stichting mathematisch centrum



AFDELING NUMERIEKE WISKUNDE

NW 8/74 APRIL

P.W. HEMKER (ed.) NUMAL, A LIBRARY OF NUMERICAL PROCEDURES IN ALGOL 60 INDEX AND KWIC INDEX

2nd edition

2e boerhaavestraat 49 amsterdam

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Acknowledgements

The numerical library NUMAL is being developed by the joint efforts of the members of the library group of the Numerical Mathematics Department of the Mathematical Centre.

But, in this place I specially want to acknowledge Mr. G.J.F. Vinkesteyn, who takes care of the library files, and Mr. A.C. IJsselstein, who adapted and ran the kwic-index program by which the kwic-index in this report was generated.

P.W.H.

Introduction

On request of the Academic Computing Centre Amsterdam (SARA) the Mathematical Centre adapted its library of numerical procedures for use with the CD CYBER 70 system. The major part is now available for use and compatible with the CD ALGOL 60 compiler version 3. The resulting library is called NUMAL.

The aim of NUMAL is to provide a high level numerical library for ALGOL 60 programmers. The library contains a set of validated numerical procedures together with supporting documentation. Except for a small number of double length scalar product routines, all the source texts are written in ALGOL 60 and they are to a high degree independent of the computer/compiler used.

Unlike the former numerical library of the Mathematical Centre, the documentation of the library NUMAL is self-contained and does not refer to other MC-publications as far as the directions for use and the source texts of the procedures are concerned.

Of course, the library is in continuous development and any description will be an instantaneous one. In this report we give an index of the procedures available in april 1974 and a kwic-index of the procedures whose full descriptions were available at december 1st 1973.

The aim of the Mathematical Centre is to distribute an extended version of the index and kwic-index approximately twice a year.

Organization of the library

The library NUMAL is stored as a number of permanent files in the CD CYBER 70 system of SARA.

These files are:

1. the file "numal 3 index"

This file contains an up to date index of the library. A listing of version 740321 (march 21st 1974) is printed below.

It gives a survey of the procedures and it describes the way one can obtain the documentation of each procedure.

2. the file "numal 3"

(Numerical procedures in ALGOL 60, version 3).

This is a library file which contains the object code of the procedures available. This library can be used when programs are loaded, compiled by the CD ALGOL 60 compiler, version 3.

3. the files "numal 3 document a"

"numal 3 document b"

etc.

These files contain the documentation.

Each of these documentation files is subdivided into a number of segments, each consisting of two successive records. The first record of a segment contains a description of a procedure (or set of procedures) and instructions for use; the second record contains the ALGOL 60 source text(s).

The files "numal 3 document a" and "numal 3 document b" only contain ALGOL 60 source texts. Full documentation is in preparation. Mostly, the user can find documentation in the LR-series of the Mathematical Centre.

The files "numal 3 document c" upto "numal 3 document f" contain full documentation of those procedures which also were available for the EL-X8 computer of the Mathematical Centre and which are now available in a revised form for the CD CYBER 70 system.

The files "numal document g" and "numal document h" contain full docomentation of the procedures, developed in 1973 for NUMAL.

The procedures described in "numal 3 document a" up to and including "numal 3 document f" are available for all users of the SARA CD CYBER 70 system. At the moment (april 1974) the procedures described in "numal 3 document g" upto and including "numal 3 document j" are only available for those who have the disposal of an MC-project number.

INDEX TO THE LIBRARY

NUMAL

OF ALGOL 60 PROCEDURES IN NUMERICAL MATHEMATICS

ON REGUEST OF THE ACADEMIC COMPUTING CENTRE AMSTERDAM (SARA) THE LIBRARY NUMAL IS DEVELOPED AND SUPPORTED BY THE NUMERICAL MATHEMATICS DEPARTMENT OF THE MATHEMATICAL CENTRE (AMSTERDAM), THE PRESENT DOCUMENT CONTAINS A SURVEY OF THE PROCEDURES AVAILABLE IN OR PLANNED FOR NUMAL, MOREOVER, IT DESCRIBES THE WAY BY WHICH ONE CAN OBTAIN FULL DOCUMENTATION OF THOSE PROCEDURES ALREADY AVAILABLE.

FILES.

THE LIBRARY NUMAL CONSISTS OF A NUMBER OF FILES:

1. FILE "NUMALBINDEX".

THIS FILE CONTAINS THIS PARTICULAR DOCUMENT, I.E. THE INDEX TO THE LIBRARY.

