FORMAT—FORTRAN
MATRIX ABSTRACTION TECHNIQUE

VOLUME VII—SUPPLEMENT I. DESCRIPTION OF DIGITAL
COMPUTER PROGRAM—PHASE III—EXTENDED

I. A. FRANK

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FOREWORD

This report was prepared by the Douglas Aircraft Company, Long Beach, California, under USAF Contract No. F33615-68-C-1633. The work was initiated under Project No. 1467 "Structural Analysis Methods", and Task No. 146705" Automatic Computer Methods of Analysis for Flight Vehicle Structures". The work was administered under the Air Force Flight Dynamics Laboratory, by Mr. J. R. Johnson, FDTR, Project Engineer.

The work reported herein was conducted during the period July 1968 through April 1970. This report was submitted by the author for publication in April 1970.

Within the Douglas Aircraft Company, Mr. P. H. Denhe, Director, Scientific Computing was responsible for administration and technical progress. Mr. D. S. Warren, Manager, Advanced Design and Research, Structural Mechanics Section was principal investigator. Many other Douglas personnel contributed significantly to the project.

The general objective of the project was to update the FORMAT System documented in Volumes I through VII, as supplemented, by incorporation of additional basic capability and refinement of existing capability. The work is reported in Volume II-Supplement III, Volume V-Supplement I, Volume VI-Supplement I and Volume VII-Supplement I. A complete description of the current FORMAT System is contained in Volumes II, V, VI and VII, as supplemented (References 1 through 10). The supplements are the final reports of the investigation and conclude the work on Contract No. F33615-68-C-1633. The contractors report number is DAC-33569.

The report has been reviewed and is approved.

FRANCIS X. FANIK, JR.
Chief, Solid Mechanics Branch
Structures Division
ABSTRACT

The FORMAT System has been updated by the incorporation of additional basic capability and the refinement of existing capability. A simpler mode of updating case data and extended force method matrix generation capability has been incorporated in Phase I of the system. A refined "Structure Cutter" module, capabilities for matrix partitioning and instruction looping, and an additional eigenvalue/eigenvector extraction module have been incorporated in Phase II. Finally the limitations which existed in the matrix plotting capability in Phase III have been eliminated. Programming documentation for the extended capability of Phase III of the FORMAT System is presented in this report.
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Approved for Public Release
INTRODUCTION

The FORMAT System has been updated to provide additional basic capability and refinements to the existing capability.

The modification to Phase III (the special output phase) of the system involves an extensive revision of the matrix plot module in order to provide complete generality in the plotting of matrix data in rectangular displays. All of the limitations which restricted the practical usage of the previous version have been eliminated and in addition a considerable reduction in execution time has been effected by modifying the mode of retrieval of the matrix data used in the plot.

This capability is an optional modification of the basic capability of Phase III as described in Reference 9. User-oriented documentation is presented in Reference 6.

Section II of this report summarizes the steps required to implement the modification. Routine error messages, description, and overlay structure are contained in Appendices I, II and III respectively.
SECTION II
IMPLEMENTATION

Implementation of the revised matrix plot module in Phase III of the FORMAT system consists of the following steps.

(i) Replace the following 2 existing subroutines with the revised versions.

1. GRAPH (Deck P400)
2. PLOTXY (Deck P403)

The plot control modules were modified to accommodate the revised plot capability.

(ii) Insert the following 4 subroutines into the Phase III overlay structure.

