIST1[3,SCORE,0],STATDIST1[3,SCORE,1]);
               2:  WRITE(LINE,HDR1N);                        %NOMINATION
                   WRITE(LINE[SPACE 2],HDR2N);
                   FOR SCORE := 0 STEP 1 UNTIL 200 DO
                       WRITE(LINE,<X4,I3,X13,I4,X7,I4>,SCORE+300,
                           STATDIST1[1,SCORE,0],STATDIST1[1,SCORE,1]);
               3:  WRITE(LINE,HDR1N);                        %PERMANENT
                   WRITE(LINE[SPACE 2],HDR2N);
                   FOR SCORE := 0 STEP 1 UNTIL 200 DO
                       WRITE(LINE,<X4,I3,X13,I4,X7,I4>,SCORE+300,
                           STATDIST1[1,SCORE,0],STATDIST1[1,SCORE,1]);
               4:  WRITE(LINE,HDR1T);                        %TEMPORARY
                   WRITE(LINE[SPACE 2],HDR2T);
                   FOR SCORE := 0 STEP 1 UNTIL 200 DO
                       WRITE(LINE,<X4,I3,X9,2(X4,I4,X7,I4,X7)>,SCORE+300,
                           STATDIST1[1,SCORE,0],STATDIST1[1,SCORE,1],
                           STATDIST1[2,SCORE,0],STATDIST1[2,SCORE,1]);
```

```
           END;
      FOR ZONE := 1 STEP 1 UNTIL 3 DO
           BEGIN
             IF ZONECNT[ZONE] = 0 THEN GO TO ENDLOOP;
             FOR PANEL := 1 STEP 1 UNTIL 100 DO
                  BEGIN
                     SAMPL := DIST[ZONE,PANEL,2];
                     SUMM := DIST[ZONE,PANEL,0];
                     IF SAMPL > 0 THEN
                         BEGIN
                           HOLD1 := (SAMPL * DIST[ZONE,PANEL,1]) -
                                 (SUMM * SUMM);
                           HOLD2 := HOLD1/(SAMPL * SAMPL);
                           DIST[ZONE,PANEL,1] := SQRT(HOLD2);
                           DIST[ZONE,PANEL,0] := SUMM/SAMPL;
                         END;
                  END;
ENDLOOP:    END;
READAGAIN:
      READ(BINARY,B,BIN)[ENDAGAIN];
      BINCNT1 := * + 1;
%     IF BINCNT1 > 1200 THEN GO TO ENDAGAIN;
      IF BINPAN > "99" OR BINPAN < "01" THEN GO TO READAGAIN;
      IF BIN[124] = "000" THEN GO TO READAGAIN;  %BOARD SCORE
      REPLACE BIN[127] BY                         %ADJ BOARD SCORE VAR87
          INTEGER(BIN[124],3) - ((DIST[ZONEDEF,INTEGER(BINPAN,2),0]
            - DIST[ZONEDEF,100,0])) FOR 3 DIGITS;
      WRITE(BINARY,B,BIN);
%**********THIS IS THE NEW
      ZNCNT[ZONEDEF] := * + 1;
      FOR X := 1 STEP 1 UNTIL 100 DO RECHOLD[X] := 0;
      X := 1;
      FOR I := 32 STEP 1 UNTIL 40,41,43,45 STEP 1 UNTIL 98,99 STEP 2
        UNTIL 107,109 STEP 1 UNTIL 123,124,127,130 STEP 1 UNTIL 134,
        135,137,139,140 DO
          BEGIN
            VARAMT := IF I=41 OR I=43 THEN INTEGER(BIN[I],2) ELSE
                       IF I >98 AND I <108 THEN INTEGER(BIN[I],2)/10 ELSE
                       IF I=124 OR I=127 THEN INTEGER(BIN[I],3) ELSE
                       IF I=135 OR I=137 THEN INTEGER(BIN[I],2)/10 ELSE
                          INTEGER(BIN[I],1);
            RECHOLD[X] := VARAMT;
            IF VARAMT > 0 THEN
              BEGIN
                IF ZONEDEF = 1 THEN                       %PRIMARY ZONE
                  BEGIN
                    SUMP[X] := * + VARAMT;
                    SUMPS[X] := * + VARAMT**2;
                  END ELSE
                IF ZONEDEF = 2 THEN                       %SECONDARY
                  BEGIN
                    SUMS[X] := * + VARAMT;
                    SUMSS[X] := * + VARAMT**2;
                  END ELSE
                IF ZONEDEF = 3 THEN                       %TERTIARY
                  BEGIN
                    SUMT[X] := * + VARAMT;
                    SUMTT[X] := * + VARAMT**2;
                  END;
              END;
```

Accumulate
data for each
observation

```
35700              X := * + 1;                                                        00035700
35800            END;                                                                 00035800
35900          FOR X := 1 STEP 1 UNTIL NRVARS-1 DO                                    00035900
36000            BEGIN                                                                00036000
36100              VARAMT := RECHOLD[X+1];                                            00036100
36200              IF VARAMT = 0 THEN ELSE                                            00036200
