MAGNETIC TAPE COPIES OF MIT GEOPHYSICS PROGRAM SET II

(TIME SERIES PROGRAMS FOR THE IBM 709, 7090, 7094)

S. M. Simpson, Jr.

Massachusetts Institute of Technology
Cambridge 39, Massachusetts

Contract No. AF19(604)-7378
Project No. 8672
Task No. 865203

Scientific Report No. 10
March 31, 1965

Work Sponsored by Advanced Research Projects Agency
Project Vela-Uniform
ARPA Order No. 180-61, Amendment 2

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UNITED STATES AIR FORCE
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ABSTRACT

The set of programs known as "MIT Geophysics Program Set I" has been expanded, edited, and upgraded to form Set II. This new set consists of 267 programs for the IBM 709, 7090, 7094 and is available to qualified applicants, via magnetic tape copies of the symbolic decks, from the Seismic Data Laboratory of United Electrodymanics. A complete copy requires two 2400 foot high density (900 BPI) tapes.

The symbolic decks of Set II form an interlocking system of self-documenting (including examples) subroutines written in FORTRAN and FAP (compatible with FORTRAN-II) concerned primarily with single and multiple time series analysis. Because of the subroutine nature of its construction, however, much of the system is readily accessible for use in other computational areas.

The new programs in Set II concentrate largely on utility functions (graphical and other input-output, miscellaneous numerical operators) and on time series operators for multidimensional and multi-input processes (including in particular high speed recursion techniques for solving least squares simultaneous equations). A handful of specialized or outmoded programs from Set I has been suppressed; most of the others have been upgraded with respect to documentation; and some have been modified with respect to coding.
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1. Introduction

MIT Geophysics Program Set II is an expanded, modified version of Program Set I which was introduced (Simpson, 1962) as follows.

"The MIT Department of Geology and Geophysics has a history in time series computations by high speed computers which extends back to 1952 when it began using Whirlwind I to instrument Wiener's optimum filter concepts in the signal-noise problems of reflection seismology. Since then it has steadily developed and expanded the computer technology of time series analysis, adapting computational concepts to the shifting ground of new machine languages.

"The programs developed in this process have been made available on an individual basis in the past but, particularly with impetus from VELA UNIFORM research, the increased volume of requests have necessitated a more concentrated effort to systematize this distribution. Moreover, the widespread adoption of FORTRAN and IBM 700 series machines justifies for us the considerable effort we have taken to carefully document and assemble the large number of our most useful programs which we are now making available as "MIT Geophysics Program Set I.

"Symbolic programs are the best for general distribution and because of the number of cards involved (over 23,000) we have chosen to transmit them by magnetic tape. The symbolic programs on the tape copies are completely self-explanatory. The present report is concerned with supplementary information such as complete tables of contents, conventions used in program design and description, details on the production and testing of the master tape, and a KWIC-type index to the programs.

"The bulk of the programs included are the work of Stephen M. Simpson, Jr., Jon F. Claerbout, James N. Galbraith, and Ralph A. Wiggins, but they include contributions from Jacqueline Clark, Enders A. Robinson, Roy J. Greenfield, and there are a few programs originating in the MIT Computation Center as well as one or two modifications
of FORTRAN system routines. Authorship is given individually in the comment cards of each program.

"The production and testing of the master tape involved not only the work of the authors but also extensive test program writing by Joseph Procito and seemingly endless card preparation, handling and editing by Elizabeth Studer, Dauna Trop, and Karl Gentili to whom the authors are most grateful.

"Test computations were performed both on the IBM 7090 at the MIT Computation Center and on the IBM 709 of the Cooperative Computing Laboratory of MIT, with the valuable assistance of Michael Saxton and Anthony Sacco, respectively."

The above serves to introduce Program Set II with the following additional comments

1. The symbolic card count never exceeds 50,000.

2. The names of Mrs. Myrna Kasser, Regina Lahteine, and Mrs. Barbara Cullum should be added to the list of those assisting in punched card work and the names of John Harmon, Thomas Burhoe, Mason Fleming and William Jarvis to the list of computer operators.

3. The IBM 7094 of the MIT Computation Center was the principal computing instrument used during the period since Program Set I.

REFERENCE

2. Tables of Contents of the Symbolic Tapes

The symbolic versions of the 267 programs of Set II appear on two BCD tapes, 116 on the first tape and 151 on the second. The first file of each tape gives a table of contents for that tape, and the remaining files are the successive programs, ordered alphabetically by program name, terminated by an "END TAPE" file. Consequently the first tape contains 118 files and the second one 153 files. The following 11 pages show listings of the first files of the two tapes.
Listing of first file of Tape 1 of
Program Set II (Page 1 of 5)

• TABLE OF CONTENTS
• FILE NO. 1 ON THIS TAPE IS
• TABLE OF CONTENTS
• FILE NO. 2 ON THIS TAPE IS
• A'SVAL
  • FAST ABSOLUTE VALUE OF A VECTOR
• FILE NO. 3 ON THIS TAPE IS
• ADANL
  • MODIFY AUTO- OR CROSS-CORRELATIONS FOR DANI ELL SPECTRA
• FILE NO. 4 ON THIS TAPE IS
• ADDK
  • MODIFY A SET OF VARIABLES BY A CONSTANT OR BY CONSTANTS
• FILE NO. 5 ON THIS TAPE IS
• AMPHZ
  • AMPLITUDE AND PHASE FROM REAL AND IMAGINARY, OR REVERSE
• FILE NO. 6 ON THIS TAPE IS
• ARCCCL
  • FIND A MATRIX COLUMN WITH ARBITRARY INDEX BY INTERPOLATION
• FILE NO. 7 ON THIS TAPE IS
• ARCTAN
  • ARCTANGENT FUNCTION
• FILE NO. 8 ON THIS TAPE IS
• ASPECT
  • FAST COSINE TRANSFORMS OF ONE-SIDED AUTOCORRELATIONS
• FILE NO. 9 ON THIS TAPE IS
• ASPEC?
  • AUTOSPECTRUM BY COSINE TRANSFORM OF AUTOCORRELATION
• FILE NO. 10 ON THIS TAPE IS
• AVRACE
  • FIND AVERAGE OF FLOATING VECTOR
• FILE NO. 11 ON THIS TAPE IS
• BLKSLM
  • SUMMATION OF VECTOR OVER ABUTTING BLOCKS OF CONSTANT LENGTH
• FILE NO. 12 ON THIS TAPE IS
• BRONST
  • ADD A CONSTANT TO ELEMENTS OF A FIXED OR FLOATING VECTOR
• FILE NO. 13 ON THIS TAPE IS
• CARIGE
  • SPACE CARRIAGE N LINES OR RESTORE PAGE
• FILE NO. 14 ON THIS TAPE IS
• CHISCR
  • COMPUTE CHI-SQUARE FOR CONSTANT PROBABILITY CASE
• FILE NO. 15 ON THIS TAPE IS
• CHOOSE
  • SET A LIST OF VARIABLES TO ONE OF TWO SETS OF VALUES
• FILE NO. 16 ON THIS TAPE IS
• CMPRWS
  • FAST REVERSAL OF SPECIAL VECTORS (AS PRODUCED BY SPLIT)
• FILE NO. 17 ON THIS TAPE IS
• CHSIGN
  • CHANGE ALL SIGN BITS OF A VECTOR
• FILE NO. 18 ON THIS TAPE IS
• CLKON
  • CHECK IF INTERVAL TIMER IS ON MAKING ON-LINE REQUEST IF NOT
• FILE NO. 19 ON THIS TAPE IS
• CLOCK1 (7090)
  • FOR REAL TIME TIMING IN SECONDS USING 7090 INTERVAL CLOCK
• FILE NO. 20 ON THIS TAPE IS
• CMPPAR
  • COMPARE PAIRS OF VARIABLES OR A SET OF VARIABLES FOR EQUALITY
• FILE NO. 21 ON THIS TAPE IS
• CMPPARV
  • FAST COMPARE TWO ARBITRARY MODE VECTORS FOR IDENTITY
• FILE NO. 22 ON THIS TAPE IS
• CMPRA
  • COMPARE ARITHMETICALLY TWO WORDS WHERE -0 IS LESS THAN +0
• FILE NO. 23 ON THIS TAPE IS
• CNTRCC6
  • CONTOUR A MATRIX ON THE PRINTER IN DECIBELS
• FILE NO. 24 ON THIS TAPE IS
• CNTRCM
  • FIND CONTOUR LEVELS FOR PLOTTING A ROW OF DATA
• FILE NO. 25 ON THIS TAPE IS
• COLABL
  • LABEL PRINTER COLUMNS WITH INCREASING 3-DIGIT INTEGERS
• FILE NO. 26 ON THIS TAPE IS
• COLAPS
  • COLLAPSE ONE-SIDED VECTOR INTO SMALLER RANGE
• FILE NO. 27 ON THIS TAPE IS
• CONTLN
  • CONTOUR OF MATRIX SUBSET ON OFF-LINE PRINTER
Listing of first file of Tape 1 of Program Set II (Page 2 of 5)

- FILE NO.  28 ON THIS TAPE IS COMPLETE CONVOLUTION OF TWO TRANSIENTS
- FILE NO.  29 ON THIS TAPE IS COMPLETE CONVOLUTION OF TWO TRANSIENTS
- FILE NO.  30 ON THIS TAPE IS FAST COSINE AND/OR SINE TRANSFORMS OF ODD-LENGTH SERIES
- FILE NO.  31 ON THIS TAPE IS FAST COSINE AND/OR SINE TRANSFORMS FROM 2 OR 4 EVEN-ODD PARTS
- FILE NO.  32 ON THIS TAPE IS GENERATE COSINE OR SINE HALF-WAVE TABLES, FIXED OR FLOATING
- FILE NO.  33 ON THIS TAPE IS FAST COPY FILE FROM ONE TAPE TO ANOTHER - VERSION 2
- FILE NO.  34 ON THIS TAPE IS CROSSCORRELATION OF TRANSIENTS BEGINNING WITH ZERO LAG
- FILE NO.  35 ON THIS TAPE IS CROSSCORRELATION OF TRANSIENTS BEGINNING WITH ANY LAG
- FILE NO.  36 ON THIS TAPE IS CROSSCORRELATION OF TRANSIENT VECTORS OF MATRICES
- FILE NO.  37 ON THIS TAPE IS OUTPUT VARIABLES FIVE PER LINE IN G FORMAT
- FILE NO.  38 ON THIS TAPE IS FIND CUBIC WHICH EXACTLY FITS 4 EQUALLY ED POINTS
- FILE NO.  39 ON THIS TAPE IS OUTPUT COLUMN VECTORS BY NORMAL OR LITERAL FORMATS
- FILE NO.  40 ON THIS TAPE IS LIST DATA DECK AND REPOSITION TAPE TO FRONT OF DECK
- FILE NO.  41 ON THIS TAPE IS DELTA FUNCTION AND STEP FUNCTIONS, FLOATING AND FIXED POINT
- FILE NO.  42 ON THIS TAPE IS DERIVATIVE OF A VECTOR BY DIFFERENCING
- FILE NO.  43 ON THIS TAPE IS DIFFERENCE FIXED OR FLOATING VECTOR ELEMENTS IN PAIRS
- FILE NO.  44 ON THIS TAPE IS WRITE HOLLERITH TEXT ON SCOPE
- FILE NO.  45 ON THIS TAPE IS WRITE HOLLERITH TEXT ON SCOPE
- FILE NO.  46 ON THIS TAPE IS DIVIDE A FLOATING VECTOR BY A CONSTANT
- FILE NO.  47 ON THIS TAPE IS VECTOR DOT PRODUCT WITH ARBITRARY INCREMENTS
- FILE NO.  48 ON THIS TAPE IS DISPLACED DOT PRODUCT OF 2-DIMENSIONAL ARRAYS
- FILE NO.  49 ON THIS TAPE IS VARIABLE ORIGIN FORMAT GENERATOR FOR SCOPE SUBROUTINE DISPLA
- FILE NO.  50 ON THIS TAPE IS FAST DOUBLING OR HALVING OF A VECTOR (FIXED OR FLOATING)
- FILE NO.  51 ON THIS TAPE IS EXCHANGE ANY TWO VECTORS
- FILE NO.  52 ON THIS TAPE IS HI-SPEED EXPANSION OF A VECTOR UNDER CUBIC INTERPOLATION
- FILE NO.  53 ON THIS TAPE IS FACTOR POWER SPECTRUM TO FIND MINIMUM PHASE WAVELET
- FILE NO.  54 ON THIS TAPE IS COMPUTE A LOGICAL SUMCHECK
Listing of first file of Tape 1 of
Program Set II (Page 3 of 5)

• FILE NO.  55 ON THIS TAPE IS
  • FAST\n  FAST SCAN VECTOR FOR ELEMENT EQUAL OR GREATER THAN GIVEN VALUE
• FILE NO.  56 ON THIS TAPE IS
  • FASTC\n  FAST EVALUATE CUBIC FOR EVENLY SPACED ARGUMENTS
• FILE NO.  57 ON THIS TAPE IS
  • FASTK\n  FAST TRACK THROUGH A VECTOR OF INDICES
• FILE NO.  58 ON THIS TAPE IS
  • FAST\n  FAST DOT PRODUCT OF TWO VECTORS
• FILE NO.  59 ON THIS TAPE IS
  • FAST\n  TWO-DIMENSIONAL FILTER BY RECURSION
• FILE NO.  60 ON THIS TAPE IS
  • FIX\n  FIX A FLOATING VECTOR WITH OR WITHOUT ROUNDI NG
• FILE NO.  61 ON THIS TAPE IS
  • FLOAT\n  FLOAT ANY MACHINE LANGUAGE INTEGER
• FILE NO.  62 ON THIS TAPE IS
  • FLOAT\n  FLOAT A VECTOR
• FILE NO.  63 ON THIS TAPE IS
  • FMT\n  WRITE OUTPUT TAPE WITH NORMAL OR LITERAL FORMAT VECTOR
• FILE NO.  64 ON THIS TAPE IS
  • FNCF\n  ACCESS TO LITERAL OR ORDINARY FORMAT
• FILE NO.  65 ON THIS TAPE IS
  • FRAME\n  ADVANCE FILM FRAME ON SCOPE
• FILE NO.  66 ON THIS TAPE IS
  • FRAME\n  ADVANCE FILM FRAME ON SCOPE
• FILE NO.  67 ON THIS TAPE IS
  • FRQCT\n  FREQUENCY DISTRIBUTION OF A FIXED POINT VECTOR
• FILE NO.  68 ON THIS TAPE IS
  • FRQCT\n  FREQUENCY COUNT OF NUMBER OF VALUES OF A SERIES IN GIVEN RANGES
• FILE NO.  69 ON THIS TAPE IS
  • FSK\n  SKIP FORWARD OR BACKWARD OVER FILES ON TAPE
• FILE NO.  70 ON THIS TAPE IS
  • FT24\n  HIGH SPEED 24 POINT SPECTRUM
• FILE NO.  71 ON THIS TAPE IS
  • FT24\n  HIGH SPEED 24 POINT SPECTRUM
• FILE NO.  72 ON THIS TAPE IS
  • FXC\n  SCALE, CONVERT FLT. VECTOR TO MACHINE INTEGERS OR CONVERSELY
• FILE NO.  73 ON THIS TAPE IS
  • GENH\n  GENERATE HOLLERITH FIELD
• FILE NO.  74 ON THIS TAPE IS
  • GETH\n  GET HOLLERITH DATA FROM CALLING SEQUENCE
• FILE NO.  75 ON THIS TAPE IS
  • GETRC\n  ACCESS ROUTINE FOR RAND CORP. MILLION RANDOM DIGITS FROM TAPE
• FILE NO.  76 ON THIS TAPE IS
  • GETX\n  ALLOWS VARIABLE DEPTH INDEXING OF VECTORS
• FILE NO.  77 ON THIS TAPE IS
  • GNFLT\n  GENERATE SYMMETRICAL FILTER WITH GIVEN AMPLITUDE RESPONSE
• FILE NO.  78 ON THIS TAPE IS
  • GNHOL\n  GENERATE HOLLERITH CHARACTERS
• FILE NO.  79 ON THIS TAPE IS
  • GRAP\n  MULTIPLE FRAME SCOPE PLOTS OF VECTOR SETS
• FILE NO.  80 ON THIS TAPE IS
  • GRAPX\n  SUBROUTINE GRAPH EXPANDED OVER VERTICAL FRAMES
• FILE NO.  81 ON THIS TAPE IS
  • GRUP\n  DIVIDE THE X AXIS INTO EQUALLY PROBABLE RANGES

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Listing of first file of Tape 1 of Program Set II (Page 4 of 5)

- FILE NO. 82 ON THIS TAPE IS HLAOJ HOLLERITH LEFT ADJUST OR RIGHT ADJUST FUNCTION
- FILE NO. 83 ON THIS TAPE IS HSTPLT HISTOGRAM PLOTTING FOR SUBROUTINE GRAPH
- FILE NO. 84 ON THIS TAPE IS HSTPLT-II BAR GRAPH PLOTTING FOR SUBROUTINE GRAPH
- FILE NO. 85 ON THIS TAPE IS HSTPLT-III(709) CUBIC CURVE SCOPE PLOTTING FOR SUBROUTINE GRAPH
- FILE NO. 86 ON THIS TAPE IS HSTPLT-III(7090) CUBIC CURVE SCOPE PLOTTING FOR SUBROUTINE GRAPH
- FILE NO. 87 ON THIS TAPE IS MWT0IV SPREAD OUT HOLLERITH VECTOR AS FORTRAN INTEGERS
- FILE NO. 88 ON THIS TAPE IS IDERIV INVERSION OF DIFFERENTIATION BY DIFFERENCING
- FILE NO. 89 ON THIS TAPE IS IFNCTN INVERSION OF A MONOTONE FUNCTION BY LINEAR INTERPOLATION
- FILE NO. 90 ON THIS TAPE IS IINTEGR INVERSION OF TRAPEZOIDAL INTEGRAL
- FILE NO. 91 ON THIS TAPE IS INDATA FAST AND CONVENIENT RETRIEVAL OF DATA FROM A SPECIAL TAPE
- FILE NO. 92 ON THIS TAPE IS INDEX HYBRID SUBPROGRAMS FOR INCREMENTING, TESTING, AND SETTING
- FILE NO. 93 ON THIS TAPE IS INTGRA INDEFINITE INTEGRAL BY TRAPEZOIDAL RULE
- FILE NO. 94 ON THIS TAPE IS INTHCL INTERPRET HOLLERITH
- FILE NO. 95 ON THIS TAPE IS INTOPR INTERPOLATION OPERATOR FOR 1 TO 4 EVENLY SPACED DATA VALUES
- FILE NO. 96 ON THIS TAPE IS INTSLM INTEGRATED SUMMATION OF A FLOATING OF FIXED VECTOR
- FILE NO. 97 ON THIS TAPE IS IPLYEV COMPLEX POLYNOMIAL EVALUATION
- FILE NO. 98 ON THIS TAPE IS ITOMLI FAST CONVERT FORTRAN INTEGER VECTOR TO ML I VECTOR
- FILE NO. 99 ON THIS TAPE IS IVTOIV PACK UP FORTRAN INTEGER VECTOR AS HOLLERITH VECTOR
- FILE NO. 100 ON THIS TAPE IS IXCARG LOCATE ARGUMENT WITH RESPECT TO COMMON
- FILE NO. 101 ON THIS TAPE IS KIINT1 PROBABILITY THAT A CHI-SQUARED VARIATE EXCEEDS A VALUE
- FILE NO. 102 ON THIS TAPE IS KOLAPS COLLAPSE ODD-LENGTHED VECTOR ABOUT ITS MIDPOINT
- FILE NO. 103 ON THIS TAPE IS LIMITS CHECK THAT VARIABLES FROM LIST FALL WITHIN GIVEN LIMITS
- FILE NO. 104 ON THIS TAPE IS LINE (709) FAST ARBITRARY STRAIGHT LINE SEGMENT ON SCOPE
- FILE NO. 105 ON THIS TAPE IS LINE (7090) FAST ARBITRARY STRAIGHT LINE SEGMENT ON SCOPE
- FILE NO. 106 ON THIS TAPE IS LINEH (709) PLOT FAST HORIZONTAL LINE ON SCOPE
- FILE NO. 107 ON THIS TAPE IS LINEV (709) PLOT FAST HORIZONTAL LINE ON SCOPE
- FILE NO. 108 ON THIS TAPE IS LINEV (709) PLOT FAST VERTICAL LINE ON SCOPE
Listing of first file of Tape 1 of
Program Set II (Page 5 of 5)