1. MCOPY (Deck P405)
2. SORT (Deck P456)
3. SEARCH (Deck P407)
4. PLTXY (Deck P408)
PHASE III ERROR MESSAGES - EXTENDED

MATRIX PLOT MODULE

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>TABLE SIZE LIMITS HAVE BEEN EXCEEDED</td>
<td>GRAPH</td>
</tr>
<tr>
<td>NSETS = ****, DUE TO SIZE LIMITS ONLY FIRST TEN VALUES WILL BE USED</td>
<td>PLOTXY</td>
</tr>
<tr>
<td>NORDS = ****, DUE TO SIZE LIMITS ONLY FIRST 100 VALUES WILL BE USED</td>
<td>PLOTXY</td>
</tr>
<tr>
<td>NUMCOL = ****, DUE TO SIZE LIMITS ONLY FIRST 10 COLS WILL BE USED</td>
<td>PLOTXY</td>
</tr>
<tr>
<td>NCASE = ****, DUE TO SIZE LIMITS ONLY FIRST 10 CASES WILL BE USED</td>
<td>PLOTXY</td>
</tr>
<tr>
<td>PLOTXY ERROR IN X-AXIS SCALING</td>
<td>PLCTXY</td>
</tr>
<tr>
<td>PLOTXY ERRIR IN Y-AXIS SCALING</td>
<td>PLOTXY</td>
</tr>
<tr>
<td>NCOL = ****, WARNING - THIS COL DOES NOT EXIST IN THE ****TH MATRIX</td>
<td>MCOPY</td>
</tr>
<tr>
<td>INCORRECT COPY CARD OR CARD NONEXISTENT</td>
<td>MCOPY</td>
</tr>
<tr>
<td>COPY ERROR - THE ****TH MATRIX COULD NOT BE FOUND</td>
<td>MCOPY</td>
</tr>
<tr>
<td>THE MAX NUMBER OF 100 COLS TO BE COPIED HAS BEEN EXCEEDED IN THE ABOVE LINE</td>
<td>MCOPY</td>
</tr>
<tr>
<td>PLY03 MATRIX **** COULD NOT BE FOUND</td>
<td>SEARCH</td>
</tr>
<tr>
<td>PLY04 MATRIX **** IS NOT AMONG ONE OF THE AVAILABLE INPUT MATRICES</td>
<td>SEARCH</td>
</tr>
<tr>
<td>PLY05 ALL ELEMENTS IN COLUMN **** OF MATRIX **** ARE ZERO OR THIS COLUMN NUMBER EXCEEDS THE MAXIMUM COLUMN NUMBER OF THE MATRIX</td>
<td>SEARCH</td>
</tr>
</tbody>
</table>
Error Message

THE MAXIMUM NO. OF COLS HAS BEEN EXCEEDED -
ICOL = **** JMAX = ****

THE MAXIMUM NO. OF ROWS HAS BEEN
EXCEEDED - IROW = **** IMAX = ****

COLUMN **** DOES NOT EXIST IN THIS MATRIX -
***** - IT WILL BE IGNORED *****
APPENDIX II

PHASE III ROUTINES - EXTENDED

This appendix contains a detailed description of all subroutines that were significantly modified or added to Phase III in the FORMAT system. Each subroutine is divided into sections which are the following:

(a) Algorithm
(b) Input/Output
(c) Error
(d) Subroutines Required
(e) Argument List
(f) Subroutine Length
(g) Symbol List

The symbol list is divided into five fields which are described as follows:

i. The first field contains the symbol.

ii. The second field contains the letters I, L, or R denoting integer, logical, or real variable, respectively.

iii. The third field contains the letters A, C, D, or U denoting argument list, common, dimensioned, or undimensioned variable respectively. The hierarchy of the above letters is A, C, D, U.

iv. The fourth field contains the definition of the symbol.

v. The fifth field contains the name of the subroutine in which the symbol occurs.
<table>
<thead>
<tr>
<th>Subroutine</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SUBROUTINE GRAPH (DECK P400)</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>2. SUBROUTINE PLOTXY (DECK P403)</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>3. SUBROUTINE MCOPY (DECK P405)</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>4. SUBROUTINE SORT (DECK P406)</td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>5. SUBROUTINE SEARCH (DECK P407)</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>6. SUBROUTINE PLTXY1 (DECK P408)</td>
<td></td>
<td>31</td>
</tr>
</tbody>
</table>
1. SUBROUTINE GRAPH (DECK P400)

This routine acts as the control routine for the plot module.

a. Algorithm

"IWHICH" in the argument list is examined to determine which option has been requested. If "IWHICH" is not equal to two, the MATRIX option has been requested. The number of cases (frames), the number of x-values, and the number of sets of row numbers are then read in. Storage is allocated for, and control is passed to routine PLOTXY which plots the general matrix data.