36300                BEGIN                                                            00036300
36400                  M := X*NRVARS;                                                 00036400
36500                  FOR K := 1 STEP 1 UNTIL X DO                                   00036500
36600                    IF RECHOLD[K] > 0 THEN                                       00036600
36700                       BEGIN                                                     00036700
36800                         IF ZONEDEF = 1 THEN                                     00036800
36900                            XYSUMP[M+K] := * + (VARAMT*RECHOLD[K]) ELSE          00036900
37000                        IF ZONEDEF = 2 THEN                                      00037000
37100                             XYSUMS[M+K] := * + (VARAMT*RECHOLD[K]) ELSE         00037100
37200                          IF ZONEDEF = 3 THEN                                    00037200
37300                             XYSUMT[M+K] := * + (VARAMT*RECHOLD[K]);             00037300
37400                       END;                                                      00037400
37500                END;                                                             00037500
37600            END;                                                                 00037600
37700          GO TO READAGAIN;                                                       00037700
37800    ENDAGAIN:                                                                    00037800
37900          FOR X := 1 STEP 1 UNTIL 3 DO                                           00037900
38000            BEGIN                                                                00038000
38100               IF ZONECNT[X] = 0  THEN GO TO ENDLOOP2;                           00038100
38200               WRITE(LINE[SKIP 1]);                                              00038200
38300               WRITE(LINE[SPACE 2],HDR4,TITL[X*12],TITL[X*12+6]);                00038300
38400               FOR PANEL := 1 STEP 1 UNTIL 100 DO                                00038400
38500                 IF DIST[X,PANEL,2] > 0 THEN                                     00038500
38600                  WRITE(LINE,DET4,PANEL,DIST[X,PANEL,0],                         00038600
38700                        DIST[X,PANEL,1],DIST[X,PANEL,2]);                        00038700
38800    ENDLOOP2: END;                                                               00038800
38900    %********NEW                                                                 00038900
39000          XX := NRVARS DIV 8; XY := NRVARS MOD 8;                                00039000
39100          IF ZNCNT[1] > 0 THEN                                                   00039100
39200            BEGIN                                                                00039200
39300              M1 := ZNCNT[1] -1;                                                 00039300
39400              FOR X := 1 STEP 1 UNTIL NRVARS DO                                  00039400
39500 compute       BEGIN                                                             00039500
39600 mean and         MEANP[X] := SUMP[X]/ZNCNT[1];                                  00039600
39700 standard         STDVP[X]:=(SUMPS[X]-ZNCNT[1]*(MEANP[X]**2))/M1;                00039700
39800 deviation        IF STDVP[X] > 0 THEN STDVP[X] := STDVP[X]**0.5;                00039800
39900               END;                                                              00039900
40000              FOR X := 0 STEP 1 UNTIL XX -1 DO                                   00040000
40100                 WRITE(PRI,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO              00040100
40200                     MEANP[X*8+K]);                                              00040200
40300              IF XY > 0 THEN                                                     00040300
40400                 WRITE(PRI,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO             00040400
40500                     MEANP[XX*8+K]);                                             00040500
40600              FOR X := 0 STEP 1 UNTIL XX -1 DO                                   00040600