* FILE NO. 109 ON THIS TAPE IS
  *LINEV(7090) PLOT FAST VERTICAL LINE ON SCOPE
* FILE NO. 110 ON THIS TAPE IS
  *LINTR1 LINEAR INTERPOLATION IN A TABLE
* FILE NO. 111 ON THIS TAPE IS
  *LISTNG LIST AUXILIARY INFORMATION FOR AN INDATA-OUTDATA TYPE TAPE
* FILE NO. 112 ON THIS TAPE IS
  *LOC CORE LOCATION WITH INDEXABLE ARGUMENT
* FILE NO. 113 ON THIS TAPE IS
  *LOCATE LOCATE AND OPERATE SUBROUTINES BY PROXY CALL STATEMENTS
* FILE NO. 114 ON THIS TAPE IS
  *LSHFT LOGICAL SHIFT FUNCTION
* FILE NO. 115 ON THIS TAPE IS
  *LSLIND LEAST SQUARES LINE
* FILE NO. 116 ON THIS TAPE IS
  *LSSSI LEAST SQUARES SHAPER BY SIDEWAYS ITERATION
* FILE NO. 117 ON THIS TAPE IS
  *MATINV INVERSE OF A MATRIX
* FILE NO. 118 ON THIS TAPE IS
  *ENC TAPE CARD IN FORMAT(1H*,6X,8MEND TAPE)
Listing of first file of Tape 2 of
Program Set II (Page 1 of 6)

* TABLE OF CONTENTS
* FILE NO. 1 ON THIS TAPE IS
* TABLE OF CONTENTS
* FILE NO. 2 ON THIS TAPE IS
* MATML1 SQUARE MATRIX MULTIPLICATION
* FILE NO. 3 ON THIS TAPE IS
* MATML3 N X M MATRIX BY M X L MATRIX MULTIPLICATION
* FILE NO. 4 ON THIS TAPE IS
* MATRA MATRIX TRANSPOSE
* FILE NO. 5 ON THIS TAPE IS
* MATRA1 SQUARE MATRIX TRANSPOSE
* FILE NO. 6 ON THIS TAPE IS
* MAXSA FIND SIGNED OR UNSIGNED EXTREME VALUES OF A VECTOR
* FILE NO. 7 ON THIS TAPE IS
* MAXSAM EXTREME VALUES OF MATRIX ELEMENTS
* FILE NO. 8 ON THIS TAPE IS
* MDOOT DOT PRODUCT OR REVERSED DOT PRODUCT OF VECTORS OF MATRICES
* FILE NO. 9 ON THIS TAPE IS
* MDOOT3 DOT PRODUCT OR REVERSED DOT PRODUCT OF VECTORS OF MATRICES
* FILE NO. 10 ON THIS TAPE IS
* MEMUSE OFF-LINE PRINT OF MEMORY USAGE - PROGRAM AND COMMON
* FILE NO. 11 ON THIS TAPE IS
* MFACT FACTOR A SYMMETRIC POSITIVE DEFINITE MATRIX
* FILE NO. 12 ON THIS TAPE IS
* MIFLS MULTI-INPUT FILTER BY LEAST SQUARES
* FILE NO. 13 ON THIS TAPE IS
* MIPLS MULTI-INPUT PREDICTOR BY LEAST SQUARES
* FILE NO. 14 ON THIS TAPE IS
* MISS MULTI-INPUT SIDEWAYS ITERATION
* FILE NO. 15 ON THIS TAPE IS
* MLISCL MULTIPLY AN MLI VECTOR BY A FORTRAN FIXED POINT INTEGER
* FILE NO. 16 ON THIS TAPE IS
* ML12A6 CONVERT MACHINE LANGUAGE INTEGER TO EQUIVALENT HOLLERITH
* FILE NO. 17 ON THIS TAPE IS
* MONOCK CHECK VECTOR FOR MONOTONE INCREASING OR DECREASING BEHAVIOR
* FILE NO. 18 ON THIS TAPE IS
* MOUT MATRIX OUTPUT IN G FORMAT
* FILE NO. 19 ON THIS TAPE IS
* MOUTAI OUTPUT A MATRIX AS INTEGERS DENSELY PACKED OFF-LINE
* FILE NO. 20 ON THIS TAPE IS
* MOVE MOVE A VECTOR TO A DIFFERENT LOCATION
* FILE NO. 21 ON THIS TAPE IS
* MOVECS MOVE AN ARBITRARY SET OF VECTORS
* FILE NO. 22 ON THIS TAPE IS
* MOVREV MOVE, REVERSE, CHANGE SPACING, OR CHANGE SIGN OF A VECTOR
* FILE NO. 23 ON THIS TAPE IS
* MPSEC1 MAP A SEQUENCE OF NUMBERS INTO AN INTEGER SERIES
* FILE NO. 24 ON THIS TAPE IS
* MRVRS REVERSE VECTOR OF MATRICES
* FILE NO. 25 ON THIS TAPE IS
* MSCON1 MEAN SQUARE CONTINGENCY AND DEPENDENCY FROM PROBABILITY DENSITY
* FILE NO. 26 ON THIS TAPE IS
* MULK -II MULTIPLY ANY NO. OF VARIABLES BY A SINGLE FLTG. PT. CONSTANT
* FILE NO. 27 ON THIS TAPE IS
* MULLER POLYNOMIAL ROOT FINDER
FILE NO.  28 ON THIS TAPE IS
MULPLY MULTPLY VECTOR BY FLOATING OR FIXED CONSTANT
FILE NO.  29 ON THIS TAPE IS
MVACAO FAST MOVING SUMMATION OF A FIXED POINT VECTOR
FILE NO.  30 ON THIS TAPE IS
MVBLCK MOVE DATA BLOCK
FILE NO.  31 ON THIS TAPE IS
MVNAV MOVING AVERAGE OF A VECTOR
FILE NO.  32 ON THIS TAPE IS
MVNSLM MOVING SUMMATION WITH DIVISION BY A CONSTANT
FILE NO.  33 ON THIS TAPE IS
MVNTIN MOVING TRAPEZOIDAL INTEGRAL OR ABSOLUTE VALUE INTEGRAL
FILE NO.  34 ON THIS TAPE IS
MVSQAV MOVING MEAN SQUARE AVERAGE OF A VECTOR
FILE NO.  35 ON THIS TAPE IS
MXRARE REGION TO MAXIMIZE RATIO OF TWO DISTRIBUTION FUNCTIONS
FILE NO.  36 ON THIS TAPE IS
NHZMC1 NORMALIZE A VECTOR TO GIVEN MAXIMUM VALUE
FILE NO.  37 ON THIS TAPE IS
NORM1 NORMAL DISTRIBUTION AND DIVISION INTO EQUALLY LIKELY SECTIONS
FILE NO.  38 ON THIS TAPE IS
NRMVCT NORMALIZE AND CHANGE MEAN OF A VECTOR
FILE NO.  39 ON THIS TAPE IS
NTHA RETURN N-TH ARGUMENT BEYOND THE FIRST
FILE NO.  40 ON THIS TAPE IS
NURIAC CREATE ONE VECTOR FROM ANOTHER WITH NEW RANGE AND INCREMENT
FILE NO.  41 ON THIS TAPE IS
NXALRM SCAN VECTOR FOR POSSIBLE BLOCK OF VALUES ALL ABOVE GIVEN LEVEL
FILE NO.  42 ON THIS TAPE IS
ONLINE OPTIONAL ONLINE MONITOR OF BCD TAPE WRITING
FILE NO.  43 ON THIS TAPE IS
OUCATA FAST AND CONVENIENT DATA STORAGE ON TAPE
FILE NO.  44 ON THIS TAPE IS
PACDAT READ EVERY N-TH WORD FROM BINARY TAPE
FILE NO.  45 ON THIS TAPE IS
PAKN SCALE AND FIX DATA VECTOR, PACK N DATA POINTS PER REGISTER
FILE NO.  46 ON THIS TAPE IS
PLANSP FAST TWO-DIMENSIONAL SPATIAL SPECTRUM
FILE NO.  47 ON THIS TAPE IS
PLOTVS PRINTER- PLOT OF ARBITRARY SET OF VECTORS
FILE NO.  48 ON THIS TAPE IS
PLTVS1 PRINTER PLOT OF A SET OF EQUAL LENGTH VECTORS
FILE NO.  49 ON THIS TAPE IS
PLURAS PLURALIZE THE NEXT SUBROUTINE
FILE NO.  50 ON THIS TAPE IS
PLYSN POLYNOMIAL SYNTHESIZED FROM ITS REAL AND COMPLEX ROOTS
FILE NO.  51 ON THIS TAPE IS
POKCTI EVALUATION OF INTEGER SEQUENCE IN GROUPS OF FIVE AS POKER HANDS
FILE NO.  52 ON THIS TAPE IS
POLYCV PERFORM LONG DIVISION OF TWO POLYNOMIALS
FILE NO.  53 ON THIS TAPE IS
POLYEV EVALUATE A POLYNOMIAL WITH REAL COEFFICIENTS FOR REAL ARGUMENT
FILE NO.  54 ON THIS TAPE IS
POLYSN POLYNOMIAL SYNTHESIS FROM REAL AND COMPLEX ROOTS
Listing of first file of Tape 2 of
Program Set II (Page 3 of 6)

* FILE NO.  55 ON THIS TAPE IS
  *POWER  RAISE VECTOR TO POWER OR SUM POWER OF DEVIATIONS FROM BASE
* FILE NO.  56 ON THIS TAPE IS
  *PROFIT  GENERATE PROBABILITY DISTRIBUTION WITH SPECIFIED MOMENTS
* FILE NO.  57 ON THIS TAPE IS
  *PROB2  SECOND PROBABILITY DENSITY OF INTEGER SERIES AT GIVEN LAG
* FILE NO.  58 ON THIS TAPE IS
  *PROCR  FAST CORRELATIONS FOR LONG SERIES OF FIXED POINT INTEGERS
* FILE NO.  59 ON THIS TAPE IS
  *PSQRT  FIND THE POWER SERIES SQUARE ROOT OF A POLYNOMIAL
* FILE NO.  60 ON THIS TAPE IS
  *PWMLIV  PRINT OR WRITE OUTPUT TAPE A MACHINE LANGUAGE INTEGER VECTOR
* FILE NO.  61 ON THIS TAPE IS
  *QACORR  FAST AUTOCORRELATIONS FOR LONG, LIMITED ACCURACY SERIES
* FILE NO.  62 ON THIS TAPE IS
  *QCNVLV  FAST CONVOLUTIONS FOR LONG, LIMITED ACCURACY SERIES
* FILE NO.  63 ON THIS TAPE IS
  *QFURY  FAST FOURIER TRANSFORM OF TRANSIENT WITH ARBITRARY TIME ORIGIN
* FILE NO.  64 ON THIS TAPE IS
  *QIFURY  QUICK INVERSE FOURIER TRANSFORM WITH ARBITRARY TIME ORIGIN
* FILE NO.  65 ON THIS TAPE IS
  *QINTRI  QUADRATIC INTERPOLATION IN A TABLE
* FILE NO.  66 ON THIS TAPE IS
  *QUTFIT1  FIND QUADRATIC WHICH EXACTLY FITS 3 EQUALLY SPACED POINTS
* FILE NO.  67 ON THIS TAPE IS
  *QXCORR  FAST CROSS-CORRELATIONS FOR LONG, LIMITED ACCURACY SERIES
* FILE NO.  68 ON THIS TAPE IS
  *QXCORR1  QUICK CROSSCORRELATION OF MIL TRANSIENTS
* FILE NO.  69 ON THIS TAPE IS
  *RDATA  READ DATA IN GENERALIZED FORMAT
* FILE NO.  70 ON THIS TAPE IS
  *REFC  REFLECT A FIXED OR FLOATING VECTOR THROUGH A CONSTANT
* FILE NO.  71 ON THIS TAPE IS
  *REMAV  REMOVE THE MEAN FROM A FLOATING VECTOR
* FILE NO.  72 ON THIS TAPE IS
  *REREAD  REREAD DATA RECORD AND END FILE MONITOR
* FILE NO.  73 ON THIS TAPE IS
  *REVER  REVERSE A VECTOR ELSEWHERE OR IN PLACE
* FILE NO.  74 ON THIS TAPE IS
  *REVERS  FAST REVERSE STORAGE ORDER OF A VECTOR
* FILE NO.  75 ON THIS TAPE IS
  *RLSPR  REALIZABLE LEAST SQUARES PREDICTOR BY RECURSION, 1-DIMENSION
* FILE NO.  76 ON THIS TAPE IS
  *RLSPR2  REALIZABLE LEAST SQUARES PREDICTOR BY RECURSION, 2-DIMENSIONS
* FILE NO.  77 ON THIS TAPE IS
  *RLSSR  REALIZABLE LEAST SQUARES SHAPER BY RECURSION
* FILE NO.  78 ON THIS TAPE IS
  *RMSOEV  RMS DEVIATION FROM GIVEN BASE OR FROM TRUE AVERAGE
* FILE NO.  79 ON THIS TAPE IS
  *RND  ROUND FLTG. PT. NO. UP, DOWN, OR TO NEAREST FLTG. PT. INTEGER
* FILE NO.  80 ON THIS TAPE IS
  *RNDV  ROUND, ROUND UP, OR ROUND DOWN A FLOATING VECTOR
* FILE NO.  81 ON THIS TAPE IS
  *ROAR2  ROTATE CENTRO-SYMMETRIC 0- TISYMMETRIC 2-DIMENSIONAL ARRAY
Listing of first file of Tape 2 of Program Set II (Page 4 of 6)

• ROTAT  FILE NO. 82 ON THIS TAPE IS
  ROTATE A VECTOR UPWARDS OR DOWNWARDS AN ARBITRARY AMOUNT
• RPLFP FILE NO. 83 ON THIS TAPE IS
  REPLACE THE FORMAT OF A SUCCEEDING INPUT OR OUTPUT STATEMENT
• RSKIP FILE NO. 84 ON THIS TAPE IS
  SKIP FORWARD OR BACKWARD OVER RECORDS ON TAPE
• SAME FILE NO. 85 ON THIS TAPE IS
  ENABLE MIXED EXPRESSIONS IN FORTRAN
• SCPSCL FILE NO. 86 ON THIS TAPE IS
  SCALE VECTOR TO INTEGERS FOR SCOPE, CLIPPING EXCESSIVE VALUES
• SEARCH FILE NO. 87 ON THIS TAPE IS
  SEARCH A VECTOR FOR A VALUE
• SEQSAC FILE NO. 88 ON THIS TAPE IS
  FAST FUNCTIONS FOR SEQUENTIAL SINES AND COSINES
• SETINO FILE NO. 89 ON THIS TAPE IS
  INITIALIZE FOR ADDING TO AN INDATA-OUTDATA TAPE
• SETK FILE NO. 90 ON THIS TAPE IS
  SET VARIABLES OR VECTORS TO GIVEN VALUES
• SETK -II FILE NO. 91 ON THIS TAPE IS
  SET ANY NO. OF VARIABLES EQUAL TO A SINGLE VALUE (FXD OR FLTG)
• SETKP FILE NO. 92 ON THIS TAPE IS
  PLURALIZED FORMS OF SUBROUTINES SETK AND SETVEC
• SETKS -II FILE NO. 93 ON THIS TAPE IS
  SET ANY NO. OF VARIABLES EQUAL TO SEPARATE VALUES (FXD OR FLTG)
• SETKV FILE NO. 94 ON THIS TAPE IS
  SET ALL ELEMENTS OF VECTOR EQUAL TO A CONSTANT (ANY MODE)
• SETKVS FILE NO. 95 ON THIS TAPE IS
  SET ANY NO. OF VECTORS EQUAL TO SEPARATE VALUES (FXD OR FLTG)
• SETLIN FILE NO. 96 ON THIS TAPE IS
  SET FXD OR FLTG VECTOR EQUAL TO A LINEAR SEGMENT
• SETLNS FILE NO. 97 ON THIS TAPE IS
  SET LINEAR VECTORS, FIXED AND/OR FLOATING
• SETLAV FILE NO. 98 ON THIS TAPE IS
  SET ANY NO. OF VECTORS EQUAL TO SEPARATE VALUES (FXD OR FLTG)
• SEVRAL FILE NO. 99 ON THIS TAPE IS
  OPERATE SEVERAL SUBROUTINES OR ONE SUBROUTINE REPEATEDLY
• SHFTR1 FILE NO. 100 ON THIS TAPE IS
  SHIFT VECTOR ELEMENTS ARITHMETICALLY LEFT OR RIGHT
• SHFTR2 FILE NO. 101 ON THIS TAPE IS
  SHIFT VECTOR ELEMENTS LOGICALLY LEFT OR RIGHT
• SHUFFL FILE NO. 102 ON THIS TAPE IS
  SHUFFLE A LIST OF INTEGERS FROM 1 TO N
• SIFT FILE NO. 103 ON THIS TAPE IS
  FORM A VECTOR BY SIFTING ANOTHER AT EVEN INCREMENTS
• SIMEG FILE NO. 104 ON THIS TAPE IS
  SOLUTION OF SIMULTANEOUS EQUATIONS AND DETERMINANT EVALUATION
• SIZELP FILE NO. 105 ON THIS TAPE IS
  FAST MAKE INDEX (BY INCREASING SIZE) OF ELEMENTS IN A VECTOR
• SMPSCN FILE NO. 106 ON THIS TAPE IS
  UNSCALE OR SCALE VECTOR FOR SIMPSON INTEGRAL AND/OR INTEGRATE
• SPCOR? FILE NO. 107 ON THIS TAPE IS
  SPATIAL CROSSCORRELATION OF 2-DIMENSIONAL SPATIAL ARRAYS
• SPLIT FILE NO. 108 ON THIS TAPE IS
  SPLIT A VECTOR INTO ITS EVEN AND ODD PARTS (OR INVERSE)
• SQRDFR FILE NO. 109 ON THIS TAPE IS
  SUM SQUARE DIFF. OF FLTG VECTOR FROM ANOTHER OR FROM A CONSTANT
LISTING OF FIRST FILE OF TAPE 2 OF
Program Set II (Page 3 of 6)