If "IWHICH" is two, the GEOMETRY option has been requested. The indicator for the vector option (IVECTOR) is read in, subroutine TUTL3 is called to locate the specified case header on the master case data set, and subroutine TUTL7 is called to retrieve logical records from a specified table. After eliminating the duplicated bars, storage is allocated for, and control is passed to subroutine PLUT which plots structural geometry from the master case data set.

b. Input/Output

The number of cases, the number of x-values, the number of sets of row numbers and the indicator for the vector option are read from the system input data set.

c. Error

An error condition results when an error is returned from a subroutine, the amount of working storage available is exceeded, or when the specified data set or the joint coordinate data cannot be read.

d. Subroutines Required

TUTL3
TUTL7
PLOTXY
PLUT

e. Argument List

IWHICH - A variable indicating the option requested
ERROR - Logical error flag
NWORK - A variable defining the number of words of working storage available
IWORK - Is the working array
NAME - An array containing the name of the input case
f. Subroutine Length

1150 words (approximate)
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>END</td>
<td>U LOGICAL VARIABLE</td>
</tr>
<tr>
<td>ERROR</td>
<td>L A LOGICAL VARIABLE WHICH IS SET TO .TRUE. IF AN ERROR OCCURS</td>
</tr>
<tr>
<td>I</td>
<td>U DD LOOP INDEX</td>
</tr>
<tr>
<td>IEIJK</td>
<td>C QUICK SIZE OF MASTER CASE DATA SET</td>
</tr>
<tr>
<td>JK</td>
<td>U INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>IPANEL</td>
<td>D ARRAY OF PANEL TABLE</td>
</tr>
<tr>
<td>ITABN</td>
<td>I THE NUMBER OF THE TABLE REQUESTED</td>
</tr>
<tr>
<td>IVECTR</td>
<td>I VECTUR OPTION INDICATOR</td>
</tr>
<tr>
<td>IWICH</td>
<td>I A INDICATOR TO LEAD EITHER PLOTX OR PLOT</td>
</tr>
<tr>
<td>IWORK</td>
<td>I A THE WORKING ARRAY</td>
</tr>
<tr>
<td>J</td>
<td>U INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>J9</td>
<td>U INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>JBARI</td>
<td>U FIRST LOCATION OF JBAR ARRAY</td>
</tr>
<tr>
<td>JB1I</td>
<td>U INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>JCOOP</td>
<td>U FIRST LOCATION OF COOR ARRAY</td>
</tr>
<tr>
<td>JJ</td>
<td>U INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>JK</td>
<td>U DU LOOP INDEX</td>
</tr>
<tr>
<td>JLDAP</td>
<td>U FIRST LOCATION OF WLOAD ARRAY</td>
</tr>
<tr>
<td>JNEAC</td>
<td>U FIRST LOCATION OF VREAC ARRAY</td>
</tr>
<tr>
<td>J1</td>
<td>U FIRST LOCATION OF TTEMP ARRAY</td>
</tr>
<tr>
<td>J2</td>
<td>U FIRST LOCATION OF ITEMP ARRAY</td>
</tr>
<tr>
<td>J3</td>
<td>U FIRST LOCATION OF X ARRAY</td>
</tr>