40700                 WRITE(PRI,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO              00040700
40800                     STDVP[X*8+K]);                                              00040800
40900              IF XY > 0 THEN                                                     00040900
41000                 WRITE(PRI,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO             00041000
41100                    STDVP[XX*8+K]);                                              00041100
41200            END;                                                                 00041200
41300          IF ZNCNT[2] > 0 THEN                                                   00041300
41400            BEGIN                                                                00041400
41500              M2 := ZNCNT[2] -1;                                                 00041500
41600              FOR X := 1 STEP 1 UNTIL NRVARS DO                                  00041600
```

```
           BEGIN                                                              00041700
             MEANS[X] := SUMS[X]/ZNCNT[2];                                    00041800
             STDVS[X]:=(SUMSS[X]-ZNCNT[2]*(MEANS[X]**2))/M2;                  00041900
             IF STDVS[X] > 0 THEN STDVS[X] := STDVS[X]**0.5;                  00042000
           END;                                                               00042100
%**WRITE MEANS                                                                00042200
         FOR X := 0 STEP 1 UNTIL XX -1 DO                                     00042300
            WRITE(SEC,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO                00042400
                MEANS[X*8+K]);                                                00042500
         IF XY > 0 THEN                                                       00042600
            WRITE(SEC,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO               00042700
                MEANS[XX*8+K]);                                               00042800
         FOR X := 0 STEP 1 UNTIL XX -1 DO                                     00042900
            WRITE(SEC,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO                00043000
                STDVS[X*8+K]);                                                00043100
         IF XY > 0 THEN                                                       00043200
            WRITE(SEC,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO               00043300
                STDVS[XX*8+K]);                                               00043400
       END;                                                                   00043500
     IF ZNCNT[3] > 0 THEN                            %TERTIARY                00043600
       BEGIN                                                                  00043700
         M3 := ZNCNT[3] - 1;                                                  00043800
         FOR X := 1 STEP 1 UNTIL NRVARS DO                                    00043900
           BEGIN                                                              00044000
             MEANT[X] := SUMT[X]/ZNCNT[3];                                    00044100
             STDVT[X]:=(SUMTT[X]-ZNCNT[3]*(MEANT[X]**2))/M3;                  00044200
             IF STDVT[X] > 0 THEN STDVT[X] := STDVT[X]**0.5;                  00044300
           END;                                                               00044400
         FOR X := 0 STEP 1 UNTIL XX -1 DO                                     00044500
            WRITE(TER,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO                00044600
                MEANT[X*8+K]);                                                00044700
         IF XY > 0 THEN                                                       00044800
            WRITE(TER,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO               00044900
                MEANT[XX*8+K]);                                               00045000
         FOR X := 0 STEP 1 UNTIL XX -1 DO                                     00045100
            WRITE(TER,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO                00045200