- FILE NO. 109 ON THIS TAPE IS
  SQRMLI  FAST SQUARE ELEMENTS OF A MACHINE LANGUAGE INTEGER VECTOR
- FILE NO. 110 ON THIS TAPE IS
  SQRDOCT  SQUARE ROOT OF A FLOATING VECTOR
- FILE NO. 111 ON THIS TAPE IS
  SQRSLM  SUM THE SQUARED ELEMENTS OF A FLTG OR FXD VECTOR
- FILE NO. 112 ON THIS TAPE IS
  SQUARE  SQUARE ELEMENTS OF FXD OR FLTG VECTOR
- FILE NO. 113 ON THIS TAPE IS
  SRCH1  SEARCH VECTOR FOR NUMBER, STARTING FROM FIRST OR LAST TERM
- FILE NO. 114 ON THIS TAPE IS
  STZ  FAST SET VECTOR TO ZERO
- FILE NO. 115 ON THIS TAPE IS
  STZS  SET A LIST OF VECTORS TO ZERO
- FILE NO. 116 ON THIS TAPE IS
  SUM  SUM ELEMENTS OF FLOATING OR FIXED VECTOR
- FILE NO. 117 ON THIS TAPE IS
  SUMDFR  SUM DIFFERENCE OF VECTOR FROM ANOTHER OR FROM A CONSTANT
- FILE NO. 118 ON THIS TAPE IS
  SWITCH  TEST THE CONDITION OF ANY SENSE SWITCH
- FILE NO. 119 ON THIS TAPE IS
  TAMVL  TRIANGULAR AVERAGING, MOVING LEFT OR RIGHT END
- FILE NO. 120 ON THIS TAPE IS
  TIMA2B (7094)  REAL TIME, TO SPECIFIED ACCURACY, OF GIVEN PROGRAM RANGE
- FILE NO. 121 ON THIS TAPE IS
  TIMSLB  FIND OPERATION TIME OF NEXT SUBROUTINE TO GIVEN ACCURACY
- FILE NO. 122 ON THIS TAPE IS
  TINGL  DEFINITE TRAPEZOIDAL INTEGRAL OF FUNCTION OR ITS MAGNITUDE
- FILE NO. 123 ON THIS TAPE IS
  TRMIAO  TERMINATE AN INDATA-OUTDATA TAPE
- FILE NO. 124 ON THIS TAPE IS
  UNPAKN  UNPACK AND RESCALE A PACKED DATA VECTOR
- FILE NO. 125 ON THIS TAPE IS
  VARARG  ENABLE FORTRAN VARIABLE LENGTH CALLING SEQUENCES
- FILE NO. 126 ON THIS TAPE IS
  VDOTV  DOT PRODUCT OF TWO VECTORS WITH DIVISION BY CONSTANT
- FILE NO. 127 ON THIS TAPE IS
  VDIVBYV  DIVIDE ELEMENTS OF ONE VECTOR BY THOSE OF ANOTHER
- FILE NO. 128 ON THIS TAPE IS
  VECOLT  OFFLINE VECTOR OUTPUT WITH NORMAL OR LITERAL FORMAT
- FILE NO. 129 ON THIS TAPE IS
  VOUT  OUTPUT NAMED VECTOR BY NORMAL OR LITERAL FORMAT WITH SPACING
- FILE NO. 130 ON THIS TAPE IS
  VPLUSV  ADD OR SUBTRACT TWO FLOATING OR FIXED VECTORS
- FILE NO. 131 ON THIS TAPE IS
  VRSOLT  OUTPUT VARIABLES BY NORMAL OR LITERAL FORMAT
- FILE No. 132 ON THIS TAPE IS
  VSOUT  OUTPUT NAMED VECTORS BY NORMAL OR LITERAL FORMATS WITH SPACING
- FILE NO. 133 ON THIS TAPE IS
  VTIMSV  MULTIPLY ELEMENTS OF TWO VECTORS FIXED OR FLOATING
- FILE NO. 134 ON THIS TAPE IS
  WAC  WIENER AUTOCORRELATION
- FILE NO. 135 ON THIS TAPE IS
  WHICH  CHOOSE BETWEEN TWO VARIABLES BY A THIRD ONE BEING ZERO

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Listing of first file of Tape 2 of
Program Set II (Page 6 of 6)

- FILE NO. 136 ON THIS TAPE IS
  - WLLSFP 
  - WRTDAT 
  - FILE NO. 138 ON THIS TAPE IS
  - XACTEQ 
  - FILE NO. 139 ON THIS TAPE IS
  - XAVRGE 
  - FILE NO. 140 ON THIS TAPE IS
  - XDIV 
  - FILE NO. 141 ON THIS TAPE IS
  - XDVICE 
  - FILE NO. 142 ON THIS TAPE IS
  - XFIXM 
  - FILE NO. 143 ON THIS TAPE IS
  - XLCCV 
  - FILE NO. 144 ON THIS TAPE IS
  - XLIMIT 
  - FILE NO. 145 ON THIS TAPE IS
  - XLCCV 
  - FILE NO. 146 ON THIS TAPE IS
  - XOCZE 
  - FILE NO. 147 ON THIS TAPE IS
  - XREMAV 
  - FILE NO. 148 ON THIS TAPE IS
  - XSPECT 
  - FILE NO. 149 ON THIS TAPE IS
  - XSQDFR 
  - FILE NO. 150 ON THIS TAPE IS
  - XSQRLT 
  - FILE NO. 151 ON THIS TAPE IS
  - XVCEV 
  - FILE NO. 152 ON THIS TAPE IS
  - ZEFBCD 
  - FILE NO. 153 ON THIS TAPE IS

ENC TAPE CARD IN FORMAT(1H*,6X,8HEND TAPE)
3. Program Statistics

All of the programs of Set II are subroutines or functions, and the name of each program coincides with the name of the entry point to the subroutine or function. In the case of multiple-entry routines the name of the program coincides with that of the first entry card in the deck, and is called the "principal entry". The total count of principal and secondary entries is 395.

The program statistics tabulation which follows provides an alphabetical listing of all entries, with their secondary entries, transfer vectors, storage requirements, acceptance dates of symbolic deck, symbolic deck card counts, binary card counts, authors, and language. The symbol "M" is used for machine language (i.e. FAP), and "F" for FORTRAN. Authors are coded by initials as follows.

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<tr>
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<td>Jon F. Claerbout</td>
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<td>James N. Galbraith, Jr.</td>
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<td>J. T. Olsztyn</td>
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<tr>
<td>JTP</td>
<td>Joseph T. Procito, Jr.</td>
</tr>
<tr>
<td>MIT</td>
<td>MIT Lincoln Lab or Computation Center Staff</td>
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<tr>
<td>RAW</td>
<td>Ralph A. Wiggins</td>
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<td>RJQ</td>
<td>Roy J. Greenfield</td>
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<td>Stephen M. Simpson, Jr.</td>
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ADANX  XDANL  SIN

ADANX  XDANX

ADANX  (SEE ADANL)

ADDK  114  9/29/64  366  8  SMS  M

ADDK  SUBK  MULK  DIVK  XADDK  XSU*K  XMULK  XDIVK  XDVRK  ADDKS  SUBKS  MULKS  DIVKS  XADDKS  XSSUBKS  XMULKS  XDIVKS  XDVRKS

ADDKS  (SEE ADDK)

AMPHZ  149  10/1/64  251  10  JFC  M

REIM  ATAN  SQRT  RND  COS  SIN

ARBCOL  129  9/9/64  271  8  SMS  M

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Notes: SMS = Source Module, J = Jumps, F = Flags, M = Mainline.
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4. Conventions Used in Program Writeups

The general format of preparation of symbolic decks we have adhered to is illustrated by the sample listings shown on the next few pages for the two very short routines CONVLV and RND (File 28 of Tape 1 and File 79 of Tape 2). In all cases the general sequence is 1) Control Cards, 2) Subroutine or Entry cards, 3) Comment cards giving Abstract (including language, equipment, length, speed, and author), 4) Comment cards giving Usage (including FORTRAN usage, transfer vector, input-output descriptions, and examples), and 5) Program proper. All cards are serialized after the first one, in columns 76-79. The following observations should assist the interpretation of our comment cards.

1. All programs are designed to operate under the FORTRAN-II system.

2. In general we adhere to FORTRAN conventions in naming fixed, floating point, octal, and hollerith variables regardless of whether the program is FAP or FORTRAN. This convention should always be assumed for subroutine arguments unless otherwise noted.

3. The term "FORTRAN INTEGER" or FORTRAN-II INTEGER" or sometimes just "INTEGER" is used to refer to a fixed point integer in the decrement (binary point between bits 17 and 18,
• CONVLV (SUBROUTINE)

4/29/64    LAST CARD IN DECK IS NO. 0098

CONVLV

SUBROUTINE CONVLV(LX,XX,LY,YY,CC)

---ABSTRACT---

C TITLE - CONVLV

COMPLETE CONVOLUTION OF TWO TRANSIENTS

CONVLV CONVOLVES TWO TRANSIENTS, X(I) I=0,1,...,LX-1
AND Y(I) I=0,1,...,LY-1, TO PRODUCE THE COMPLETE
CONVOLUTION FUNCTION

FOR I = 0,1,...,LX+LY-2
WHERE
LX AND LY ARE INPUT PARAMETERS
Y(K) IS ASSUMED = 0.0 FOR K OUTSIDE OF
THE RANGE 0 TO LY-1
NOTC THAT THE CONVOLUTION IS INDEPENDENT OF THE ORDER
OF THE INPUTS X AND Y.

TECHNIQUE USED IS AN ALGORITHM BASED ON ANALOGY TO
MULTIPLICATION OF POLYNOMIALS

C LANGUAGE - FORTRAN II SUBROUTINE
C EQUIPMENT - 709 OR 7090 (MAIN FRAME ONLY)
C STORAGE - 96 REGISTERS
C SPEED - ABOUT .49 * (LX*LY) MILLISEC ON THE 709
C         ABOUT .082 * (LX*LY) MILLISEC ON THE 7090
C AUTHOR - J. CLAERBOUT

-----USAGE-----

C TRANSFER VECTOR CONTAINS ROUTINES - (NJNE)
AND FORTRAN SYSTEM ROUTINES - (NONE)
C FORTRAN USAGE
CALL CONVLV(LX,XX,LY,YY,CC)

INPUTS

LX IS NO. OF TERMS IN X VECTOR
MUST EXCEED ZERO (PROGRAM EXITS IF ZERO OR LESS)

XX(I) I=1,...,LX CONTAINS X(0),...,X(LX-1) RESPECTIVELY
Sample program listings

C  LY IS NO. OF TERMS IN Y VECTOR
C  MUST EXCEED ZERO (PROGRAM EXITS IF ZERO OR LESS)  0051
C  YY(I) = I=1..LY CONTAINS Y(0),...,Y(LY-1) RESPECTIVELY
C  EQUIVALENCE (XX,YY IS PERMITTED)  0054
C  OUTPUTS  0055
C  CC(I) I=1,...,LY-LY-1 CONTAINS C(0),...,C(LY-LY-2) RESPECTIVELY
C  WHERE C(I) IS GIVEN IN ABSTRACT  0059
C  EXAMPLES  0060
C  1. SHOWING REVERSIBILITY OF X AND Y
C  INPUTS  LX = 3 XX(1...3) = 1,2,3.
C  LY = 2 YY(1...2) = 10.,L.  0065
C  USAGE  0066
C  CALL CONVOLV(LX,XX,LY,YY,CC1)
C  CALL CONVOLV(LY,YY,LY,XX,CC2)  0068
C  OUTPUTS  CC1(1...4) = CC2(1...4) = 10.,21..32.,3.  0069
C  2. ILLEGAL INPUT CASES (NO OUTPUT)
C  INPUTS  SAME AS EXAMPLE 1. EXCEPT START WITH OUTPUT VECTORS
C  CLEANED, I.E. CC1(1...4) = CC2(1...4) = 0.,0.,0.,0.  0074
C  USAGE  0075
C  CALL CONVOLV(-2,XX,LY,YY,CC1)
C  CALL CONVOLV(LX,XX,0,YY,CC2)  0076
C  OUTPUTS  CC1(1...4) = 0.,0.,0.,0. (ILLEGAL LX)
C  CC2(1...4) = 0.,0.,0.,0. (ILLEGAL LY)  0077
C  PROGRAM FOLLOWS BELOW  0078
C  C  DU'MMY DIMENSION STATEMENTS
C  DIMENSION XX(2),YY(2),CC(2)  0082
C  CHECK LEGALITIES
C  IF (LX) 9999,9999,10
C  10 IF (LY) 9999,9999,20  0084
C  CLEAR OUTPUT VECTOR
C  20 LC=LX+LY-1
C  30 CC(I)=0.0  0087
C  CONVOLVE
C  DO 40 I=1,LX
C  DO 40 J=1,LY
C  K=I+J
C  40 CC(K-1)=CC(K-1)+XX(I)*YY(J)  0089
C  EXIT
C  RETURN  0090
C  END

43
Sample program listings

* RND (FUNCTION)  9/29/64  LAST CARD IN DECK IS NO. 0078
* RNC
  COUNT  60
  LBL RND
  ENTRY RND  F(Y)
  ENTRY RNDUP  F(Y)
  ENTRY RNDDN  F(Y)

  ----ABSTRACT----

  * TITLE - RND, WITH SECONDARY ENTRY POINTS RNDUP, RNDDN
  * ROUNDS FLT. PT. NO. UP, DOWN, OR TO NEAREST FLT. PT. INTEGER
  * RND ROUNDS A FLOATING POINT NUMBER TO THE NEAREST FLOATING
    POINT INTEGER.
  * RNDUP ROUNDS A POSITIVE (NEGATIVE) FLOATING POINT NUMBER
    TO THE NEXT HIGHER (LOWER) FLOATING POINT INTEGER.
  * RNDDN ROUNDS A POSITIVE (NEGATIVE) FLOATING POINT NUMBER
    TO THE NEXT LOWER (HIGHER) FLOATING POINT INTEGER.

  * LANGUAGE - FAP, FORTRAN II FUNCTION
  * EQUIPMENT - 709 OR 7090 (MAIN FRAME ONLY)
  * STORAGE - 15 REGISTERS
  * SPEED - 26 MACHINE CYCLES FOR RND
  * AUTHOR - R.A. WIGGINS, 15/9/62

  ----USAGE----

  * TRANSFER VECTOR CONTAINS ROUTINES - NONE
  * AND FORTRAN SYSTEM ROUTINES - NONE

  * FORTRAN USAGE
    X1 = RNDF(Y)
    X2 = RNDUPF(Y)
    X3 = RNDDNF(Y)

  * INPUTS
    Y      IS A FLOATING POINT NUMBER
    MUST BE LESS THAN 10.000

  * OUTPUTS
    X1      IS A FLOATING POINT INTEGER
    X2      IS A FLOATING POINT INTEGER
    X3      IS A FLOATING POINT INTEGER

  0001
  0002
  0003
  0004
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  0049
  0050

44
Sample program listings

- EXAMPLES

1. INPUT - Y=104.2
   CUTPUTS - X1=104.  X2=105.  X3=104.

2. INPUT - Y=.5
   CUTPUTS - X1=1.  X2=.1.  X3=0.

3. INPUT - Y=-49.7

4. INPUT - Y=1015.
   CUTPUTS - X1=1015.  X2=1015.  X3=1015.

   BCI 1.RND
   RNCUP YMI A
   FAD =0177777777777
   FAD =.5
   RNCDA UFA =0233000000000
   FAD =0233000000000
   TRA 1.4
   A FSA =0177777777777
   FSB =.5
   TRA RNDNM
   RND YMI A+1
   TRA RNDUP+2
   END
4. The term "MACHINE LANGUAGE INTEGER" or "MACHINE INTEGER", or sometimes "MLI" is used to refer to fixed point integers in the address (binary point beyond bit 35, maximum magnitude = \(2^{35} - 1\)).

5. The terms "LSTHN" and "LSTHN-" are equivalent to "<" and "<". The terms "ORTHN" and "ORTHN-" are equivalent to ">" and ">".

6. The names of all our subprogram-type routines (subroutines, functions) are always the same as their entry point (in the case of multiple entry point routines the first entry point listed is equated with the name). A serial number "-II" or "-III" following the name indicates that this program is one of a series, all of which have identical calling sequences and essentially the same functions, but the user must choose the appropriate one in terms of his requirements. A "(709)" following the name indicates that this routine can only be used on the 709. A "(7090)" indicates the program works on either the 7090 or the 7094. All the routines without such specification can be used on any of the three machines.

7. Expressions appearing under "ABSTRACT" may deviate from FORTRAN conventions. The emphasis here has been to produce expressions which are visually
close to those of ordinary mathematics.

3. In the listings of required routines as found in the transfer vectors we list separately the FORTRAN system routines (which can be ignored) and non-FORTRAN-system routines (which cannot be ignored). All of the non-FORTRAN system routines required are included somewhere in the program set. In this connection the word "NONE" or "(NONE)" means "none required" and does not refer to routines by those names.

9. It should be stressed that the transfer vector as listed is only the first level of subprogram requirements and the subprograms listed should be checked for further subprogram requirements. The table in Section 3 is probably the most rapid and accurate for determining the complete requirements.

10. In the usage of these programs it should be assumed that none of the subprogram arguments can be safely equated (either by equivalence statements or repeated use of the same name) except as specifically noted.

11. The numerical examples given involve some notation conventions which should be fairly obvious. Thus

A) "IX(1...5) = 2,4,6,8,10" or
"IX(1,2,...,5) = 2,4,6,8,10" stands for "IX(1) = 2", "IX(2) = 4," etc.
B) "OCT" stands for octal data
C) "MLI" is machine language integer

The representation of hollerith data is not too satisfactory or consistent as given here. In most cases we use either

\[ X(1...) = 6H(\text{something}) \]
\[ = 6H\text{something} \]

to imply that the "something" is a string of hollerith characters stored 6 to a register (i.e. FORMAT(A6)). However, in some cases the "something" may be split into groups of six characters separated by commas to conform to a representation such as A) above. The reader will have to use his judgment from the context.

12. In the examples, if no "USAGE" is given, the user is to assume that, following the setting up of the "INPUTS", a "CALL" statement is to be executed in the exact literal form as given under "FORTRAN USAGE".