<tr>
<td>J4</td>
<td>U FIRST LOCATION OF IRCW ARRAY</td>
</tr>
<tr>
<td>J5</td>
<td>U FIRST LOCATION OF VTITLE ARRAY</td>
</tr>
<tr>
<td>J6</td>
<td>U FIRST LOCATION OF HITLE ARRAY</td>
</tr>
<tr>
<td>J7</td>
<td>U FIRST LOCATION OF RW_ARRAY</td>
</tr>
<tr>
<td>J8</td>
<td>U FIRST LOCATION OF TNAME ARRAY</td>
</tr>
<tr>
<td>J9</td>
<td>U FIRST LOCATION OF ICCL ARRAY</td>
</tr>
<tr>
<td>J10</td>
<td>U FIRST LOCATION OF K ARRAY</td>
</tr>
<tr>
<td>J11</td>
<td>U FIRST LOCATION OF LINE ARRAY</td>
</tr>
<tr>
<td>J12</td>
<td>U FIRST LOCATION OF YMIX ARRAY</td>
</tr>
<tr>
<td>J13</td>
<td>U FIRST LOCATION OF YMIX ARRAY</td>
</tr>
<tr>
<td>SYMBOLS USED IN SUBROUTINE GRAPH</td>
<td>DESCRIPTION</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>J14</td>
<td>FIRST LOCATION OF NROWS ARRAY</td>
</tr>
<tr>
<td>J15</td>
<td>FIRST LOCATION OF INSPEC ARRAY</td>
</tr>
<tr>
<td>J16</td>
<td>FIRST LOCATION OF INTPAR ARRAY</td>
</tr>
<tr>
<td>J17</td>
<td>LAST LOCATION OF INTPAR ARRAY</td>
</tr>
<tr>
<td>K</td>
<td>INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>KK</td>
<td>INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>KONST</td>
<td>ORDER OF THE LARGEST MATRIX</td>
</tr>
<tr>
<td>L</td>
<td>INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>LREC</td>
<td>ACTUAL LENGTH OF THE LOGICAL RECORD</td>
</tr>
<tr>
<td>MAXREC</td>
<td>THE LENGTH OF THE LONGEST LOGICAL RECORD IN THE CASE</td>
</tr>
<tr>
<td>MM</td>
<td>INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>NWORK</td>
<td>THE LENGTH OF THE TABLE OF IWORK</td>
</tr>
<tr>
<td>NAME</td>
<td>NAME OF THE INPUT CASE</td>
</tr>
<tr>
<td>NBAR</td>
<td>NUMBER OF THE BARS</td>
</tr>
<tr>
<td>NCASE</td>
<td>NUMBER OF CASES</td>
</tr>
<tr>
<td>NJB</td>
<td>FIRST LOCATION OF P ARRAY</td>
</tr>
<tr>
<td>NJOINT</td>
<td>NUMBER OF JOINTS</td>
</tr>
<tr>
<td>NLOAD</td>
<td>NUMBER OF APPLIED LOAD VECTORS</td>
</tr>
<tr>
<td>NM</td>
<td>INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>NNRDOS</td>
<td>NUMBER OF X-VALUES</td>
</tr>
<tr>
<td>NP</td>
<td>ARRAY OF INTERMEDIATE VARIABLES</td>
</tr>
<tr>
<td>NPIOT</td>
<td>LOGICAL DATA SET NUMBER OF THE SYSTEM INPUT UNIT</td>
</tr>
<tr>
<td>NPOIT</td>
<td>LOGICAL DATA SET NUMBER OF THE SYSTEM OUTPUT UNIT</td>
</tr>
<tr>
<td>NNREAC</td>
<td>NUMBER OF REACTION VECTORS</td>
</tr>
<tr>
<td>NSETS</td>
<td>NUMBER OF SETS OF RCN NUMBERS</td>
</tr>
<tr>
<td>NTAH</td>
<td>THE NUMBER OF TABLES IN THIS CASE</td>
</tr>
<tr>
<td>NTBAR</td>
<td>INTERMEDIATE VARIABLE</td>
</tr>
<tr>
<td>NTTEMP</td>
<td>FIRST LOCATION OF CT ARRAY</td>
</tr>
<tr>
<td>NWURK</td>
<td>A NUMBER OF WORDS OF WORKING STORAGE AVAILABLE</td>
</tr>
</tbody>
</table>
2. SUBROUTINE PLOTXY (DECK 1403)