                STDVT[X*8+K]);                                                00045300
         IF XY > 0 THEN                                                       00045400
            WRITE(TER,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO               00045500
                STDVT[XX*8+K]);                                               00045600
       END;                                                                   00045700
     FOR I := 2 STEP 1 UNTIL NRVARS DO                                        00045800
       BEGIN                                                                  00045900
         L := (I-1) * NRVARS;                                                 00046000
         TEMP := SUMP[I]; TEMS := SUMS[I]; TEMT := SUMT[I];                   00046100
         IF ZNCNT[1] > 0 THEN              %PRIMARY ZONE                      00046200
           TVAP := STDVP[I];                                                  00046300
         IF ZNCNT[2] > 0 THEN              %SEC ZONE                          00046400
           TVAS := STDVS[I];                                                  00046500
         IF ZNCNT[3] > 0 THEN              %TER ZONE                          00046600
           TVAT := STDVT[I];                                                  00046700
         FOR J := 1 STEP 1 UNTIL I-1 DO                                       00046800
           BEGIN                                                              00046900
             M := L+J;                                                        00047000
             IF ZNCNT[1] > 0 THEN          %PRIMARY ZONE                      00047100
                BEGIN                                                         00047200
                  VAP := TVAP*STDVP[J];                                       00047300
                  IF VAP > 0 THEN                                             00047400
                    BEGIN                                                     00047500
                     XYSUMP[M] := ((XYSUMP[M]-(TEMP*SUMP[J]/ZNCNT[1]))/       00047600
```

```
           M1)/VAP;
        IF ABS(XYSUMP[M]) < 0.80 THEN ELSE
        IF I = 86 OR I = 87 THEN ELSE       %DEP VARIABLE
        IF J = 86 OR J = 87 THEN ELSE
          BEGIN
            ISW := 0;
            FOR MRPRI := 1 STEP 1 UNTIL LSPRI+1 DO
               IF IAPRI[MRPRI] = I THEN ISW := 1;
            IF ISW = 1 THEN ELSE
               BEGIN
                 LSPRI := * + 1;
                 IAPRI[LSPRI] := I;
               END;
            ISW := 0;
            FOR MRPRI := 1 STEP 1 UNTIL LSPRI+1 DO
               IF IAPRI[MRPRI] = J THEN ISW := 1;
            IF ISW = 1 THEN ELSE
               BEGIN
                 LSPRI := * + 1;
                 IAPRI[LSPRI] := J;
               END;
          END;
       END ELSE XYSUMP[M] := 0.0019;
     XYSUMP[((J-1)*NRVARS)+I] := XYSUMP[M];
   END;
IF ZNCNT[2] > 0 THEN          %SEC ZONE
   BEGIN
     VAS := TVAS*STDVS[J];
     IF VAS > 0 THEN
        BEGIN
        XYSUMS[M] := ((XYSUMS[M]-(TEMS*SUMS[J]/ZNCNT[2]))/
           M2)/VAS;
        IF ABS(XYSUMS[M]) < 0.80 THEN ELSE
        IF I = 86 OR I = 87 THEN ELSE       %DEP VARIABLE
        IF J = 86 OR J = 87 THEN ELSE
          BEGIN
            ISW := 0;
            FOR MRSEC := 1 STEP 1 UNTIL LSSEC+1 DO
               IF IASEC[MRSEC] = I THEN ISW := 1;
            IF ISW = 1 THEN ELSE
               BEGIN
                 LSSEC := * + 1;
                 IASEC[LSSEC] := I;
               END;
            ISW := 0;
            FOR MRSEC := 1 STEP 1 UNTIL LSSEC+1 DO
               IF IASEC[MRSEC] = J THEN ISW := 1;
            IF ISW = 1 THEN ELSE
               BEGIN
                 LSSEC := * + 1;
                 IASEC[LSSEC] := J;
               END;
          END;
       END ELSE XYSUMS[M] := 0.0019;
     XYSUMS[((J-1)*NRVARS)+I] := XYSUMS[M];
   END;
IF ZNCNT[3] > 0 THEN          %TER ZONE
   BEGIN
     VAT := TVAT*STDVT[J];
     IF VAT > 0 THEN
```

compute the
correlation
matrix

```
                     BEGIN
                     XYSUMT[M] := ((XYSUMT[M]-(TEMT*SUMT[J]/ZNCNT[3]))/
                        M3)/VAT;