13. In the case of programs with scope output, blank comment cards are inserted at appropriate places in the example outputs so that photographs of the actual outputs can be pasted there on the listings.

14. Instructions equivalent to the linkage director have been inserted in many of the FAP programs so that they may operate properly with systems which do not have the standard error procedure. The pro-
grams will, of course, operate with systems which do have the standard error procedure option operative but the error tracing scheme will not be able to function completely since index register four will be stored in the "artificial linkage" director rather than in the one constructed by the assembler. In many cases the error procedure may be made completely operative by removing the PZE 0 and BCI 1, NAME cards appearing at the beginning of the program.
5. Magnetic Tape Copies

The following steps have been taken in the production of the master tape from which copies will be made.

1. All programs to be included had special test programs written which tested, among other things, all examples given in the program comment cards. These tests were passed individually.

2. The symbolic decks were divided into groups, each group being loaded on a separate tape.

3. Each such tape was then serialized and dated by a special program and then the serialized tapes were compiled to produce sets of binary decks.

4. The binary decks thus compiled were rerun through the test programs, and the test results compared with earlier test results.

5. The serialized tapes were merged by program to form the master tape.

6. The master tape was then compiled and the binaries from this compilations compared by the 519 reproducing punch against the binary decks used in step 4.

VELA UNIFORM associates desiring a copy of these programs should write their request to
The letter should request

"MIT Geophysics Program Set II".

By separate mail the requester should also send two 2400' blank tapes.
6. KWIC Index to Programs

The remaining pages are a KWIC (Key Work in Context) index of the 267 programs in the program set (produced by the routine ROKWIC). Our coding in this index is as follows:

Column  | 65  | F means FORTRAN program  
         |     | M means FAP program       
         | 66  | Blank means FORTRAN-type subroutine or functions  
         |     | * means main program       
         | 67-80 | give the program name     

KWIC Index

Squares Predictor by Recursion: 1-Dimensional $\text{Realizable Least}$ F RLSPR
$\text{Displaced Dot Product of 2-Dimensional Arrays}$ F DOTP
Entro-Symmetric or Antisymmetric 2-Dimensional Array $\text{Rotate Center}$ C ROAR2
Spatial Crosscorrelation of 2-Dimensional Spatial Arrays F SPCOR2
Squares Predictor by Recursion: 2-Dimensions $\text{Realizable Least}$ F RLSPR2
High Speed 24 Point Spectrum F FT24 -II
High Speed 24 Point Spectrum M ABSVAL
Moving Trapezoidal Integral or Absolute Value Integral M MVTIN
Magnitude of Vector Over Abutting Blocks of Constant Length M BLKSUM
Million Random Digits from Tape $\text{Access Routine for Rand Corp.}$ F GETRD1
Format $\text{Access to Literal or Ordinary}$ M FNDFMT
Time of Next Subroutine to Given Accuracy $\text{Find Operation}$ M 709TIMA2B
Real Time: To Specified Accuracy, of Given Program Run M 709TIMAB
Correlations for Long, Limited Accuracy Series $\text{Fast Au}$ F QACORR
Convolutions for Long, Limited Accuracy Series $\text{Fast}$ F GCNVLV
Correlations for Long, Limited Accuracy Series $\text{Fast Cross}$ F QXCORR
$\text{Initialized for Adding to an Indata-Odata Tape}$ F SETINO
Create Vector of Machine Addresses of Variables in a List M XLOCV
Shollerith Left Adjust or Right Adjust Function M HLADJ
Shollerith Left Adjust or Right Adjust Function M HLADJ
Advance Film Frame on Scope M 709FRAME
$\text{Advance Film Frame on Scope}$ M 709FRAME
Towards or Downwards an Arbitrary Amount $\text{Rotate a Vector}$ M ROTAT1
And Imaginary, or Reverse $\text{Amplitude and Phase from Real}$ M AMPHZ
Symmetrical Filter with Given Amplitude Response $\text{Genera}$ F GNFLT1
Ray $\text{Rotate Center-Symmetric or Antisymmetric 2-Dimensional}$ A F ARCTAN
$\text{Core Location with Indexable Argument}$ M LOC
Locate Argument with Respect to Common M IXCARG
Return N-TH Argument Beyond the M NTHA
Find If Argument Falls Inside Two Limits M XLIMIT
With Real Coefficients for Real Arguments $\text{Evaluate a Polynomial}$ F POLYEV
Evaluate Cubic for Evenly Spaced Arguments $\text{Fast}$ M FASCUB
-0 Is Less Than +0 $\text{Compare Arbitrarily Two Words Where}$ M CMPLA
Shift Vector Elements Arbitrarily Left or Right M SHFTR1
C or Antisymmetric 2-Dimensional Array $\text{Rotate Center-Symmetric}$ F ROAR2
Cosine Dot Product of 2-Dimensional Arrays $\text{Displa}$ F DOTP
Correlation of 2-Dimensional Spatial Arrays $\text{Spatial Crosscorr}$ F SPCOR2
Daniell Spectra $\text{Modify Auto- or Cross-Correlations For}$ M ADANL
Spectrum by Cosine Transform of Autocorrelation $\text{Auto}$ M ASPEC2
$\text{Wiener Autocorrelation}$ F WAC
Cosine Transforms of One-Sided Autocorrelations $\text{Fast}$ M ASPECT
$\text{Iterated Accuracy Series}$ F QACORR
$\text{Auto}$ $\text{Spectrum by Cosine Transform}$ M ASPEC2
List Auxiliary Information for an if F LISTING
Find Average of Floating Vector $\text{Average}$ M AVG
From Given Base or from True Average $\text{Sr. M.S. Deviat}$ M RMSDEV
$\text{Moving Average of a Vector}$ F MVNAV
$\text{Moving Mean Square Average of a Vector}$ F MVSQAV
$\text{FIND AVERAGE OF FIXED PT VECTOR } M \quad \text{XAVRGE}$

$\text{TEND}$

$\text{TRIANGULAR AVERAGING, MOVING LEFT OR RIGHT } M \quad \text{TAMVL}$

$\text{GES}$

$\text{DIVIDE THE X AXIS INTO EQUALLY PROBABLE RANGE } M \quad \text{GRUP2}$

$\text{INE GRAPH}$

$\text{SBR GRAPH PLOTTING FOR SUBROUT M } M \quad \text{HSPLT-1I}$

$\text{OR SUM POWER OF DEVIATIONS FROM BASE } \text{RAISE VECTOR TO POWER } M \quad \text{POWER}$

$\text{SR,VS,} \text{S OPTIONAL ONLINE MONITOR OF BCD TAPE WRITING } \text{ONLINE}$

$\text{SSKID}$

$\text{FORWARD OR AVERAGE OF FIXED PT VECTOR } M \quad \text{FSKIP}$

$\text{SKIP FORWARD OR BACKWARD OVER FILES ON TAPE } M \quad \text{FSKIP}$

$\text{READ EVERY N-TH WORD FROM BINARY TAPE } N \quad \text{PADAT}$

$\text{CHANGE ALL SIGN BITS OF A VECTOR } M \quad \text{CHSIGN}$

$\text{MOVE DATA BLOCK } M \quad \text{MVBLK}$

$\text{N LEVELS SCAN VECTOR FOR POSSIBLE BLOCK OF VALUES ALL ABOVE GIVE SHORTEN}$

$\text{UMMATION OF VECTOR OVER ABUTTING BLOCKS OF CONSTANT LENGTH } S \quad \text{BLKSUM}$

$\text{AND OPERATE SUBROUTINES BY PROXY CALL STATEMENTS } S \quad \text{LOCATE}$

$\text{MOVE REVERSE, CHANGE SPACING, OR CHANGE SIGN OF A VECTOR } S \quad \text{MOVREV}$

$\text{OF A VECTOR } S \quad \text{MOVREV}$

$\text{GENERATE HOLLERITH CHARACTERS } M \quad \text{GNH0L2}$

$\text{HAVING ON-LINE REQUEST IF NOT CHECK IF INTERVAL TIMER IS ON } M \quad \text{CLKON}$

$\text{FALL WITHIN GIVEN LIMITS } \text{CHECK THAT VARIABLES FROM LIST M LIMITS}$

$\text{FASING OR DECREASING BEHAVIOR } \text{CHECK VECTOR FOR MOMOTONE INCR M MONOCK}$

$\text{ILLITY CASE } \text{COMPUTE CHI-SQUARE FOR CONSTANT PROBAB M CHISOR}$

$\text{VALUE $P$PROBABILITY THAT A CHI-SQUARED VARIATE EXCEEDS A } M \quad \text{K1INT1}$

$\text{Y A THIRD ONE BEING ZERO } \text{CHOOSE BETWEEN TWO VARIABLES B M WHICH}$

$\text{F Vector TO Integers FOR SCOPE, CLIPPING EXCESSIVE VALUES $SCA } M \quad \text{SCP0SL}$

$\text{G IN SECONDS USING 7090 INTERVAL CLOCK } \text{FOR REAL TIME TIMIN M 7090CLOCK1}$

$\text{EVALUATE A POLYNOMIAL WITH REAL COEFFICIENTS FOR REAL ARGUMENT F POLYEV}$

$\text{BOUT ITS MIDPOINT } \text{SCOLLAPSE ODD-LENGTHED VECTOR A M KOLAPS}$

$\text{SWALLER RANGE } \text{SCOLLAPSE ONE-SIDED VECTOR INTO M COLAPS}$

$\text{FERAL FORMATS } \text{OUTPUT COLUMN VECTORS BY NORMAL OR LI M CVSOUT}$

$\text{INTERPOLATION } \text{FIND A MATRIX COLUMN WITH ARBITRARY INDEX BY M ARBCOL}$

$\text{T INTERGERS } \text{LABEL PRINTER COLUMNS WITH INCREASING 3-DIGIT F COLABL}$

$\text{LOCATE ARGUMENT WITH RESPECT TO COMMON } \text{LOCATE FROM MEMORY USAGE - PROGRAM AND COMMON M MEMUSE}$

$\text{FIND LENGTH OF COMMON STORAGE } M \quad \text{XLCOMN}$

$\text{DS WHERE $-9$ IS LESS THAN $+9$ } \text{COMPARE ARITHMETICALLY TWO WORDS M CMPRA}$

$\text{A SET OF VARIABLES FOR EQUALITY } \text{COMPARE PAIRS OF VARIABLES OR M CMAPP}$

$\text{TORS FOR IDENTITY } \text{COMPARE TWO ARBITRARY MODE VECTORS M CMARRV}$

$\text{LYNOMIAL SYNTHESIS FROM REAL AND COMPLEX ROOTS } S \quad \text{POLYSYN}$

$\text{AL SYNTHESIZED FROM ITS REAL AND COMPLEX ROOTS $POLYNOMI M \quad \text{POLYSYN}$}

$\text{TEST THE CONDITION OF ANY SENSE SWITCH M SWITCH}$

$\text{DIVIDE A FLOATING VECTOR BY A CONSTANT M DIVIDE}$

$\text{VARIABLES BY A SINGLE FLTG. PT, CONSTANT } \text{MULTIPLY ANY NO. OF F M MULK-1I}$

$\text{F VECTOR OVER ABUTTING BLOCKS OF CONSTANT LENGTH $SUMMATION ON M BLKSUM}$
MODIFY A SET OF VARIABLES BY A CONSTANT OR BY CONSTANTS