This routine plots general matrix data

a. Algorithm

After testing and initializing variables, the matrix copy routine (MCOPY) is called to read the copy card and carry out the appropriate procedures. Upon returning the input table of x-values and sets of row numbers to be plotted is read in. At this point the table is sorted into appropriate arrays eliminating undesired x-values for a given set of row numbers. The number of columns to be plotted, extreme values for the x and y axes, their respective increments, and the vertical and horizontal titles are read in. In addition, for each column, the name of the matrix, the column number, the row set number and the line option is read in. At this point the sorting routine (SORT) is called to sort the input cases. Subroutine SEARCH is called to locate the maximum and minimum values in each column. PLTXY1 is then called to calculate the remaining necessary variables and to call the appropriate SC-4020 routines.

b. Input/Output

Sets of row numbers, x-values, number of columns to be plotted, extreme values and increment values for axes, axes titles, matrix name, column number, the row set number and the line option are read from the system input data set. SC-4020 plots are output onto the SC-4020 data set.

c. Error

When the size limit for the input value is exceeded, the limit will be used and an appropriate message printed.

An error condition results when an error is returned from a subroutine. This occurs when a copy error is detected, the specified matrix could not be found, or when every element of the column is zero.

d. Subroutines Required

MCOPY
SORT
FIND
SEARCH
PLTXY1
SCLSIZ
SC-4020
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMP</td>
<td>Temporary storage for input x-values</td>
</tr>
<tr>
<td>ITEMP</td>
<td>Temporary storage for the input sets of row numbers</td>
</tr>
<tr>
<td>X</td>
<td>An array containing x-values for a given row set</td>
</tr>
<tr>
<td>IROW</td>
<td>An array containing the row numbers to be plotted (row set)</td>
</tr>
<tr>
<td>VTITLE</td>
<td>Vertical axis title</td>
</tr>
<tr>
<td>HTITLF</td>
<td>Horizontal axis title</td>
</tr>
<tr>
<td>ROW</td>
<td>An array containing the row values of the matrix column to be plotted</td>
</tr>
<tr>
<td>INAME</td>
<td>An array containing the matrix names of the columns to be plotted</td>
</tr>
<tr>
<td>ICOL</td>
<td>An array containing the number of the column to be plotted</td>
</tr>
<tr>
<td>N</td>
<td>An array containing row set numbers</td>
</tr>
<tr>
<td>LINE</td>
<td>An array containing for each column to be plotted either a 1 to denote that lines connecting the plotted points are desired or a 0 (zero) to denote the absence of lines</td>
</tr>
<tr>
<td>YMAX</td>
<td>An array containing the largest value in each column</td>
</tr>
<tr>
<td>YMIN</td>
<td>An array containing the smallest values in each column</td>
</tr>
<tr>
<td>NROWS</td>
<td>An array containing the number of row values to be plotted for each row set</td>
</tr>
<tr>
<td>INSPEC</td>
<td>Logical input data set numbers for input matrices</td>
</tr>
<tr>
<td>INMTAP</td>
<td>Names of input matrix data sets</td>
</tr>
<tr>
<td>NCASE</td>
<td>The number of cases (frames)</td>
</tr>
<tr>
<td>NORDS</td>
<td>Number of x-values</td>
</tr>
<tr>
<td>NSETS</td>
<td>Number of sets of row numbers</td>
</tr>
<tr>
<td>ERROR</td>
<td>Logical variable which is set to .TRUE. if an error occurs</td>
</tr>
</tbody>
</table>
f. Subroutine Length

1365 words (approximate)
SYMBOLS USED IN SUBROUTINE PLOTXY

ANY R U DUMMY ARGUMENT
COPYED L V LOGICAL MATRIX COPY VARIABLE
DX K U DATA INCREMENT AT WHICH VERTICAL GRID LINES WILL BE DISPLAYED PLOTXY
DY K U DATA INCREMENT AT WHICH HORIZONTAL GRID LINES IS DISPLAYED PLOTXY
ERROR L A LOGICAL ERROR FLAG
HTITLE D ARRAY TO BE USED FOR HORIZONTAL LABEL
I I U DI LOOP INDEX
IBLK C I BLOCK SIZE OF THE MASTER CASE DATA SET
ICOL I A ARRAY OF COLUMN NUMBERS TO BE PLOTTED PLOTXY
II I U DI LOOP INDEX
IK I U DI LOOP INDEX
IM I U INTERMEDIATE VARIABLE
IMAX I U NUMBER OF ROWS IN LOCATED MATRIX
INAME I A ARRAY OF THE NAMES OF THE MATRICES TO BE PLOTTED PLOTXY
INMAT I A NAMES OF INPUT MATRICES DATA SETS PLOTXY
INSPEC I A LOGICAL DATA SET NUMBER OF INPUT MATRICES PLOTXY
IPON I A ARRAY OF ROW NUMBERS PLOTXY
ISET I U DATA SET WHICH CONTAINS MATRIX TO BE LOCATED PLOTXY
ITCOL I D TEMPORARY STORAGE PLOTXY
ITEMP I D TEMPORARY STORAGE PLOTXY
ITNAME I D TEMPORARY STORAGE PLOTXY
J I U DI LOOP INDEX
JFINO I U NUMBER OF THE MATRIX WHICH WAS LOCATED FIRST PLOTXY
JMAX I U NUMBER OF COLUMNS IN LOCATED MATRIX
KUDE I U COLUMN COMPRESSION CODE PLOTXY
KONST I C THE ORDER OF THE LARGEST MATRIX PLOTXY
LINE L I INDICATOR TO CONNECT POINTS PLOTXY
LINET I D TEMPORARY STORAGE PLOTXY
MWORK I C THE LENGTH OF THE WORKING STORAGE AREA
N I A ARRAY OF ROW SET NUMBERS PLOTXY
NCASE I A NUMBER OF CASES PLOTXY
SYMBOLS USED IN SUBROUTINE PLOTXY