                     IF ABS(XYSUMT[M]) < 0.80 THEN ELSE
                     IF I = 86 OR I = 87 THEN ELSE       %DEP VARIABLE
                     IF J = 86 OR J = 87 THEN ELSE
                       BEGIN
                         ISW := 0;
                         FOR MRTER := 1 STEP 1 UNTIL LSTER+1 DO
                            IF IATER[MRTER] = I THEN ISW := 1;
                         IF ISW = 1 THEN ELSE
                            BEGIN
                              LSTER := * + 1;
                              IATER[LSTER] := I;
                            END;
                         ISW := 0;
                         FOR MRTER := 1 STEP 1 UNTIL LSTER+1 DO
                            IF IATER[MRTER] = J THEN ISW := 1;
                         IF ISW = 1 THEN ELSE
                            BEGIN
                              LSTER := * + 1;
                              IATER[LSTER] := J;
                            END;
                       END;
                     END ELSE XYSUMT[M] := 0.0019;
                 XYSUMT[((J-1)*NRVARS)+I] := XYSUMT[M];
                END;
           END;
          XYSUMP[L+I] := XYSUMS[L+I] := XYSUMT[L+I] := 1.0;
       END;
     XYSUMP[1] := XYSUMS[1] := XYSUMT[1] := 1.0;
     I := NRVARS**2;
     XYSUMP[I] := XYSUMS[I] := XYSUMT[I] := 1.0;
     IF ZNCNT[1] > 0 THEN
        BEGIN
          WRITE(LINE[SKIP 1]);
          WRITE(LINE,<"PRIMARY/PILOT ZONE CORRELATION MATRIX"/>);
          CORPRINT(XYSUMP);
          WRITE(LINE,<"PRIMARY/PILOT ZONE HICOR:"/>);
          HICOR(XYSUMP,IAPRI,LSPRI);
        END;
     IF ZNCNT[2] > 0 THEN
        BEGIN
          WRITE(LINE[SKIP 1]);
          WRITE(LINE,<"SECONDARY/NAV ZONE CORRELATION MATRIX"/>);
          CORPRINT(XYSUMS);
          WRITE(LINE,<"SECONDARY/NAV ZONE HICOR:"/>);
          HICOR(XYSUMS,IASEC,LSSEC);
        END;
     IF ZNCNT[3] > 0 THEN
        BEGIN
          WRITE(LINE[SKIP 1]);
          WRITE(LINE,<"TERTIARY/SPT ZONE CORRELATION MATRIX"/>);
          CORPRINT(XYSUMT);
          WRITE(LINE,<"TERTIARY/SPT ZONE HICOR:"/>);
          HICOR(XYSUMT,IATER,LSTER);
        END;
%**  XX = NRVARS DIV 8, XY= NRVARS MOD 8 (CONTROL NR LINES WRITTEN)
     FOR I := 0 STEP 1 UNTIL NRVARS-1 DO
       BEGIN
```

```
        L := I * NRVARS;
        IF ZNCNT[1] > 0 THEN
           BEGIN
              FOR X := 0 STEP 1 UNTIL XX-1 DO
                 WRITE(PRI,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO
                       XYSUMP[L+(X*8+K)]);
              IF XY > 0 THEN
                 WRITE(PRI,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO
                       XYSUMP[L+(XX*8+K)]);
            END;
        IF ZNCNT[2] > 0 THEN
           BEGIN
              FOR X := 0 STEP 1 UNTIL XX-1 DO
                 WRITE(SEC,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO
                       XYSUMS[L+(X*8+K)]);
              IF XY > 0 THEN
                 WRITE(SEC,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO
                       XYSUMS[L+(XX*8+K)]);
           END;
        IF ZNCNT[3] > 0 THEN
           BEGIN
              FOR X := 0 STEP 1 UNTIL XX-1 DO
                 WRITE(TER,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL 8 DO
                       XYSUMT[L+(X*8+K)]);
              IF XY > 0 THEN
                 WRITE(TER,<8F10.5,X2>,FOR K := 1 STEP 1 UNTIL XY DO
                       XYSUMT[L+(XX*8+K)]);
           END;
     END;
     IF ZNCNT[1] > 0 THEN
        LOCK(PRI);
     IF ZNCNT[2] > 0 THEN
        LOCK(SEC);
     IF ZNCNT[3] > 0 THEN
        LOCK(TER);
     WRITE(LINE[SKIP 1]);
     WRITE(LINE[SKIP 1],<X61,"END REPORT">);
     WRITE(LINE,<"PREPARED(MMDDYY): ",A6>,TIME(15));
     WRITE(LINE,<"MERGE ",A1,A3>,BOARD,GRBD);
     WRITE(LINE,<X10,"BOARD COUNT - ",I6>,BDCNT);
     WRITE(LINE,<X10,"BIN REC IN - ",I6>,BINCNT);
     WRITE(LINE,<X10,"BIN REC IN/OUT - ",I6>,BINCNT1);
     WRITE(LINE,<X10,"RECORD COUNTS INPUT TO REG BUILD - ",
         3(I5,X2)>,FOR I := 1 STEP 1 UNTIL 3 DO ZNCNT[I]);
     WRITE(LINE,<X10,"PROCESS TIME - ",F6.2," SECS">,TIME(2)/60);
     WRITE(LINE,<X10,"I/O TIME - ",F6.2," SECS">,TIME(3)/60);
     WRITE(LINE,<X10,"PARITY ERR CNT:",I3>,PARCNT);
     END.
```