$COMPUTE CHI-SQUARE FOR CONSTANT PROBABILITY CASE

OR FLTG VECTOR $ADD A CONSTANT TO ELEMENTS OF A FXD

$DIVIDE A FXD VECTOR BY A CONSTANT

OF TWO VECTORS WITH DIVISION BY CONSTANT $DOT PRODUCT

ING SUMMATION WITH DIVISION BY A CONSTANT $MOV

IPLY VECTOR BY FLOATING OR FIXED CONSTANT $MUL

XED OR FLOATING VECTOR THROUGH A CONSTANT $REFLECT A FI

OF VECTOR FROM ANOTHER OR FROM A CONSTANT $SUM DIFFERENCE

LL ELEMENTS OF VECTOR EQUAL TO A CONSTANT (ANY MODE) $SET A M

TG VECTOR FROM ANOTHER OR FROM A CONSTANT $SUM SQUARE DIFF. OF FL

D. VECTOR FROM ANOTHER OR FROM A CONSTANT $SUM SQUARE DIFF. OR FX

OF VARIABLES BY A CONSTANT OR BY CONSTANTS $MODIFY A SET

M PROBABILITY DENSITIES $SUM SQUARE CONTINGENCY AND DEPENDENCY FROM F

R IN DECIBELS $CONTOUR A MATRIX ON THE PRINT F

ROW OF DATA $FIND CONTOUR LEVELS FOR PLOTTING A F

F-LINE PRINTER $CONTOUR OF MATRIX SUBSET ON OF F

E INTEGERS OR CONVERSELY $SCALE; CONVERT FLTG. VECTOR TO MACHIN

TO MLI VECTOR $FAST CONVERT FORTRAN INTEGER VECTOR M

ER TO EQUIVALENT HOLLERITH $CONVERT MACHINE LANGUAGE INTG

M TO COMPLETE CONVOLUTION OF TWO VECTORS M

COMPLETE CONVOLUTION OF TWO TRANSIENTS $CONV

ACURACY SERIES $FAST CONVOLUTIONS FOR LONG, LIMITED F

HER - VERSION 2 $FAST COPY FILE FROM ONE TAPE TO ANOTHER M

RGUMENT $SCORE LOCATION WITH INDEXABLE A M

COSINE + SINE TRANSFORMS OF CROSS-CORRELATION FUNCTIONS $FAST F

RA $MODIFY AUTO- OR CROSS-CORR. LATIONS FOR DANIELL SPECT M

ACCURACY SERIES $FAST CROSS-CORRELATIONS FOR LONG, LIMITED F

F FIXED POINT INTEGERS $FAST CORRELATIONS FOR LONG SERIES OF M

FROM 2 OR A EVEN-ODD PARTS $FAST COSINE AND/or SINE TRANSFORMS M

OF ODD-LENGTH SERIES $FAST COSINE AND/or SINE TRANSFORMS F

S, FIXED OR FLOATING $GENERATE COSINE OR SINE HALF-WAVE TABLE M

ATION $AUTOSPECTRUM BY COSINE TRANSFORM OF AUTOCORREL M

AUTOCORRELATIONS $FAST COSINE TRANSFORMS OF ONE-SIDED M

SS-CORRELATION FUNCTIONS $FAST COSINE SINE TRANSFORMS OF CRO F

CTIONS FOR SEQUENTIAL SINES AND COSINES $FAST FU M

SERIES IN GIVEN RANGE $FREQUENCY COUNT OF NUMBER OF VALUES OF A M

WITH NEW RANGE AND INCREMENT $SCREATE ONE VECTOR FROM ANOTHER M

SSFS OF VARIABLES IN A LIST $SCREATE VECTOR OF MACHINE ADDR M

$FAST COSINE SINE TRANSFORMS OF CROSS-CORRELATION FUNCTIONS F

SPSPECTRA $MODIFY AUTO- OR CROSS-CORRELATIONS FOR DANIELL M

ITED ACCURACY SERIES $FAST CROSS-CORRELATIONS FOR LONG, L F

VECTORS OF MATRICES $SCROSSCORRELATION OF TRANSIENT F

BEGINNING WITH ANY LAG $SCROSSCORRELATION OF TRANSIENTS F

BEGINNING WITH ZERO LAG $SCROSSCORRELATION OF TRANSIENTS F

V AL SPATIAL ARRAYS $SPATIAL CROSSCORRELATION OF 2-DIMENSIONAL F

ENTS $QUICK CROSSCORRELATION OF MLI TRANS F

SUBROUTINE GRAPH $SCUBIC CURVE SCOPE PLOTTING FOR M

SUBROUTINE GRAPH $SCUBIC CURVE SCOPE PLOTTING FOR M

NTS $FAST EVALUATE CUBIC FOR EVENLY SPACED ARGUMEN M

55
OF SIMULTANEOUS EQUATIONS AND
OF A FREQUENCY FIXED VECTOR
POINT DISTRIBUTION FROM TRUE AVERAGE
OF DATA ON TAPE
READ DATA IN GENERALIZED FORMAT
OR 
WRITE BINARY DATA ON TAPE
CALE AND FIX DATA VECTOR, PACK N DATA POINTS PER REGISTER $S$
S PER REGISTER $SCALE$ AND FIX DATA VECTOR, PACK N DATA POINT M
FUTURE A MATRIX ON THE PRINTER IN DECIBELS $CO$
AND REPOSITION TAPE TO FRONT OF DECK $SLIST$ DATA DECK $F$
OF DECK $SLIST$ DATA DECK AND REPOSITION TAPE TO FR $F$
ECTOR FOR MOMOTONE INCREASING OR DECREASING BEHAVIOR $CHECK$ V M
OF FUNCTION OR ITS MAGNITUDE $DEFINITE$ TRAPEZOIDAL INTEGRAL M
OFS: FLOATING AND FIXED POINT $DELTA$ FUNCTION AND STEP FUNCTION M
AND DEPENDENCY FROM PROBABILITY DENSITY MEAN SQUARE CONTINGENCY F
IVEN LAG $SECOND$ PROBABILITY DENSITY OF INTEGER SERIES AT G F
NSITY MEAN SQUARE CONTINGENCY AND DEPENDENCY FROM PROBABILITY D E
FRENCING $DERIVATIVE$ OF A VECTOR OF DIFF M
ON OF SIMULTANEOUS EQUATIONS AND DETERMINANT EVALUATION $SOLUTION$ M
ROM TRUE AVERAGE $RMS$ DEVIATION FROM GIVEN BASE OR F
VECTOR TO POWER OR SUM POWER OF DEVIATIONS FROM BASE $RAISE$ M
CTOR ELEMENTS IN PAIRS $DIFFERENCE$ FIXED OR FLOATING V M
IF SAME INCLUDING SIGN $SIGN$ OF DIFFERENCE OF 2 VARIABLES OR O M
HER OR FROM A CONSTANT $SUM$ DIFFERENCE OF VECTOR FROM ANOT M
ER OR FROM A CONSTANT $SUM$ SQUARE DIFF, OF FLTG VECTOR FROM ANOTH M
ER OR FROM A CONSTANT $SUM$ SQUARE DIFF, OR FXD, VECTOR FROM ANOTH M
$DERIVATIVE$ OF A VECTOR OF DIFFERING M
$INVERSION$ OF DIFFERENTIATION BY DIFFERING M
G $INVERSION$ OF DIFFERENTIATION BY DIFFERENCIN M
INTER COLUMNS WITH INCREASING 3-DIGIT INTEGERS $LABEL$ P F
NE FOR RAND CORP. MILLION RANDOM DIGITS FROM TAPE $ACCESS$ ROUTI F
QUAD PREDICTOR BY RECURSION: 1-DIMENSION $REALIZABLE$ LEAST S F
$DISPLACED$ DOT PRODUCT OF 2-DIMENSIONAL ARRAYS F
QUAD PREDICTOR BY RECURSION: 2-DIMENSIONAL $REALIZABLE$ LEAST S F
T GENERATOR FOR SCOPE SUBROUTINE $DISPLAY$ $VARIABLE$ ORIGIN FORMA M
ENSIONAL ARRAYS $DISPLACED$ DOT PRODUCT OF 2-DIM F
VECTOR $FREQUENCY$ DISTRIBUTION OF A FIXED POINT F
EQUALLY LIKELY SECTIONS $NORMAL$ DISTRIBUTION AND DIVISION INTO M
REGION TO MAXIMIZE RATIO OF TWO DISTRIBUTION FUNCTIONS, F
CONS $GENERATE$ PROBABILITY DISTRIBUTION WITH SPECIFIED MO F
CON $DIVIDE$ A FLOATING VECTOR BY A M"
$DIVIDE THE X AXIS INTO EQUALLY F
ANT
$DIVIDE A FIXED VECTOR BY A CONSTANT M
BY THOSE OF ANOTHER $DIVIDE ELEMENTS OF ONE VECTOR M
ECTORS WITH OR WITHOUT Rounding $DIVIDE ELEMENTS OF TWO FIXED Vectors M
TING TO FORTAN-II INTERES$FIXED-VECTOR DIVIDE WITH TRUNCATION OR ROUND M
MOVING SUMMATION WITH DIVISION BY A CONSTANT M
PRODUCT OF TWO VECTORS WITH DIVISION BY CONSTANT M
PTIONS $NORMAL DISTRIBUTION AND DIVISION INTO EQUALLY LIKELY SECTIONS M
$PERFORM LONG DIVISION OF TWO POLYNOMIALS F
UTES $DISPLACED DOT PRODUCT OF 2-DIMENSIONAL A F
AST $FAST DOT PRODUCT OF TWO VECTORS M
ICES $DOT PRODUCT OR REVERSED DOT PRODUCT OF VECTORS OF MATRICES M
ICES $DOT PRODUCT OR REVERSED DOT PRODUCT OF VECTORS OF MATRICES M
DUCT OF VECTORS OF MATRICES $DOT PRODUCT OR REVERSED DOT PRODUCTS M
MENTS $VECTOR DOT PRODUCT WITH ARBITRARY INC M
ITION BY CONSTANT $DOT PRODUCT OF TWO VECTORS WITH M
R (FIXED OR FLOATING) $FAST DOUBLING OR HALVING OF A VECTOR M
IVEN VALUES $FAST SCAN VECTOR FOR ELEMENT EQUAL OR GREATER THAN M
ETREME VALUES OF MATRIX ELEMENTS M
ERENCE FIXED OR FLOATING VECTOR ELEMENTS IN PAIRS $DIFF M
OR $ADD A CONSTANT TO ELEMENTS OF A FIXED OR FLOATING VECTOR M
IGHT $SHIFT VECTOR ELEMENTS ARITHMETICALLY LEFT OR RIGHT M
INDEX (BY INCREASING SIZE) OF ELEMENTS IN A VECTOR $FAST MAX M
HT $SHIFT VECTOR ELEMENTS LOGICALLY LEFT OR RIGHT M
OR $SUM THE SQUARES OF ELEMENTS OF A FLOATING OR FIXED VECTOR M
TEGER VECTOR $FAST SQUARE ELEMENTS OF A MACHINE LANGUAGE M
ECTION $SUM ELEMENTS OF FLOATING OR FIXED M
T ELEMENTS OF A FIXED OR FLOATING VECTOR M
OF ANOTHER $DIVIDE ELEMENTS OF ONE VECTOR BY THOSE M
WITH OR WITHOUT Rounding $DIVIDE ELEMENTS OF TWO FIXED VECTORS M
OR FLOATING $MULTIPLY ELEMENTS OF TWO VECTORS FIXED M
NTANT (ANY MODE) $SET ALL ELEMENTS OF VECTOR EQUAL TO A M
ALLING SEQUENCES $ENABLE FORTRAN VARIABLE LENGTH M
TRAN $ENABLE MIXED EXPRESSIONS IN FIXED M
VING LEFT OR RIGHT END $TRIANGULAR M
REREAD DATA RECORD AND END FILE MONITOR M
$TEST IF NEXT TAPE RECORD IS END OF FILE AND REPOSITION TAPE M
UE $FAST SCAN VECTOR FOR ELEMENT EQUAL OR GREATER THAN GIVEN VA M
INTRODUCER PLOT OF A SET OF EQUAL LENGTH VECTORS F
$SET ALL ELEMENTS OF VECTOR EQUAL TO A CONSTANT (ANY MODE) M
$SET FIXED OR FLOATING VECTOR EQUAL TO A LINEAR SEGMENT M
R FLOATING $SET ANY NO. OF VARIABLES EQUAL TO A SINGLE VALUE (FIXED OR M
R FLOATING $SET ANY NO. OF VARIABLES EQUAL TO A SINGLE VALUE (FLOATING M
R FLOATING $SET ANY NO. OF VARIABLES EQUAL TO SEPARATE VALUES (FIXED M
ABLES OR A SET OF VARIABLES FOR EQUALITY $COMPARE PAIRS OF VARI M
IDE THE X AXIS INTO EQUALLY PROBABLE RANGES F
IND CURVING WHICH EXACTLY FITS & G JALY SPACED POINTS M
LS DISTRIBUTION AND DIVISION INTO EQUALLY LIKELY SECTIONS $NORMAL M
QUADRATIC WHICH EXACTLY FITS & EQUALLY SPACED POINTS $FIN M

57
UATION $SOLUTION OF SIMULTANEOUS EQUATIONS AND DETERMINANT EVAL M
VERT MACHINE LANGUAGE INTEGER TO EQUIVALENT HOLLERITH $CON M
$WIENER-LEVINSON LEAST SQUARE ERROR FILTER OR PREDICTOR F
ED ARGUMENTS $FAST EVALUATE CUBIC FOR EVENLY SPAC M
L COEFFICIENTS FOR REAL ARGUMENT $EVALUATE A POLYNOMIAL WITH REAL F
$COMPLEX POLYNOMIAL EVALUATION F
ANEOUS EQUATIONS AND DETERMINANT EVALUATION $SOLUTION OF SIMULT M
IN GROUPS OF FIVE AS POKER HAND $EVALUATION OF INTEGER SEQUENCE F
1) $SPLIT A VECTOR INTO ITS EVEN AND ODD PARTS (OR INVERSE M
Y A VECTOR BY SIFTING ANOTHER AT EVEN INCREMENTS M
ME WHETHER FORTRAN-II INTEGER IS EVEN OR ODD $DETERM M
D/ORSINE TRANSFORMS FROM 2 OR 4 EVEN-ODD PARTS $FAST COSINE AN M
$FAST EVALUATE CUBIC FOR EVENLY SPACED ARGUMENTS M
INTERPOLATION OPERATOR FOR 1 TO 4 EVENLY SPACED DATA VALUES M
TO INTEGERS FOR SCOPE, CLIPPING EXCESSIVE VALUES $SCALE VECTOR M
$EXCHANGE ANY TWO VECTORS M
$SUBROUTINE GRAPH EXPANDED OVER VERTICAL FRAMES F
RIC INTERPOLATION $SH-SPED EXPANSION OF A VECTOR UNDER CURVE M
$ENABLE MIXED EXPRESSIONS IN FORTRAN M
SPLIT SIGNED OR UNSIGNED EXTREMAL VALUES OF A VECTOR M
ENTS $EXTREMAL VALUES OF MATRIX ELEM M
FINITE MATRIX $FACTOR A SYMMETRIC POSITIVE DE F
MINIMUM PHASE WAVELET $FACTOR POWER SPECTRUM TO FIND M
N OF DATA FROM A SPECIAL TAPE $FAST ABSOLUTE VALUE OF A VECTOR M
EMENT ON SCOPE $FAST ARBITRARY STRAIGHT LINE S $7090LINE
EMENT ON SCOPE $FAST ARBITRARY STRAIGHT LINE S $7090LINE
VECTOR FOR IDENTITY $FAST COMPMARE TWO ARBITRARY MOD M
CTOR TO ML1 VECTOR $FAST CONVERT FORTRAN INTEGER V M
O ANOTHER - VERSION 2 $FAST COPY FILE FROM ONE TAPE TO M
N OF EVEN-ODD PARTS $FAST COSINE AND/ORE SINE TRANSF M
N OF ODD-LENGTH SERIES $FAST COSINE AND/ORE SINE TRANSF M
IFIED AUTO CORRELATIONS $FAST COSINE TRANSFORMS OF ONE-M
VECTOR (FIXED OR FLOATING) $FAST DOUBLING OR HALVING OF A M
ATED ARGUMENTS $FAST EVALUATE CUBIC FOR EVENLY M
$LOT FAST HORIZONTAL LINE ON SCOPE M $7090LINEH
$LOT FAST HORIZONTAL LINE ON SCOPE M $7090LINEH
$S AS PRODUCED BY SPLIT, $FAST REVERSAL OF SPECIAL VECTOR M
UAL OR GREATER THAN GIVEN VALUES $FAST SCAN VECTOR FOR ELEMENT M
ENTS $FAST TRACK THROUGH A VECTOR OF M
$LOT FAST VERTICAL LINE ON SCOPE M $7090LINEV
$LOT FAST VERTICAL LINE ON SCOPE M $7090LINEV
ON TAPE $FAST AND CONVIEINT DATA STORAGE M
, LIMITED ACCURACY SERIES $FAST AUTOCORRELATIONS FOR LONG M
ITED ACCURACY SRFIFS $FAST CONVOLUTIONS FOR LONG, M
IES OF FIXED POINT INTEGERS $FAST CORRELATIONS FOR LONG SEM M
G CROSS-CORRELATION FUNCTIONS $FAST COSINE, SINE TRANSFORMS M
ITED ACCURACY SERIES $FAST CROSS-CORRELATIONS FOR LONG M
SPLIT WITH ARBITRARY TIME ORIGIN $FAST FOURIER TRANSFORM OF VECTOR M

58
T ROUNDFING $FIX A FLOATING VECTOR WITH OR WITHOUT $M
SET LINEAR VECTORS, FIXED AND/OR FLOATING $M
ELEMENTS OF TWO VECTORS FIXED OR FLOATING $M
$MULTIPLY VECTOR BY FLOATING OR FIXED CONSTANT $M
$SUM ELEMENTS OF FLOATING OR FIXED VECTOR $M
$ADD OR SUBTRACT TWO FLOATING OR FIXED VECTORS $M
INTEGER $M
$TRUNCATE OR ROUND FLOATING PT., NUMBER TO MACHINE $M
$REMOVE THE MEAN FROM A FLOATING VECTOR $M
ROUND UP, OR ROUND DOWN A FLOATING VECTOR $M
$SQUARE ROOT OF A FLOATING VECTOR $M

TANT $M
$REFLECT A FIXED OR FLOATING VECTOR THROUGH A CON$M
CONSTANT TO ELEMENTS OF A FXD OR FLT G VECTOR $M
ANY NO. OF VARIABLES BY A SINGLE FLT G. PT., CONSTANT $M
RS OR CONVERSELY $SCALE, CONVERT FLT G. VECTOR TO MACHINE INTEGER $M
EQUAL TO A SINGLE VALUE (FXD OR FLT G) $SET ANY NO. OF VARIABLES $M
EQUAL TO SEPARATE VALUES (FXD OR FLT G) $SET ANY NO. OF VECTORS $M
$SUM THE SQUARED ELEMENTS OF A FLT G OR FXD VECTOR $M
$SQUARE ELEMENTS OF FXD OR FLT G VECTOR $M
SEGMENT $M
$SET FXD OR FLT G VECTOR EQUAL TO A LINEAR $M
MON A CONSTANT $SUM SQUARE DIFF. OF FLT G VECTOR FROM ANOTHER OR FROM $M
EQUAL TO SEPARATE VALUES (FXD OR FLT G) $SET ANY NO. OF VARIABLES $M
PT., NO. UP, DOWN, OR TO NEAREST FLT G. PT., INTEGER $ROUND FLT G $M
NEAREST FLT G. PT., INTEGER $ROUND FLT G. PT., NO. UP, DOWN, OR TO $M
ACCESS TO LITERAL OR ORDINARY FORMAT $M
$MATRIX OUTPUT IN G FORMAT $M
PUT VARIABLES FIVE PER LINE IN G FORMAT $M
ROUTINE DISPLAY $VARIABLE ORIGIN FORMAT GENERATOR FOR SCOPE SUB $M
TPUT TAPE WITH NORMAL OR LITERAL FORMAT VECTOR $WRITE OU F $M
OR OUTPUT WITH NORMAL OR LITERAL FORMAT $OFFLINE VECT $M
T VARIABLES BY NORMAL OR LITERAL FORMAT $OUTPU M $M
READ DATA IN GENERALIZED FORMAT $M
R OUTPUT STATEMENT $REPLACE THE FORMAT OF A SUCCEEDING INPUT $M
AMED VECTOR BY NORMAL OR LITERAL FORMAT WITH SPACING $OUTPUT N F $M
UMN VECTORS BY NORMAL OR LITERAL FORMATS $OUTPUT COL $M
MED VECTORS BY NORMAL OR LITERAL FORMATS WITH SPACING $OUTPUT NA $M
MULTIPLY AN MLI VECTOR BY A FORTRAN FIXED POINT INTEGER $M
MULTIPLY AN MLI VECTOR BY A retron INTEGER VECTOR AS HOLL $M
VECTOR $FAST CONVERT FORTRAN INTEGER VECTOR TO MLI $M
$SPREAD OUT HOLLERITH VECTOR AS FORTRAN INTEGERS $M
SAME ENABLED MESSAGES IN FORTRAN $M
F WITH TRUNCATION OR ROUNDFING TO FORTRAN-II INTEGER $FIX PT. DIVID $M
ODD $Determine WHETHER FORTRAN-II INTEGER IS EVEN OR $M
G SEQUENCES $ENABLE FORTRAN VARIABLE LENGTH CALLIN $M
WITH ARBITRARY TIME ORIGIN $FAST FOURIER TRANSFORM OF TRANSIENT $M
R Y TIME ORIGIN $QUICK INVERSE FOURIER TRANSFORM WITH ARBITRA $M
$ADVANCE FILM FRAME ON SCOPE $M
$ADVANCE FILM FRAME ON SCOPE $M
TS $MULTIPLE FRAME SCOPE PLOTS OF VECTOR SE $F
INE GRAPH EXPANDED OVER VERTICAL FRAMES $SUBROUTINE $F
VALUES OF A SERIES IN GIVEN RANGE $FREQUENCY COUNT OF NUMBER OF V $M
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$WRITE HOLLERITH TEXT ON SCOPE