NHT  I  U  THE RASTER COORDINATES FOR THE CENTER OF FIRST CHARACTER
NORDS I  A  NUMBER OF X-VALUES
NPIT I  C  LOGICAL DATA SET NUMBER OF THE SYSTEM INPUT UNIT
NPUT I  C  LOGICAL DATA SET NUMBER OF THE SYSTEM OUTPUT UNIT
NRWS I  A  ARRAY CONTAINING NUMBER OF ROW VALUES FOR EACH ROW SET
NSETS I  A  NUMBER OF SETS OF ROW NUMBERS
NT I  D  TEMPORARY STORAGE
NUM I  U  NUMBER OF ELEMENTS IN THE COLUMN
NUMCOL I  A  NUMBER OF THE COLUMNS TO BE PLOTTED ON SAME FRAME
NUMID I  U  INTERMEDIATE VARIABLE
NUMTOP I  U  RASTER COORDINATE WHICH WILL POSITION FIRST CHARACTER
NVT I  U  THE RASTER COORDINATES FOR THE CENTER OF FIRST CHARACTER
ROW R  A  ARRAY WHERE ELEMENTS OF THE COLUMN TO BE STORED
TEMP I  A  TEMPORARY STORAGE
VTITLE R  D  ARRAY TO BE USED FOR VERTICAL LABEL
X I  A  ARRAY OF X-VALUES FOR EACH ROW SET
XPL R  U  FLOATING POINT VALUE FOR THE LEFT-MOST LIMIT OF THE GRID
XMAX R  R  FLOATING POINT FINAL ROW NUMBER OF THE COLUMN
XMIN R  U  FLOATING POINT INITIAL ROW NUMBER OF THE COLUMN
XR R  R  FLOATING POINT VALUE FOR THE RIGHT-MOST LIMITS OF THE GRID
YB R  U  FLOATING POINT VALUE FOR THE BOTTOM LIMIT OF THE GRID
YMAX R  A  LARGEST ELEMENT VALUE OF THE COLUMN
YMIN R  A  SMALLEST ELEMENT VALUE OF THE COLUMN
YT R  U  FLOATING POINT VALUE FOR THE TOP LIMIT OF THE GRID
ZMAX R  U  LARGEST ELEMENT OF THE COLUMN
ZMIN R  U  SMALLEST ELEMENT OF THE COLUMN
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3. SUBROUTINE MCOPY (DECK P496)

This routine copies a matrix header, specified columns, and a matrix trailer onto a scratch data set.

a. Algorithm

The subroutine first locates an available utility data set and writes a data set header and trailer on it. Then the COPY card, which contains the copy option and the number of matrix copies to be made, is read in. If NOCOPY is specified the subroutine returns to the calling routine. If COPY is specified the matrix name, the number of columns to be copied, and the column numbers of that matrix to be copied are read in. The column numbers are sorted into ascending order and subroutine FIND is called to locate the specific matrix. A matrix header is written on the scratch data set and the specified columns are copied on to it. A matrix trailer is written, the copy flag is set, and after all copies are made the subroutine returns to the calling program.

b. Input/Output

The number of matrix copies, the matrix names, and columns to be copied are read from the system input data set. The data set number onto which the matrix copies were made is passed to calling routine.

c. Error

An error condition results when an error is returned from a subroutine, a matrix or column could not be found, or the COPY option card was found to be incorrect.

d. Subroutines Required

FIND
EUTL1
EUTL3
EUTL5
EUTL6

e. Argument List

MCOPY (ISET, TEMP, COPIED, ERROR)

ISET - Data set number onto which the matrix copies were made

TEMP - Temporary storage
f. Subroutine Length

575 words (approximate)
SYMBOLS USED IN SUBROUTINE MCOPY

COPYED  L  A  LOGICAL VARIABLE  MCOPY
ERROR   L  A  LOGICAL VARIABLE  MCOPY
ICARD   I  D  ARRAY CONTAINING IMAGE OF INPUT COPY OPTION  MCOPY
ICHANG  I  U  INTERMEDIATE COUNTER  MCOPY
ICOPY   I  D  ARRAY CONTAINING COPY OPTIONS  MCOPY
I   I  U  INTERMEDIATE COUNTER  MCOPY
IMAX   I  U  MAXIMUM ROW LENGTH  MCOPY
IN     I  U  INTERMEDIATE COUNTER  MCOPY
ISET   I  A  DATA SET NUMBER ONTO WHICH THE COPY IS MADE  MCOPY
ITEM   I  U  TEMPORARY STORAGE  MCOPY
J       I  U  COLUMN NUMBER  MCOPY
JMAX   I  U  MAXIMUM COLUMN LENGTH  MCOPY
K       I  U  INTERMEDIATE COUNTER  MCOPY
KONFIG  I  D  CONFIGURATION ARRAY  MCOPY
L       I  U  INTERMEDIATE COLUMN LENGTH  MCOPY
MACARD I  D  ARRAY CONTAINING A MATRIX NAME TO BE COPIED  MCOPY
NCOL   I  U  ARRAY CONTAINING COLUMN NUMBERS TO BE COPIED  MCOPY
NI     I  U  INTERMEDIATE COUNTER  MCOPY
NM     I  U  INTERMEDIATE COUNTER  MCOPY
NSET   I  U  DATA SET NUMBER OF LOCATED MATRIX  MCOPY
NUM    I  U  NUMBER OF COLUMNS TO BE COPIED  MCOPY
NUMBER I  U  NUMBER OF REMAINING WORDS  MCOPY
NUNCOP I  U  NUMBER OF MATRIX COPIES  MCOPY
NUMA   I  U  NUMBER OF AVAILABLE DATA SETS  MCOPY
TEMP   R  D  TEMPORARY STORAGE  MCOPY
4. SUBROUTINE SORT (DECK P406)

This routine sorts input cases for subroutine PLOTXY on a per case basis.

a. Algorithm

After initializing variables the array of names are sorted into
groups of the same name while the other variables are stored into their
associated arrays. The column numbers in a given group of names are
sorted in ascending order. After all groups are sorted control is returned
to the calling routine.

b. Input/Output

None

c. Error

None

d. Subroutines Required

None

e. Argument List

SORT (ITNAME, ITCOL, NT, LINET, NUMCOL, INAME, ICOL,
N, LINE)

ITNAME - Array containing names to be sorted
ITCOL - Array containing column numbers to be sorted
NT - Array containing NSET numbers to be sorted
LINET - Array containing line options to be sorted
NUMCOL - Numbers of columns to be plotted
INAME - Array in which the sorted names are to be stored
ICOL - Array in which the sorted column numbers are to be stored
N - Array in which the sorted NSET numbers are to be stored
LINE - Array in which the sorted line options are to be stored
1. Subroutine Length

320 words (approximate)
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<thead>
<tr>
<th>Symbol</th>
<th>Type</th>
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<tr>
<td>NUMCOL</td>
<td>A</td>
<td>NUMBERS OF COLUMNS TO BE PLOTTED</td>
</tr>
<tr>
<td>M</td>
<td>U</td>
<td>INTERMEDIATE COUNTER</td>
</tr>
</tbody>
</table>
5. SUBROUTINE SEARCH (DECK F407)

This routine locates the maximum and minimum values in columns to be plotted.

a. Algorithm

If a given matrix has not been found, EUTL3 is called to locate it. If a given column has not been found, the data set is read until it is located. The column is then searched for the maximum and minimum values. After finding these extremes control is returned to the calling routine.

b. Input/Output

The specified matrices and columns are read from the master input data sets.

c. Error

An error condition results if a matrix is not available or cannot be found. Also, if a column are zero an error message is written.

d. Subroutines Required

PUTL2
EUTL3
EUTL9

e. Argument List

SEARCH (NUMCOL, ISET, INSPEC, INAME, ICOL, IROW, NROWS, YB, YT, ZMAX, ZMIN, NORDS, IFLAG, ERROR, COPYED, DY, N, RY)

NUMCOL - Number of columns to be plotted
ISET - Data set number
INSPEC - Array containing data set numbers
INAME - Array containing matrix names
ICOL - Array containing column numbers
IROW - Array containing the row numbers to be plotted
NROWS - Array containing the number of row values to be plotted for each row set
YB - Floating point value for the bottom limit of grid
YT - Floating point value for the top limit of grid
ZMAX - Largest element of the column
ZMIN - Smallest element of the column
NORDS - Number of x-values
IFLAG - Integer flag
ERROR - Logical error flag
COPYED - Logical copy flag
DY - Data increment at which horizontal grid lines displayed
N - Array of row set numbers
ROW - Array containing row values