ACK UP FORTRAN INTEGER VECTOR AS HOLLERITH VECTOR

WRITE

SPREAD OUT HOLLERITH VECTOR AS FORTRAN INTEGER VECTOR

TWO ARBITRARY MODE VECTORS FOR IDENTITY

$LABEL PRINT COLUMNS WITH INCREASING 3-DIGIT INTEGERS

$LABEL PRINTER COLUMNS WITH INCREASING 3-DIGIT INTEGERS

FOR

$CHECK VECTOR FOR HOMOTONE

M"LITUDE AND PHASE FROM REAL AND IMAGINARY, OR REVERSE

SPREADING OR ABSOLUTE VALUE

INPUT A VECTOR $FAST MAKE INDEX (BY INCREASING SIZE) OF ELEMENTS IN

FROM ANOTHER WITH NEW RANGE AND INCREMENT $CREATE ONE VECTOR

INPUT

SYM FUNCTION OF ARBITRARY INCREMENTS

VECTOR

FOR GATHERING MATCHED STATEMENTS

VECTOR

SPECIFYING ANOTHER AT EVEN INCREMENTS

FORM A

1ST AUXILIARY INFORMATION FOR AN INDATA-OUTDATA TYPE TAPE $L

HINTS FOR ADDING TO AN INDATA-OUTDATA TAPE

$TERMINATE AN INDATA-OUTDATA TAPE

TABLE RULE

$INDICTIVE INTEGRAL BY TRAPEZOIDAL RULE

A LINEAR COLUMN WITH ARBITRARY INDEX BY INTERPOLATION $FIN

ELEMENTS IN A VECTOR $FAST MAKE INDEX (BY INCREASING SIZE) OF

SCOPED LOCATION WITH INDEXABLE ARGUMENT

INDEXING VARIABLE DEPTH

INDEXING OF VECTORS

FAST TRACK THROUGH A VECTORS OF

$DATA-OUTDATA TAPE

INITIALIZED FOR ADDING TO AN

MULTI-INPUT FILTER BY LEAST SQUARES

MULTI-INPUT PREDICTOR BY LEAST SQUARE

MULTI-INPUT SIDWAYS ITERATION

MULTI-INPUT FILTER BY LEAST SQUARES

PLACE THE FORMAT OF A SUCCEEDING INPUT OR OUTPUT STATEMENT $RE

SELF-OPEN ANY MACHINE LANGUAGE INTEGER

VECTOR BY A FORTRAN FIXED POINT INTEGER

AP A SEQUENCE OF NUMBERS INTO AN INTEGER SERIES

M

CONVERT MACHINE LANGUAGE INTEGER TO EQUIVALENT HOLLERITH

$TOF

FAST CONVERT FORTRAN INTEGER VECTOR TO MLI VECTOR

ATION OR ROUNDOFF TO FORTRAN-II INTEGER FROM FIXED POINT DIVIDE WITH TRUN

D DIVIDE, OR TO NEAREST FLTG. PT. INTEGER $ROUND FLTG. PT. NO. U

D FLOATING PT. NUMBER TO MACHINE INTEGER $ROUND OR ROUN

D DETERMINE WHETHER FORTRAN-II INTEGER IS EVEN OR ODD

VE AS DOUBLE HANDSCREW OF INTEGER SEQUENCE IN GROUPS OF

$COMB PROBABILTY DENSITY OF INTEGER SERIES AT GIVEN LAG

F

ELEMENTS OF A MACHINE LANGUAGE INTEGER VECTOR $FAST SQUARE

$OUTPUT TAPE A MACHINE LANGUAGE INTEGER VECTOR $PRINT OR WRIT

OUTPUT TAPE A MACHINE LANGUAGE INTEGER VECTOR $PRINT OR WRIT

COLUMNS WITH INCREASING 3-DIGIT INTEGERS

LABEL PRINTER

OUT HOLLERITH VECTOR AS FORTRAN INTEGER

$SPREAD

NE

OUTPUT A MATRIX AS INTEGER DENSLEY PACKED OFF-LINE

CONVERT FLTG. VECTOR TO MACHINE INTEGERS OR CONVERSELY $SCALE

S FOR LONG SERIES OF FIXED POINT INTEGERS $FAST CORRELATION

EXCESSIVE VALUES $SCALE VECTOR TO

INTS FOR SCOPE, CLIPPING E

SHUFFLE A LIST OF INTEGERS FROM 1 TO N

$INVERSION OF TRAPEZOIDAL INTEGRAL

SINDENTIVE INTEGRAL BY TRAPEZOIDAL RULE

DIAGONAL INTEGRAL OR ABSOLUTE VALUE INTEGRAL

MOVING TRAPEZ

MINV
CALE OR SCALF VECTOR FOR SIMPSON INTEGRAL AND/OR INTEGRATE SUN'S F

GREEN \* DEFINITE TRAPEZOIDAL INTEGRAL OF FUNCTION OR ITS MA M TINGL

FARML \* MOVING TRAPEZOIDAL INTEGRAL OR ABSOLUTE VALUE INT M MVNTIN

CTOR FOR SIMPSON INTEGRAL AND/OR INTEGRATE SUNSCALE OR SCALE VE F SIMPSON

TING OF FIXED VECTOR \* INTEGRATED SUMMATION OF A FLOW M INTSUM

X COLUMN WITH ARBITRARY INDEX BY INTERPOLATION \* FIND A M ATRIC M ARBCOL

XPANSION OF A VECTOR UNDER CUBIC INTERPOLATION SHI-SPEED F M EXPAND

OF A MONOTONE FUNCTION BY LINEAR INTERPOLATION \* INVERSION M IFUNCTN

SLINEAR \* INTERPOLATION IN A TABLE F LINTR1

O 4 EVENLY SPACED DATA VALUES \* INTERPOLATION OPERATOR FOR 1 T M INTORPR

SURQUATIC \* INTERPOLATION IN A TABLE F INTORPR

INTERPRET \* INTERPOLATION IN A TABLE F INTORPR

TIME TIMING IN SECONDS USING 7090 INTERVAL CLOCK \* FOR REAL T M 7090CLOCK1

-LINE REQUEST IF NOT \* INVERSE OF A MATRIX F SPLIT

ARBITRARY TIME ORIGIN \* QUICK INVERSE FOURIER TRANSFORM WITH F QIFURY

ON BY LINEAR INTERPOLATION \* INVERSION OF A MONOTONE FUNCTION M IFUNCTN

Y DIFFERENCING \* INVERSION OF DIFFERENTIATION A M IDERIV

RAL \* INVERSION OF TRAPEZOIDAL INTEGR INTGR

HEST SQUARES SHAPER BY SIDEWAYS ITERATION $ F LSSS1

MULTI-INPUT SIDEWAYS ITERATION F MISS

REATING 3-DIGIT INTEGERS \* LABEL PRINTER COLUMNS WITH INC F COLABL

OF TRANSIENTS BEGINNING WITH ANY LAG \* CROSSCORRELATION F CROST

F TRANSIENTS BEGINNING WITH ZERO LAG \* CROSSCORRELATION O F CROST

FLOAT ANY MACHINE LANGUAGE INTEGER M FLOATM

HOLLERITH \* CONVERT MACHINE LANGUAGE INTEGER TO EQUIVALENT M ML12A6

AST SQUARE ELEMENTS OF A MACHINE LANGUAGE INTEGER \* SPLIT A VECTOR M SPLIT

T OR WRITE OUTPUT TAPE A MACHINE LANGUAGE INTEGER VECTOR \* PRINTS F PWMLIV

MULTI-INPUT FILTER BY LEAST SQUARES F MIPLS

MULTI-INPUT PREDICTOR BY LEAST SQUARES F MIPLS

LEASE SQUARES LINE F LSLINE

YS ITERATION \* LEAST SQUARES SHAPER BY SIDEWAY LSSS1

REDICTOR \* LEAST SQUARES SHAPER BY SIDEWAY LSSS1

URATION, 1-DIMENSION \* REALIZABLE LEAST SQUARE ERROR FILTER OR P F WLLSFSP

URATION, 2-DIMENSIONS \* REALIZABLE LEAST SQUARES PREDICTOR BY REC F RLSPR

ION \* REALIZABLE LEAST SQUARES SHAPER BY RECURS F RLSSR

ACKET \* MOLLERITH LEFT ADJUST OR RIGHT ADJUST FU M HLDJ

SHIFT VECTOR ELEMENTS LOGICALLY LEFT OR RIGHT M SMFHR2

T VECTOR ELEMENTS ARITHMETICALLY LEFT OR RIGHT M SHIFTR1

RIANGULAR AVERAGING; MOVING LEFT OR RIGHT END M TAMVL

OCK OF VALUES ALL ABOVE GIVEN LEVELS\*SCAN VECTOR FOR POSSIBLE F NXALRM

ATA \* FIND CONTOUR LEVELS FOR PLOTTING A ROW OF DF CNTROW

TER OR PREDICTOR \* WIENER-LEVINSOIN LEAST SQUARE ERROR FI F WLLSFSP

FAST AUTOCORRELATIONS FOR LONG, LIMITED ACCURACY SERIES F QACORR

FAST CONVOLUTIONS FOR LONG, LIMITED ACCURACY SERIES F QCOWNL

AST CROSS-CORRELATIONS FOR LONG, LIMITED ACCURACY SERIES \* F QXCORR

IND IF ARGUMENT FALLS INSIDE TWO LIMITING VALUES SF M XLIMIT

BLES FROM LIST FALL WITHIN GIVEN LIMITS \* CHECK THAT VARIA M LIMITS

LEASE SQUARES LINE F LSLINE
WRITE OUTPUT TAPE WITH NORMAL OR LITERAL FORMAT VECTOR

LISTING TAPE TO FRONT OF DECK

LIST AUXILIARY INFORMATION FOR TAPE

SET A LIST OF VARIABLES TO ONE OF TWO VALUES

CREATE VECTOR OF MACHINE LANGUAGE INTEGERS FROM 1 TO N

SHUFFLE A LIST OF INTEGERS FROM 1 TO N

SET A LIST OF VECTORS TO ZERO

MACHINE LANGUAGE INTEGER VECTORS TO ZERO

LOGICAL SUM CHECK

INDEXABLE ARGUMENT WITH RESPECT TO

MOVE A VECTOR TO A DIFFERENT LOCATION

STORE LOCATION WITH INDEXABLE ARGUMENT

LOGICAL SHIFT FUNCTION

SHIFT VECTOR ELEMENTS LOGICALLY LEFT OR RIGHT

PERFORM LONG DIVISION OF TWO POLYNOMIA

SCALE A VECTORS TO MACHINE INTEGERS OR CONVERSELY

FLOAT ANY MACHINE LANGUAGE INTEGER

HOMOGRAPHICALLY TO EQ M

IN A LIST CREATE VECTOR OF MACHINE ADDRESSES OF VARIABLES

OR ROUND FLOATING PT. NUMBER TO MACHINE INTEGER

DEFINE TRAPEZOID

AN INTEGER SERIES MAP A SEQUENCE OF NUMBERS INTO

FRAME OF TRANSIENT VECTORS OF MATRICES

CROSSTOES OR F

PRODUCTS OF VECTORS OF MATRICES

$DOT PRODUCT OR RF

PRINT OR WRITE OUTPUT TAPE A MACHINE LANGUAGE INTEGER VECTORS

IDENTAL INTEGRAL OF FUNCTION OR ITS MAGNITUDE

A TRANSFORM SERIES MAP A SEQUENCE OF NUMBERS INTO

FRAME OF TRANSIENT VECTORS OF MATRICES

CROSSFROES OR F

PRODUCTS OF VECTORS OF MATRICES

$DOT PRODUCT OR RF

MACHINE LANGUAGE INTEGER VECTORS TO ZERO

LOGICAL SUM CHECK

INDEXABLE ARGUMENT WITH RESPECT TO

MOVE A VECTOR TO A DIFFERENT LOCATION

STORE LOCATION WITH INDEXABLE ARGUMENT

LOGICAL SHIFT FUNCTION

SHIFT VECTOR ELEMENTS LOGICALLY LEFT OR RIGHT

PERFORM LONG DIVISION OF TWO POLYNOMIA

SCALE A VECTORS TO MACHINE INTEGERS OR CONVERSELY

FLOAT ANY MACHINE LANGUAGE INTEGER

HOMOGRAPHICALLY TO EQ M

IN A LIST CREATE VECTOR OF MACHINE ADDRESSES OF VARIABLES

OR ROUND FLOATING PT. NUMBER TO MACHINE INTEGER

DEFINE TRAPEZOID

AN INTEGER SERIES MAP A SEQUENCE OF NUMBERS INTO

FRAME OF TRANSIENT VECTORS OF MATRICES
$\text{REVERSE VECTOR OF MATRICES}$
$\text{SINVERSE OF A MATRIX}$
$\text{SFACT F}$
$\text{MREVRS}$
$\text{SFACT F}$
$\text{MFACT}$
$\text{MATINV}$
$\text{KED OFF-LINE}$
$\text{SOUTPUT A MATRIX AS INTEGERS DENSELY PAC}$
$\text{INSN X M MATRIX BY M X L MATRIX MULTIPL}$
$\text{MATOUTA1}$
$\text{INDEX BY INTERPOLATION}$
$\text{SFIND A MATRIX COLUMN WITH ARBITRARY I M}$
$\text{AMBCOL}$
$\text{SFEXTREMAL VALUES OF MATRIX ELEMENTS}$
$\text{SN X M MATRIX BY M X L MATRIX MULTIPLI}$
$\text{MATML3}$
$\text{F}$
$\text{SMAT INV}$
$\text{MATML1}$
$\text{ELS}$
$\text{SCONTOUR A MATRIX ON THE PRINTER IN DECIB}$
$\text{SMATRIX OUTPUT IN G FORMAT}$
$\text{CNTRDB}$
$\text{TER}$
$\text{SCONTOUR OF MATRIX SUBSET ON OFF-LINE PRINT}$
$\text{SMATRIX TRANSPOR}$
$\text{MATRA}$
$\text{MSQUARE MATRICE TRANSPOR}$
$\text{MTA1}$
$\text{SESSION FUNCTIONS}$
$\text{SREGION TO MAXIMIZE RATIO OF TWO DISTRIBUT}$
$\text{NMZMG1}$
$\text{PDENSITY FROM PROBABILITY DENSITY}$
$\text{MEAN SQUARE CONTINGENCY AN DE}$
$\text{MSCON1}$
$\text{SREMOVE THE MEAN FROM A FIXED VECTOR}$
$\text{KREMAV}$
$\text{SREMOVE THE MEAN FROM A FLOATING VECTOR}$
$\text{REMAV}$
$\text{SNORMALIZE AND CHANGE MEAN OF A VECTOR}$
$\text{NMVEC}$
$\text{SMOVING MEAN SQUARE AVERAGE OF A VECTOR}$
$\text{MVSQAV}$
$\text{SONLY PRINT OF MEMORY USAGE - PROGRAM AND COM}$
$\text{MEMUSE}$
$\text{SEE ODD-LENGTHED VECTOR ABOUT ITS MIDPOINT}$
$\text{KOLAPS}$
$\text{F}$
$\text{FACCESS ROUTIN FOR RAND CORP} \cdot$ $\text{MILLION RANDOM DIGITS FROM TAP}$
$\text{GETRDI}$
$\text{SFACOR POWER SPECTRUM TO FIND MINIMUM PHASE WAVELET}$
$\text{FACTOR}$
$\text{SENABLE MIXED EXPRESSIONS IN FORTRAN}$
$\text{SAME}$
$\text{ONVERT FORTRAN INTEGER VECTOR TO MLI VECTOR}$
$\text{INSTALL1}$
$\text{POINT INTEGER}$
$\text{SMULTIPLY AN MLI VECTOR BY A FORTRAN FIXED}$
$\text{MLISCL}$
$\text{SFAST COMPARE TWO ARBITRARY MLI TRANSIENTS}$
$\text{FXCORI}$
$\text{SFAST COMPARE TWO ARBITRARY MODE VECTORS FOR IDENTITY}$
$\text{CMPARV}$
$\text{VECTOR EQUAL TO A CONSTANT (ANY MODE)}$
$\text{SETKIV}$
$\text{SSET ALL ELEMENTS OF M}$
$\text{ADOK}$
$\text{CONSTANT OR BY CONSTANTS}$
$\text{SMODIFY A SET OF VARIABLES BY A M}$
$\text{ADNCL}$
$\text{IONS FOR DANIELL SPECTRA}$
$\text{SMODIFY AUTO- OR CROSS-CORRELAT}$
$\text{PRFIT}$
$\text{LITY DISTRIBUTION WITH SPECIFIED MOMENTS}$
$\text{GENERATE PROBAB}$
$\text{SREREAD DATA RECORD AND END FILE}$
$\text{RREAD}$
$\text{SMONITOR OF BCD TAPE WRITING}$
$\text{ONLINE}$
$\text{SOptional ONLINE}$
$\text{CHECK VECTOR FOR MOMOTONE INCREASING OR DECREAS}$
$\text{MONSIT}$
$\text{ING BEHAVIOR}$
$\text{SCHEK VECTOR FOR MONOTONE FUNCTION BY LINEAR IN M}$
$\text{IFNCNT}$
$\text{TION}$
$\text{SINVERSION OF A MONOTONE FUNCTION BY LINEAR IN M}$
$\text{MOVE}$
$\text{OCATION}$
$\text{SMOVE A VECTOR TO A DIFFERENT L M}$
$\text{MOVECS}$
$\text{RS}$
$\text{SMOVIE AN ARBITRARY SET OF VECTO}$
$\text{MVREV}$
$\text{OR CHANGE SIGN OF A VECTOR}$
$\text{SMOVE REVERSE, CHANGE SPACING,}$
$\text{MVBLK}$
$\text{A VECTOR MOVING DATA BLOCK}$
$\text{SMOVING AVERAGE OF A VECTOR}$
$\text{MVINAV}$
$\text{STMoving LEFT OR RIGHT END}$
$\text{TAMVL}$
$\text{A VECTOR MOVING MEAN SQUARE AVERAGE OF F}$
$\text{MVQSAV}$
$\text{INT VECTOR}$
$\text{SFAST MOVING SUMMATION OF A FIXED PO}$
$\text{MVADD}$
$\text{BY A CONSTANT MOVING SUMMATION WITH DIVISION}$
$\text{MVNSUX}$
$\text{ABSOLUTE VALUE INTEGRAL MOVING TRAPEZOIDAL INTEGRAL OR}$
$\text{MVNTIN}$
$\text{UARES}$
$\text{SMULTI-INPUT FILTER BY LEAST SQ F}$
$\text{MIFLS}$
$\text{SQUARE}$
$\text{MULTI-INPUT PREDICTOR BY LEAST F}$
$\text{MIPLS}$

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N
SN X M MATRIX BY M X N MATRIX
MULTIPLY SIDWAYS ITERATION
F
SN X M MATRIX BY M X L MATRIX
MULTIPLY
F
SQUARE MATRIX MULTIPLICATION
M
TRAN FIXED POINT INTEGER
MULTIPLY AN M L VECTOR BY A FO
F
BYS SINGLE FLTG. PT. CONSTANT
MULTIPLY ANY NO. OF VARIABLES
F
BY FIXED OR FLOATING
MULTIPLY ELEMENTS OF TWO VECTORS
M
FIXED CONSTANT
MULTIPLY VECTOR BY FLOATING OR M
ON INTO EQUALLY LIKELY SECTIONS
NORMAL DISTRIBUTION AND DIVISION
M
XMIN VALUE
NORMALIZE A VECTOR TO GIVEN MA
VECTOR
NORMALIZE AND CHANGE MEAN OF A F

M GIVEN RANGE FREQUENCY COUNT OF
NUMBER OF VALUES OF A SERIES I M
LAST TERM SEARCH VECTOR FOR
NUMBER, STARTING FROM FIRST OR F
STRUNCATE OR ROUND FLOATING PT.
NUMBER TO MACHINE INTEGER
M
$ MAP A SEQUENCE OF N UMPERS INTO AN INTEGER SERIES M
FOR FORTAN-II INTEGER IS EVEN OR ODD $ DETERMINE WHETHER M
SPLIT A VECTOR INTO ITS EVEN AND ODD PARTS (OR INVERSE) M
COSINE AND/OR SIN COSINE TRANSFORMS OF ODD-LENGTH SERIES M
$FAST
F
VARIANT $COLLAPSE ODD-LENGTHED VECTOR ABOUT ITS M
SINE TRANSFORMS FROM 2 OR 4 EVEN-ODD PARTS SFAST COSINE AND/OR M
REAL OR LITERAL FORMAT
OFFLINE VECTOR OUTPUT WITH NORMAL M
AXIS AS INTEGERS DENSELY PACKED OFF-LINE
SFAST COSINE TRANSFORMS OF ONE-SIDED AUTOCORRELATIONS M
- PROGRAM AND COMMON
SFAST OUTPUT A MATRIX M
$PRINT AND COMMON
SFAST PRINT OF MEMORY USAGE M
CONTACT OF MATRIX SUBSET ON OFF-LINE OUTPUT F
STORAGE ORDER OF A VECTOR M
OPTIMAL ONLINE MONITOR OF BCD TAPE WRITING M
ALL STATEMENTS LOCATE AND OPERATE SUBROUTINES BY PROXY CM
CFS DATA VALUES INTRAPOLATION OPERATOR FOR 1 TO 4 EVENLY SPA M
ONE SUBROUTINE REPEATEDLY
OPERATE SEVERAL SUBROUTINES OR M
NFE TO GIVEN ACCURACY FIND OPERATION TIME OF NEXT SUBROUT M
FAST REVERSE STORAGE ORDER OF A VECTOR M
ONE SUBROUTINE DISPLA A VARIABLE ORIGIN FORMATTED GENERATOR FOR SC M
FOR TRANSFORM WITH ARBITRARY TIME ORIGIN QUICK INVERSE FOURIER F
OF TRANSFORM WITH ARBITRARY TIME ORIGIN FAST FOURIER TRANSFORM M
ILLIARY INFORMATION FOR AN INDATA-OUTDATA TYPE TAPE $ LIST AUX F
TIALIZED FOR ADDING TO AN INDATA-OUTDATA TAPE $INI F
STERMINATE AN INDATA-OUTDATA TAPE F
NSLY PACKED OFF-LINE OUTPUT A MATRIX AS INTEGERS DE F
L OR LITERAL FORMATS OUTPUT COLUMN VECTORS BY NORMAL M
FRAL FORMAT VECTOR OUTPUT IN G FORMAT F
WRITE OUTPUT TAPE WITH NORMAL OR LIT M
IN G FORMAT
OUTPUT VARIABLES FIVE PER LINE M
OR LITERAL FORMAT WITH SPACING OUTPUT NAMED VECTOR BY NORMAL F
OR LITERAL FORMATS WITH SPACING OUTPUT NAMED VECTORS BY NORMAL M
FORM OF A SUCCEEDING INPUT OR OUTPUT STATEMENT $ REPLACE THE M
INTEGER VECTOR $PRINT OR WRITE OUTPUT TAPE A MACHINE LANGUAGE M
LITERAL FORMAT $OUTPUT VARIABLES AS NORMAL OR M
FORMAT $OFFLINE VECTOR OUTPUT WITH NORMAL OR LITERAL M
AS HOLLEIRITH VECTOR $PACK UP FORTAN INTEGER VECTOR M
$SCALE AND FIX DATA VECTOR, PACK N DATA POINTS PER REGISTE M
M
ISS
MATML3
MATML1
MLISCL
MULK -II
VTIMSV
MULPLY
NOINT1
NMZMG1
NRMVEC
FROCT2
SRCH1
XFIXM
MPSEQ1
XOOZE
SPLIT
COS+SI
KOLAPS
COSP
VECOUT
MOUTAI1
MEMUSE
CONTUR
COS+SI
COLAPS
ONLINE
LOCATE
INOPTR
SEVRAI
TIMSUB
REVERS
DPSPMT
QIFURY
OFURRY
LISTG
SETINO
TRMINO
MOUTAI1
CVSOUT
MOUT
FMTOUT
CSOUT
VOUT
VSOUT
RPLFMT
VRSOUT
VECOUT
IVTOHV
PAKN
PUT A MATRIX AS INTEGERS DENSELY PACKED OFF-LINE
$\text{UNPACK AND RESCALE A PACKED DATA VECTOR}$ OUT F
PACE CARTRIDGE N LINES OR RESTORE PAGE $\text{SS F}$ MOUTA1
D OR FLOATING VECTOR ELEMENTS IN PAIRS $\text{DIFFERENCE FIXE M}$ UNPAKN
VARIABLES FOR EQUALITY $\text{COMPARE PAIRS OF VARIABLES OR A SET OF}$ CARIGE
TRANSFORMS FROM 2 OR 4 EVEN-ODD PARTS $\text{FAST COSINE AND/OR SINE}$ CMPARP
A VECTOR INTO ITS EVEN AND ODD PARTS (OR INVERSE) $\text{SSPLIT M}$ COSP
OR REVERSE $\text{AMPLITUDE AND PHASE FROM REAL AND IMAGINARY}$ SPLIT
R POWER SPECTRUM TO FIND MINIMUM PHASE WAVELET FACTOR COPE
$\text{SPLT FAST HORIZONTAL LINE ON S M 7090LINES}$ LSPLT-1
PE $\text{SPLT FAST VERTICAL LINE ON SCO M 7090LINE}$ LSPLT-1
PE $\text{SPLT FAST VERTICAL LINE ON SCO M 7090LINE}$ LSPLT-1
VECTORS
$\text{SPRINTER PLOT OF A SET OF EQUAL LENGTH F}$ PTVS1
$\text{SPRINTER- PLOT OF ARBITRARY SET OF VECTOR F}$ PTVS1
$\text{MULTIPLE FRAME SCOPE PLOTS OF VECTOR SETS}$ GRAPH
$\text{SFIND CONTOUR LEVELS FOR PLOTTING A ROW OF DATA}$ CNTRROW
$\text{SBAR GRAPH PLOTTING FOR SUBROUTINE GRAPH M}$ HSPLT
$\text{SCUBIC CURVE SCOPE PLOTTING FOR SUBROUTINE GRAPH M}$ HSPLT
$\text{SCUBIC CURVE SCOPE PLOTTING FOR SUBROUTINE GRAPH M}$ HSPLT
$\text{SHISTOGRAM PLOTTING FOR SUBROUTINE GRAPH M}$ HSPLT
$\text{SPRINTER- PLOT OF A SET OF EQUAL LENGTH F}$ PTVS1
$\text{SPRINTER- PLOT OF ARBITRARY SET OF VECTOR F}$ PTVS1
$\text{SFIND T M}$ SETK
$\text{SFIND T M}$ SETK
AND EXACTLY FITS 3 EQUALLY SPACED POINTS $\text{SQUARE WHI M}$ OUTFIT1
AND FIX DATA VECTOR, PACK N DATA POINTS : ER REGISTER $\text{SCALE M}$ PAKN
ER SEQUENCE IN GROUPS OF 5 AS POKER HANDS $\text{EVALUATION OF INTEGER}$ POKT1
$\text{SCOMPLEX POLYNOMIAL EVALUATION F}$ PLYEV
HE POWER SERIES SQUARE ROOT OF A POLYNOMIAL $\text{SFIND T F}$ PSORT
$\text{SPOLYnomial ROOT FINDER F}$ MULLER
AND COMPLEX ROOTS $\text{SPOlynomial SYNTHESIS FROM REAL F}$ POLYSN
S REAL AND COMPLEX ROOTS $\text{SPOlynomial SYNTHESIZED FROM IT F}$ POLYSYN
NTS FOR REAL ARGUMENTS $\text{EVALUATE A POLYNOMIAL WITH REAL COEFFICIENT}$ POLYEVE
$\text{SPERFORM LONG DIVISION OF TWO POLYNOMIALS}$ POLYDV
$\text{SFACtor A SYMMETRIC POSITIVE DEFINITE MATRIX}$ FACTOR COPE
$\text{SFACtor POWER SPECTRUM TO FIND MINIMUM M}$ FACTOR COPE
$\text{SRAISE VECTOR TO POWER OR SUM POWER OF DEVIATIONS FROM BASE M}$ POWER COPE
NS FROM BASE $\text{SRAISE VECTOR TO POWER OR SUM POWER OF DEVIATIONS}$ POWER COPE
$\text{SFIND THE POWER SERIES SQUARE ROOT OF A F M}$ FACTOR COPE
$\text{MULTI-INPUT PREDICTOR BY LEAST SQUARES}$ MIPLS
$\text{SON LEAST SQUARE ERROR FILTER OR PREDICTOR}$ WIENER-LEVINE WLLSP
NSION $\text{REALIZABLE LEAST SQUARES PREDICTOR BY RECURSION}$ 1-DIME F RLSPR
NSION $\text{REALIZABLE LEAST SQUARES PREDICTOR BY RECURSION}$ 2-DIME F RLSPR2
$\text{M AND COMMON}$ RLSPR2
OFF-LINE PRINT OF MEMORY USAGE - PROGRA M MEMUSE
HINE LANGUAGE INTEGRATOR VECTOR $\text{PRINT OR WRITE OUTPUT TAPE A M}$ PWML1V
OUR OF MATRIX SUBSET ON OFF-LINE PRINTER $\text{SCONT F}$ CONUR
G 3-DIGIT INTEGERS $\text{LABEL PRINTER COLUMNS WITH INCREASING F}$ COLABL
$\text{SCONTOUR A MATRIX ON THE PRINTER IN DECIBELS}$ CNTRDB
LENGTH VECTORS $\text{SPRINTER PLOT OF A SET OF EQUAL F}$ PTVS1
OF VECTORS $\text{SPRINTER- PLOT OF ARBITRARY SET F}$ PTVS1
$\text{SCOMPUTE CHI-SQUARE FOR CONSTANT PROBABILITY CASE}$ CHISOR

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CONTINGENCY AND DEPENDENCY FROM VARIATE EXCEEDS A VALUE SERIES AT GIVEN LAG

$\text{SPECIFIED MOMENTS}$ $\text{GENERATE PROBABILITY DISTRIBUTION WITH}$

$\text{S}$ $\text{DIVIDE THE X AXIS INTO EQUALLY PROBABLE RANGES}$

$\text{S}$ $\text{DISPLACED DOT PRODUCT OF TWO VECTORS}$

$\text{S}$ $\text{FAST DOT PRODUCT OF 2-DIMENSIONAL ARRAY}$

$\text{S}$ $\text{DOT PRODUCT OR REVERSED DOT PRODUCT OF VECTORS OF MATRICES}$

$\text{S}$ $\text{DOT PRODUCT OR REVERSED DOT PRODUCT OF VECTORS OF MATRICES}$

$\text{S}$ $\text{DOT PRODUCT OR REVERSED DOT PRODUCT OF VECTORS OF MATRICES}$

$\text{T}$ $\text{OF VECTORS OF MATRICES}$

$\text{T}$ $\text{OF VECTORS OF MATRICES}$

$\text{T}$ $\text{OF VECTORS OF MATRICES}$

$\text{N}$ $\text{VECTOR DOT PRODUCT WITH ARBITRARY INCREMENT}$

$\text{V}$ $\text{ATION BY CONSTANT}$ $\text{DOT PRODUCT OF TWO VECTORS WITH DI}$

$\text{O}$ $\text{CAT AND OPERATE SUBROUTINES BY PROXY CALL STATEMENTS}$

$\text{S}$ $\text{LICENSED INTERPOLATION IN A REGION TO MAXIMIZE}$

$\text{EQUALLY SPACED POINTS}$ $\text{FIND QUADRATIC WHICH EXACTLY FITS 3}$

$\text{M}$ $\text{WITH ARBITRARY TIME ORIGIN}$

$\text{M}$ $\text{OBER OF DEVIATIONS FROM BASE}$

$\text{P}$ $\text{ORATE VECTOR TO POWER OR SUM P}$

$\text{S}$ $\text{FROM TAPE ACCESS ROUTINE FOR RAND CORP. MILLION RANDOM DIGITS}$

$\text{S}$ $\text{ROUTINE FOR RAND CORP. MILLION RANDOM DIGITS FROM TAPE ACCESS}$

$\text{S}$ $\text{OF VALUES OF A SERIES IN GIVEN RANGE FROM FREQUENCY COUNT OF NUMBERS}$

$\text{I}$ $\text{IFIED ACCURACY OF GIVEN PROGRAM RANGE}$

$\text{O}$ $\text{NE VECTOR FROM ANOTHER WITH NEW RANGE AND INCREMENT}$

$\text{T}$ $\text{X AXIS INTO EQUALLY PROBABLE RANGES}$

$\text{T}$ $\text{IONS}$ $\text{REGION TO MAXIMIZE RATIO OF TWO DISTRIBUTION}$

$\text{S}$ $\text{READ DATA IN GENERALIZED FORMA}$

$\text{R}$ $\text{BY TAPE}$

$\text{A}$ $\text{MPLITUDE AND PHASE FROM REAL AND IMAGINARY, OR REVERSE}$

$\text{P}$ $\text{OLYNOMIAL SYNTHESIS FROM REAL AND COMPLEX ROOTS}$

$\text{P}$ $\text{OLYNOMIAL SYNTHESIZED FROM ITS REAL AND COMPLEX ROOTS}$

$\text{O}$ $\text{MIAL WITH REAL COEFFICIENTS FOR REAL ARGUMENTS}$

$\text{U}$ $\text{MENT EVALUATE A POLYNOMIAL WITH REAL COEFFICIENTS FOR REAL ARG}$

$\text{Y}$ $\text{, OF GIVEN PROGRAM RANGE}$

$\text{C}$ $\text{TOR BY RECURSION, 2-DIMENSIONS REALIZABLE LEAST SQUARES PREDI}$

$\text{C}$ $\text{TOR BY RECURSION, 1-DIMENSION REALIZABLE LEAST SQUARES PREDI}$

$\text{R}$ $\text{BY RECURSION}$

$\text{R}$ $\text{EREAD DATA RECORD AND END FILE MONITOR}$

$\text{S}$ $\text{ITION TAPE}$

$\text{S}$ $\text{SKIP FORWARD OR BACKWARD OVER RECORDS ON TAPE}$

$\text{A}$ $\text{LIZABLE LEAST SQUARES SHAPER BY RECURSION}$

$\text{Z}$ $\text{ABLE LEAST SQUARES PREDICTOR BY RECURSION, 1-DIMENSION REALIS}$

$\text{Z}$ $\text{ABLE LEAST SQUARES PREDICTOR BY RECURSION, 2-DIMENSIONS REALIS}$

$\text{C}$ $\text{CTOR THROUGH A CONSTANT}$

$\text{O}$ $\text{DISTRIBUTION FUNCTIONS}$

$\text{A}$ $\text{VECTOR, PACK N DATA POINTS PER REGISTER}$

$\text{F}$ $\text{ORVE THE MEAN FROM A FIXED V}$
REMOVE THE MEMN FROM A FLOATING INPUT OR OUTPUT STATEMENT. REPLACE THE FORMAT OF A SUCCESSIVE SLIST DATA DECK AND REPOSITION TAPE TO FRONT OF DET TAPE. IF NEEDED, FIND OF FILE AND REPOSITION TAPE. IF NEXT MONITOR READ DATA RECORD AND END FILE. IF TIMER IS ON, MAKING ON-LINE REQUEST. IF NOT, CHECK IF INT

UNPACK ANDICAL FILTER WITH GIVEN AMPLITUDE AND RANGE. A PACKED DATA VECTOR IS PRODUCED BY SPLIT. FAST REVERSAL OF SPECIAL VECTORS. MOVE CHANGE SPACING OR CH HASE FROM REAL AND IMAGINARY OR REVERSE SAMPLITUDE AND RANGE OF A VECTOR «SHIFT VECTORS ». REVERSE A VECTOR ELSEWHERE OR FAST REVERSE STORAGE ORDER OF A VECTOR. DOT PRODUCT OR INPLACE RESPONSE «GENEPATE SYMMETRIC RESTORE PAGE OF DATA FROM A SPECIFIC DATA CARRIAGE OR REVERSE DATA DECK. AND FAST AND CONVENIENT FIRST RESPOND TO FRONT OF DATA RECORD AND TEST 17.
VEN VALUES

$SET VARIABLES OR VECTORS TO GI M
$FAST SET VECTOR TO ZERO M

IPLE FRAME SCOPE PLOTS OF VECTOR SETS
LIST OF VARIABLES TO ONE OF TWO SETS OF VALUES $SET A M
$PLURALIZED FORMS OF SUBROUTINES SETK AND SETVEC
$FD FORMS OF SUBROUTINES SETK AND SETVEC $PLURALIZ M

S FOR INCREMENTING, TESTING, AND SETTING $HYBRID SUBPROGRAM M
$LEAST SQUARES SHAPER BY SIDWAYS ITERATION F
$REALIZABLE LEAST SQUARES SHAPER BY RECURRENCE F
$LOGICAL SHIFT FUNCTION M

ICALLY LEFT OR RIGHT $SHIFT VECTOR ELEMENTS ARITHMETIC M
Y LEFT OR RIGHT $SHIFT VECTOR ELEMENTS LOGICAL M
M 1 TO N $SHUFFLE A LIST OF INTEGERS FROM 1 TO M

$MULT-INPUT SIDWAYS ITERATION F
$LEAST SQUARES SHAPER BY SIDWAYS ITERATION F

ENTS $FORM A VECTOR BY SIFTING ANOTHER AT EVEN INCREMENTS M
$CHANGE ALL SIGN BITS OF A VECTOR M

VERSE, CHANGE SPACING, OR CHANGE SIGN OF A VECTOR $MOVE$RE M
VARIABLES OR 0 IF SAME INCLUDING SIGN $SIGN OF DIFFERENCE OF 2 M
VES OR 0 IF SAME INCLUDING SIGN $SIGN OF DIFFERENCE OF 2 VARIABLES M
UES OR 0 IF SAME INCLUDING SIGN $SIGN OF DIFFERENCE OF 2 VARIABLES M
ATE $UNSSCALE OR SCALE VECTOR FOR SIMPSON INTEGRAL AND/OR INTEGRATION M
EMINANT EVALUATION $SOLUTION OF SIMULTANEOUS EQUATIONS AND DET M
R FLOATING $GENERATE COSINE OR SINE HALFWAVE TABLES, FIXED ON M
EN-ODD PARTS $FAST COSINE AND/OR SINE TRANSFORMS FROM 2 OR 4 EV M
SERIES $FAST COSINE AND/OR SINE TRANSFORMS OF ODD-LENGTH M

ATION FUNCTIONS $FAST COSINE, SINE TRANSFORMS OF CROSS-CORRELATION M
$FAST FUNCTIONS FOR SEQUENTIAL SINES AND COSINES M

$FAST MAKE INDEX (BY INCREASING SIZE) OF ELEMENTS IN A VECTOR M
FILES ON TAPE $SKIP FORWARD OR BACKWARD OVER M
RECORDS ON TAPE $SKIP FORWARD OR BACKWARD OVER M
ORE PAGE $SPACE CARRIAGE N LINES OR REST M

$FAST EVALUATE CUBIC FOR EVENLY SPACED ARGUMENTS M
ATION OPERATOR FOR 1 TO 4 EVENLY SPACED DATA VALUES $INTERPOL M
CTOR WHICH EXACTLY FITS 4 EVENLY SPACED POINTS $FIND CM
ECTOR $MOVE$REVERSE, CHANGE SPACING, OR CHANGE SIGN OF A VECTOR M
ROSSCORRELATION OF 2-DIMENSIONAL SPATIAL ARRAYS $SPATIAL CF
DIMENSIONAL SPATIAL ARRAYS $FAST TWO-DIMENSIONAL SPATIAL SPECTRUM M
R CROSS-CORRELATIONS FOR DANIELL SPECTRA $MODIFY AUTO M