f. Subroutine Length

587 words (approximate)
SYMBOLS USED IN SUBROUTINE SEARCH

COPYED I V LOGICAL MATRIX COPY VARIABLE
DO I U DATA INCREMENT AT WHICH HORIZONTAL GRID LINES DISPLAYED
ERROR L A LOGICAL ERROR FLAG
I I U DO LOOP INDEX
ICOL I A ARRAY OF COLUMN NUMBERS TO BE PLOTTED
IMAX I U NUMBER OF ROWS IN LOCATED MATRIX
INAME I A ARRAY OF THE NAMES OF THE MATRICES TO BE PLOTTED
INSPEC I A LOGICAL DATA SET NUMBER OF INPUT MATRICES
INROW I A ARRAY OF ROW NUMBERS
ISET I U DATA SET WHICH CONTAINS MATRIX TO BE LOCATED
J I U COLUMN NUMBER
JMAX I U NUMBER OF COLUMNS IN LOCATED MATRIX
KODE I U COLUMN COMPRESSION CODE
N I A ARRAY OF ROW SET NUMBERS
NKDS I A NUMBER OF X-VALUES
NPIT I C LOGICAL DATA SET NUMBER OF THE SYSTEM INPUT UNIT
NPIT I C LOGICAL DATA SET NUMBER OF THE SYSTEM OUTPUT UNIT
NRWS I A ARRAY CONTAINING NUMBER OF ROW VALUES FOR EACH ROW SET
NUM I U NUMBER OF ELEMENTS IN A COLUMN
NUMCOL I A NUMBER OF THE COLUMNS TO BE PLOTTED ON THE SAME FRAME
ROW R A ARRAY WHERE ELEMENTS OF THE COLUMN ARE TO BE STORED
YB R U FLOATING POINT VALUE FOR THE BOTTOM LIMIT OF THE GRID
YMAX R A LARGEST ELEMENT VALUE OF THE COLUMN
YMIN R A SMALLEST ELEMENT VALUE OF THE COLUMN
YR U FLOATING POINT VALUE FOR THE TOP LIMIT OF THE GRID
ZMAX R U LARGEST ELEMENT OF THE COLUMN
ZMIN R U SMALLEST ELEMENT OF THE COLUMN
6. SUBROUTINE PLTXY1 (DECK P408)

This routine calls appropriate SC-4020 routines to plot the specified points.

a. Algorithm

After locating the specified matrices and columns, this routine initializes and sets the appropriate variables and then calls the required SC-4020 routines to plot the points desired. In order to save search time, this routine is designed to locate matrices and columns not previously located (provided SORT has been used).

b. Input/Output

The matrix names, and columns are extracted from the master input data sets. The matrix names, column numbers, next numbers, line options, and plotted values are written on the system output unit.

c. Error

When a matrix cannot be found, or the maximum number of rows or columns is exceeded on error conditions results.

d. Subroutines Required

PUT12
EUT12
EUT13
SC-4020

e. Argument List

PLTXY1 (NUMCOL, INAME, INSPEC, ICOL, N, NROWS, IROW, ROW, LINE, X, NORDS, LINES)

NUMCOL - Number of columns to be plotted
INAME - Array containing matrix names to be plotted
INSPEC - Logical data set number of input matrices
ICOL - Array of column numbers to be plotted
N - Array of row set numbers
NROWS - Array containing the number of row values to be plotted for each row set
IROW - Array containing the row numbers to be plotted
ROW - Array containing row values
LINE - Array containing line options
X - Array of x-values for each row set
NORDS - Number of x-values
LINES - Number of lines of output

f. Subroutine Length

725 words (approximate)
PHASE III OVERLAY STRUCTURE - EXTENDED
OVERLAY STRUCTURE FOR MATRIX PLOT MODULE

GRAPH

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Approved for Public Release
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**UNCLASSIFIED**

The FORMAT System has been updated by the incorporation of additional basic capability and the refinement of existing capability. A simpler mode of updating case data and extended force method matrix generation capability has been incorporated in Phase I of the system. A refined “Structure Cutter” module, capabilities for matrix partitioning and instruction looping, and an additional eigenvalue/eigenvector extraction module have been incorporated in Phase II. Finally the limitations which existed in the matrix plotting capability in Phase III have been eliminated. Programming documentation for the extended capability of Phase III of the FORMAT System is presented in this report.
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