$HIGH SPEED 24 POINT SPECTRUM M
$HIGH SPEED 24 POINT SPECTRUM M

WAVELET $FACTOR LOWER SPECTRUM TO FIND MINIMUM PHASE M
$FAST TWO-DIMENSIONAL SPATIAL SPECTRUM M

$HIGH SPEED 24 POINT SPECTRUM M
$HIGH SPEED 24 POINT SPECTRUM M

DER CUBIC INTERPOLATION $SHAPE EXPANSION OF A VECTOR UN
SPECIAL VECTORS $AS PRODUCED BY SPLIT M
ODD PARTS (INVERSE) $SPLIT A VECTOR INTO ITS EVEN AND M
FORTRAN INTEGERS $SPREAD OUT HOLLERITH VECTOR AS M
NCY FROM PROBABILITY DENSITY MEAN SQUARE CONTINGENCY AND DEPEND
Y CASE $COMPUTE CHI-SQUARE FOR CONSTANT PROBABILI
$SQUARE MATRIX MULTIPLICATION M $MATML1
$SQUARE MATRIX TRANSPOSE M $MATRA1
$MOVING MEAN SQUARE AVERAGE OF A VECTOR M $MSQAV
M ANOTHER OR FROM A CONSTANT SUM SQUARE DIFF. OF FLTG VECTOR FROM M $MSQDFR
M ANOTHER OR FROM A CONSTANT SUM SQUARE DIFF. OR FXD VECTOR FROM M $MSQDFR
LANGUAGE INTEGRAL VECTOR $FAST SQUARE ELEMENTS OF A MACHINE M $SORML1
VECTOR OR $WIENER-LEVINSON LEAST SQUARE ERROR FILTER OR PREDICT F $WLLSFP
WITH ROUNDED $SQUARE ROOT OF A FIXED VECTOR M $XSQRUT
OR $SQUARE ROOT OF A FLOATING VECTOR M $SROOT
$FIND THE POWER SERIES SQUARE ROOT OF A POLYNOMIAL F $PSORT
$PROBABILITY THAT A CHI-SQUARED VARIATE EXCEEDS A VALU $MSQAV
$FD VECTOR $SUM THE SQUARE ELEMENTS OF A FLTG OR M $SQRSUM
$MULTI-INPUT PREDICTOR BY LEAST SQUARES M $MIPLS
$MULTI-INPUT PREDICTOR BY LFAST SQUARES M $MIPLS
$LEAST SQUARES LINE F $LSLINE
1-DIMENSIONS $REALIZABLE LEAST SQUARES PREDICTOR BY RECURSION F $RLSPR
2-DIMENSIONS $REALIZABLE LEAST SQUARES PREDICTOR BY RECURSION F $RLSPR2
OF A SUCCEEDING INPUT OR OUTPUT STATEMENT $REPLACE THE FORMAT M $RPLFMT
PERATE SUBROUTINES BY PROXY CALL STATEMENTS $LOCATE AND O${FIXED POINT $DELTA FUNCTION AND SIZE FUNCTIONS, FLOATING AND F M $DELTA
$FIND LENGTH OF COMMON STORAGE M $XLCOMM
$FAST AND CONVIENT DATA STORAGE ON TAPE F $OADATA
$FAST REVERSE STORAGE ORDER OF A VECTOR M $REVERSE
ENTS $LOCATE AND OPERATE SUBROUTINES BY PROXY CALL STAT M $LOCATE
REPEATEDLY $OPERATE SEVERAL SUBROUTINES OR ONE SUBROUTINE M $SEVRAL
VECTORS $PLUS ALIZED FORMS OF SUBROUTINES SETK AND SETVEC M $SETKP
OTHER OR FROM A CONSTANT $SUM DIFFERENCE OF VECTOR FROM M $SUMDIFFR
XFD VECTOR $SUM ELEMENTS OF FLOATING OR FI M $SUM
ASE $RAISE VECTOR TO POWER OR SUM POWER OF DEVIATIONS FROM B M $SQRDFR
FROM ANOTHER OR FROM A CONSTANT SUM SQUARE DIFF. OF FLTG VECTOR M $XSODFR
FROM ANOTHER OR FROM A CONSTANT SUM SQUARE DIFF. OR FXD, VECTOR M $SQRSUM
FLTG OR FXD VECTOR $SUM THE SQUARE ELEMENTS OF A M $SUM
$COMPUTE A LOGICAL SUMCHECK M $FAPSUM
ED VECTOR $INTEGRATED SUMMATION OF A FLOATING OF FIX M $INTSUM
ING BLOCKS OF CONSTANT LENGTH $SUMMATION OF VECTOR OVER ABUT M $BLKSUM
TOR $FAST MOVING SUMMATION OF A FIXED POINT VECC M $MVUADD
ONSTANT $MOVING SUMMATION WITH DIVISION BY A C M $MVNSUM
$FAST THE CONDITION OF ANY SENSE SWITCH M $SWITCH
TRIX $FACTOR A SYMMETRIC POSITIVE DEFINITE M $MFACT
DIMENSIONAL ARRAY $ROTA TE CENTRO-SYMMETRIC OR ANTI-SYMMETRIC 2-D M $ROAR2
AMPLITUDE RESPONSE $GENERATE SYMMETRICAL FILTER WITH GIVEN M $GNPLT1
X ROOTS $POLYNOMIAL SYNTHESIZED FROM REAL AND COMPLEX M $POLYSN
COMPLEX ROOTS $POLYNOMIAL SYNTHESIZED FROM ITS REAL AND M $PLYSYN
$LINEAR INTERPOLATION IN A TABLE
QUADRATIC INTERPOLATION IN A TABLE

QUERATE COSINE OR SINE HALF-WAVE TABLES, FIXED OR FLOATING $G M

CORP, MILLION RANDOM DIGITS FROM TAPE $ACCESS ROUTINE FOR RAND F

RETRIEVAL OF DATA FROM A SPECIAL TAPE $FAST AND CONVENIENT F

MATION FOR AN INDATA-ODATA TYPE TAPE $LIST AUXILIARY INF OR F

ORDER OR BACKWARD OVER FILES ON TAPE $SKP F M

$FAST COPY FILE FROM ONE TAPE TO ANOTHER - VERSION 2 M

$LIST DATA DECK AND REPOSITION TAPE TO FRONT OF DECK F

RMAT VECTOR $WRITE OUTPUT TAPE WITH NORMAL OR LITERAL FO F

AD AND CONVIENT DATA STORAGE ON TAPE $INITIALIZE F

D FOR ADDING TO AN INDATA-ODATA TAPE $N

READ EVERY N-TH WORD FROM BINARY TAPE $N

WARD OR BACKWARD OVER RECORDS ON TAPE $SKP FOR M

STERMINATE AN INDATA-ODATA TAPE $TRMINO F

RD IS END OF FILE AND REPOSITION TAPE $TEST IF NEXT TAPE RECO M

$WRITE BINARY DATA ON TAPE $WRITE HOLLERITH TEXT ON SCOPE M 7090DISPLA

$WRITE BINARY DATA ON TAPE $WRITE HOLLERITH TEXT ON SCOPE M 7090DISPLA

90 INTERVAL CLOCK FOR REAL TIME TIMING IN SECONDS USING 7 M 7090CLOCK1

END ACCURACY $FIND OPERATION TIME OF NEXT SUBROUTINE TO GIV M 7090CLOCK1

FOURIER TRANSFORM WITH ARBITRARY TIME ORIGIN $QUICK INVERSE F

FORM OF TRANSIENT WITH ARBITRARY TIME ORIGIN $FAST FOURIER TRANS M 7090CLOCK1

F GIVEN PROGRAM RANGE $REAL TIME, TO SPECIFIED ACCURACY, E M 7090CLOCK1

UEST IF NOT $CHECK IF INTERVAL TIMER IS ON MAKING ON-LINE REQ M

INTERVAL CLOCK FOR REAL TIME TIMING IN SECONDS USING 7 M 7090CLOCK1

CES $FAST TRACK THROUGH A VECTOR OF INDI

$AUTOSPECTRUM BY COSINE TRANSFORM OF AUTOCORRELATION M

BITARY TIME ORIGIN $FAST FOURIER TRANSFORM OF TRANSIENT WITH AR F

ORIGIN $QUICK INVERSE FOURIER TRANSFORM WITH ARBITRARY TIME F

D PARTS $FAST COSINE AND/OR SINE TRANSFORMS FROM 0 TO 4 EVEN-OD M

S $FAST COSINE AND/OR SINE TRANSFORMS OF ODD-LENGTH SERIES F

$RELATIONS $FAST COSINE TRANSFORMS OF ONE-SIDED AUTO M

N FUNCTIONS $FAST COSINE, SINE TRANSFORMS OF CROSS-CORRELATION F

$CROSSCORRELATION OF TRANSIENT VECTORS OF MATRICES F

ORIGIN $FAST FOURIER TRANSFORM OF TRANSIENT WITH ARBITRARY TIME F

$COMPLETE CONVOLUTION OF TWO TRANSIENTS M

$COMPLETE CONVOLUTION OF TWO TRANSIENTS F

LAG $CROSSCORRELATION OF TRANSIENTS BEGINNING WITH ANY M

LAG $CROSSCORRELATION OF TRANSIENTS BEGINNING WITH ZERO F

$QUICK CROSSCORRELATION OF MLI TRANSIENTS F

$MATRIX TRANSPOSE M

$SQUARE MATRIX TRANSPOSE M

$INVERSION OF TRAPEZOIDAL INTEGRAL M
$\text{INDEFINITE INTEGRAL BY TRAPEZOIDAL RULE}$

$\text{ON OR ITS MAGNITUDE}$

$\text{INDEFINITE INTEGRAL OF FUNCTION M}$

$\text{OF VALUE INTEGRAL}$

$\text{MOVING TRAPEZOIDAL INTEGRAL OR ABSOLUTE M}$

$\text{OR RIGHT END}$

$\text{TRIANGULAR AVERAGING, MOVING LIMIT M}$

$\text{NUMER TO MACHINE INTEGER}$

$\text{TRUNCATE OR ROUND FLOATING LIMIT M}$

$\text{DAN-II INTEGER}$

$\text{DIVIDE WITH TRUNCATION OR ROUNDING TO LIMIT M}$

$\text{ATCHED}$

$\text{ADD TWO-DIMENSIONAL FILTER BY RECURSIVE M}$

$\text{HE VECTOR}$

$\text{UNPACK AND RESCALE A PACKED M}$

$\text{OMETOR INTEGRAL AND/OR INTEGRATE SUNSCALE OR SCALE VECTOR FOR SI F}$

$\text{VECTOR}$

$\text{FIND SIGNED OR UNSIGNED EXTREMAL VALUES OF A M}$

$\text{A CHI-SQUARED VARIATE EXCEEDS A VALUE}$

$\text{F PROBABILITY THAT F}$

$\text{FAST ABSOLUTE VALUE OF A VECTOR M}$

$\text{FAST EQUAL OR GREATER THAN GIVEN VALUES FAST SCAN VECTOR FOR ELEMENT M}$

$\text{ALIZE A VECTOR TO GIVEN MAXIMUM VALUE SNOR M}$

$\text{SEARCH A VECTOR FOR A VALUE M}$

$\text{OF VARIABLES EQUAL TO A SINGLE VALUE (FXD OR FLTG) SET ANY NO F}$

$\text{TRAPEZOIDAL INTEGRAL OR ABSOLUTE VALUE INTEGRAL MOVING M}$

$\text{OR FOR 1 TO 4 EVENLY SPACED DATA VALUES INTERPOLATION OPERATE M}$

$\text{VARIABLES TO ONE OF TWO SETS OF VALUES SET A LIST OF M}$

$\text{FREQUENCY COUNT OF NUMBER OF VALUES OF A SERIES IN GIVEN RANGE M}$

$\text{FIND SIGNED OR UNSIGNED EXTREMAL VALUES OF A VECTOR M}$

$\text{EXTREMAL VALUES OF MATRIX ELEMENTS M}$

$\text{CALCULATE FALLS INSIDE TWO LIMITING VALUES M}$

$\text{IF AN AR M}$

$\text{AS FOR SCONE, CLIPPING EXCESSIVE VALUES SCALE VECTOR TO INTEGRATE M}$

$\text{SET VARIABLES OR VECTORS TO GIVEN VALUES M}$

$\text{SCALE VECTORS FOR POSSIBLE BLOCK OF VALUES ALL ABOVE GIVEN LEVELS F}$

$\text{NO. OF VECTORS EQUAL TO SEPARATE VALUES (FXD OR FLTG) SET ANY NO F}$

$\text{OF VARIABLES EQUAL TO SEPARATE VALUES (FXD OR FLTG) SET ANY NO F}$

$\text{TAPS ALLOW VARIABLE DEPTH INDEXING OF VECTOR M}$

$\text{FOR SCONE SUBROUTINE DISPLAY VARIABLE ORIGIN FORMAT GENERATE M}$

$\text{ENABLE FORTRAN VARIABLE LENGTH CALLING SEQUENCES M}$

$\text{CONSTANTS MODIFY A SET OF VARIABLES BY A CONSTANT OR BY M}$

$\text{CONSTANT MODIFY ANY NO. OF VARIABLES BY A SINGLE FLTG. PT F}$

$\text{OR AT M}$

$\text{E PAIRS OF VARIABLES OR A SET OF VARIABLES FOR EQUALITY COMPARE M}$

$\text{N GIVBN LIMITS CHECK THAT VARIABLES FROM LIST FALL WITHIN M}$

$\text{S FOR EQUALITY COMPARE PAIRS OF VARIABLES OR A SET OF VARIABLE M}$

$\text{F VALUES SET A LIST OF VARIABLES TO ONE OF TWO SETS OR M}$

$\text{ZERO CODE CHOOSE BETWEEN TWO VARIABLES BY A THIRD ONE FINDING M}$

$\text{FORMAT OUTPUT VARIABLES FIVE PER LINE IN G F M}$

$\text{E PAIRS OF VARIABLES OR A SET OF VARIABLES FOR EQUALITY COMPARE M}$

$\text{N GIVEN LIMITS CHECK THAT VARIABLES FROM LIST FALL WITHIN M}$

$\text{S FOR EQUALITY COMPARE PAIRS OF VARIABLES OR A SET OF VARIABLE M}$

$\text{F VALUES SET A LIST OF VARIABLES TO ONE OF TWO SETS OR M}$

$\text{ZERO CODE CHOOSE BETWEEN TWO VARIABLES BY A THIRD ONE FINDING M}$

$\text{FORMAT OUTPUT VARIABLES BY NORMAL OR LITERAL M}$

$\text{FUNCTION (FXD OR FLTG) SET ANY NO. OF VARIABLES EQUAL TO A SINGLE VALUE M}$

$\text{FUNCTION (FXD OR FLTG) SET ANY NO. OF VARIABLES EQUAL TO SEPARATE VALUE M}$

$\text{VECTOR OF MACHINE ADDRESSES OF VARIABLES IN A LIST CREATE M}$

$\text{SIGN SIGN OF DIFFERENCE OF 2 VARIABLES OR 0 IF SAME INCLUDE M}$

$\text{VALUES SET VARIABLES OR VECTORS TO GIVEN M}$

$\text{PROBABILITY THAT A CHI-SQUARED VARIATE EXCEEDS A VALUE M}$

$\text{ANT TO ELEMENTS OF A FXD OR FLTG VECTOR ADD A CONSTANT M}$

$\text{CHANGE ALL SIGN BITS OF A VECTOR M}$

$\text{FAST ABSOLUTE VALUE OF A VECTOR M}$

$\text{OTHERS}$
RROR FILTER OR PREDICTOR  SIWIENER-LEVINSON LEAST SQUARE E F  WLLSFP
READ EVERY N-TH WORD FROM BINARY TAPE  N  PACDAT
COMPARE ARITHMETICALLY TWO WORDS WHERE -0 IS LESS THAN +0  M  CMPRA
WRITE HOLLERITH TEXT ON SCOPE M 7090DISPLA
WRITE HOLLERITH TEXT ON SCOPE M 7090DISPLA
OR LITERAL FORMAT VECTOR
WRITE OUTPUT TAPE WITH NORMAL F  FMTOUT
WRITE BINARY DATA ON TAPE M  WRTDAT
NGUAGE INTEGER VECTOR
PRINT OR WRITE OUTPUT TAPE A MACHINE LANGUAGE
IONAL ONLINE MONITOR OF BCD TAPE WRITING
ONLINE
VARIABLES BY A THIRD ONE BEING ZERO
$CHOOSE BETWEEN TWO
$FAST SET VECTOR TO ZERO
$SET A LIST OF VECTORS TO ZERO

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7. Difference Between Programs Sets I and II

Additions 172 programs have been added to Set I in forming Set II. They are

- ADDK
- ARBCOL
- ARCTAN
- ASPC2
- AVERAGE
- BLKSUM
- BOOST
- CARIGE
- CHOOSE
- CHSIGN
- CLKON
- CMPARP
- CMPARV
- CMPRA
- CNTRDB
- CNTROW
- COLAFL
- CONTUR
- COSIS1
- CPYFL2
- CROSS
- CROST
- CRSVM
- COUT
- CUPIT1
- CVOSOUT
- DABECK
- DELTA
- DERIVA
- DIPPRS
- DIVIDE
- DOTJ
- DOTP
- EXCHVS
- EXPAND
- FASCUB
- FASTRK
- FIRE2
- FIXV
- FLOATV
- FMTOUT
- FNDFMT
- FT24-II
- GETHOL
- GETX
- GNHOL2
- GRPHX
- HLADJ
- HVDIV
- IFNCTN
- IINTGR
- INDEX
- INTGRA
- INTHOL
- INTOPR
- INTSUM
- IVTOHV
- IXCARQ
- LIMITS
- LOCATE
- LSHTF
- LSLINE
- LSSS1
- MATINV
- MATML1
- MATML3
- MATRA
- MATRA1
- MDFOT
- MDOT3
- MFACF
- MIPLS
- MIPLS
- MOUTA1
- MOVCS
- MOVREV
- MRVRS
- MULFLY
- MVINAV
- MVNSUM
- MVNTN
- MVSQAV
- NRMVEC
- NTHA
- NURINC
- ONLINE
- PACDAT
- PLANSF
- PLOTWS
- PLTVS1
- PLTVS2
- PLURNS
- POLYSN
- POWER
- QCURRY
- QIPURY
- QIPURY
- QMNSM
- QMNSM
- QUFIT1
- QXCOR1
- RDATA1
- REFLEC
- REMAV
- REREAD
- REVER
- RLSPR
- RLSPREAD
- ROAR2
- RNDV
- RMSDEV
- SEFSAC
- SETINO
- SETK
- SETK
- SETK-II
- SETKV
- SETKV
- SETKVS
- SFTF
- SIZEUP
- SHUFFL
- SHTF
- SMPSON
- SPCOR2
- SQRSUM
- SQROOT
- SQRRMD
- SQUARE
- STZS
- SUM
- SUMDPR
- SWITCH
- TAVML
- TAMSUB
- TINL
- TRMINO
- VECOUT
- VDOTV
- VDVBV
- VPLUS1
- VRSOUT
- VSOUT
- WHICH
- WRTDAT
- XACTEQ
- XAVRAGE
- XDIV
- XDIVIDE
- XLCOMN
- XLIMIT
- XLOCV
- XOZE
- XREMAV
- XSRQFPR
- XSRQRT
- XVDVBV
- ZJFBCD
Deletions 11 programs have been deleted from Set I in forming Set II. They are

ATSH  CRST1  GNFMT1  UPDATE
BENIMP  GETREC  ORGDLT  WRTREC
BENSPT  GETREC-II  ROKWIC

Carryovers  95 programs were carried over from Set I to Set II. In all cases the date appearing on the first card of the symbolic deck has been changed and in most cases other changes have also been made, mostly to upgrade the documentation but in some cases to improve the coding.

The carryovers are

ABSVAL  FSKIP  LOC  QXCORR
ADANL  PT24  MAXSN  REVERS
AMPHZ  FXDATA  MLISCL  RND
ASPECT  GENMIOI  MLI2A6  ROTAT1
CHISQR  GETRD1  MOVE  RSKIP
CHPRTS  GNFLT1  MPSEQ1  SAME
CLOCK1(7050)  GRAP1H  MSCON1  SCPSCP
COLAPS  GRUP2  MUVADD  SEARCH
CONVLV  HSTPLT  MVBOUND  SHPT1
CONVLV-II  HSTPLT-II  NMZM01  SHPT2
COSP  HSTPLT-III(709)  N0INT1  SIMEQ
COSTBL  HSTPLT-III(7090)  NXALRM  SPLIT
DISPLA(709)  INDATA  OUDATA  SQRMLI
DISPLA(7090)  IPLYEV  PKNN  STZ
DSPFMT  ITOMLI  PLYSYN  UNPAKN
DUBLX  KINT1  PKCT1  VARARG
FACTOR  KOLAPS  POLYDV  WAC
FAPSUM  LINE (709)  POLYEV  WLLSFP
FASCN1  LINE (7090)  PREPFT  XFIXM
FDOT  LINEH (709)  PROB2  XSPEC
FLOATM  LINEH (7090)  PROCOR
FRAME (709)  LINEV (709)  PSQRT
FRAME (7090)  LINEV (7090)  PWMLIV
FRQCT1  LINTR1  QACORR
FRQCT2  LISTNG  QCNVLV