- 2, FILE "NUMAL3" A LIBRARY FILE WHICH CONTAINS THE OBJECT CODE UF THE PROCEDURES AVAILABLE, THIS LIBRARY CAN BE USED WHEN PROGRAMS, COMPILED UNDER ALGOL3, ARE LOADED, FOR THE USE OF A LIBRARY FILE SEE E.G.
 - SCOPE REF MANUAL, CHAPTER 6.
 INTERCOM REF MANUAL, CHAPTER 3, XEQ COMMAND.
- 3. THE FILES "NUMAL 3DOCUMENTA"

"NUMAL 3DOCUMENTE"

"NUMAL 3DOCUMENTO"

THESE FILES CONTAIN THE DOCUMENTATION OF THE PROCEDURES, EACH OF THESE FILES IS SUBDIVIDED INTO A NUMBER OF SEGMENTS, EACH CONSISTING OF TWO SUCCESSIVE RECORDS, THE FIRST RECORD OF A SEGMENT CONTAINS A DESCRIPTION OF A PROCEDURE (OR SET OF PROCEDURES); THE SECOND RECORD CONTAINS THE ALGOL 60 SOURCE TEXT(S), THE FILES "NUMALSDOCUMENTA" AND "NUMALSDOCUMENTB" DNLY CONTAIN ALGOL 60 SOURCE TEXTS, FULL DOCUMENTATION IS IN PREPARATION, MOSTLY THE USER CAN FIND DOCUMENTATION IN THE LR-SERIES OF THE MATHEMATICAL CENTRE, WHICH CONTAINS DESCRIPTIONS OF THE EL-X8 IMPLEMENTATION OF THE ALGORITHMS, THE FILES "NUMALSDOCUMENTO", "NUMALSDOCUMENTO" ETC. CONTAIN FULL DOCUMENTATION,

HOW TO GET ENTRANCE TO THE DOCUMENTATION,

CLASSIFIED ACCORDING TO SUBJECT, THE PRESENT INDEX CONTAINS THE NAMES OF THE PROCEDURES, THE CORRESPONDING CODE NUMBERS IN NUMALS AND A REFERENCE TO THE DOCUMENTATION. THIS REFERENCE GIVES A FILENAME AND A NUMBER OF RECORDS TO BE SKIPPED ON THAT FILE (SKIPR), IN ORDER TO CONSULT A SPECIFIED RECORD OF DOCUMENTATION, ALL PRECEDING RECORDS HAVE TO BE SKIPPED.

EXAMPLE.

IN ORDER TO OBTAIN THE DESCRIPTION OF THE PROCEDURE "MULTISTEP" (SECTION 5.2.1.1.1.1.1., ON FILE "NUMAL3DOCUMENTC", SKIPR=30)
THE NEXT CONTROL CARDS CAN BE USED

ATTACH, N3C, NUMAL 3DDCUMENTC, SKIPF, N3C, 30, COPYBR, N3C, OUTPUT.

IN ORDER TO OBTAIN THE SOURCE TEXT, ONE MORE RECORD HAD TO BE SKIPPED.

SERVICE.

ADVICE ABOUT THE USE OF THE LIBRARY OR ABOUT THE USE OF THE INDIVIDUAL PROCEDURES CAN BE OBTAINED FROM THE PROGRAM ADVISOR OF THE MATHEMATICAL CENTRE.

NOTE.

FOR FUTURE PUBLICATION THE DOCUMENTATION IS SCATTERED WITH LAYOUT SYMBOLS: S+ S< S> S: S= S; S. ETC.,

P.W.HEMKER (MATHEMATICAL CENTRE)

REMARK.

AT THE MOMENT (1974-3-20) THE PROCEDURES DESCRIBED IN NUMALDOCUMENTG, NUMAL3DOCUMENTH AND NUMALDOCEMENTJ ARE ONLY AVAILABLE FOR THOSE WHO HAVE THE DISPOSAL OF AN MC-PROJECTNUMBER.

NO PART OF THE LIBRARY NUMAL MAY BE REPRODUCED, STORED IN A RETRIEVAL SYSTEM OR TRANSMITTED, IN ANY FORM OR BY ANY MEANS, ELECTRONIC, PHOTOCOPYING, RECORDING, OR OTHERWISE, WITHOUT THE PRIOR WRITTEN PERMISSION OF THE ACADEMIC COMPUTING CENTRE AMSTERDAM (SARA) OR THE MATHEMATICAL CENTRE (AMSTERDAM).

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Kwic index to the library NUMAL of ALGOL 60 procedures in numerical mathematics.

This key word in context (kwic) index is based upon only those procedures whose full documentation was available on 1 december 1973.

Directions for use:

The kwic index is based upon program abstracts such as:
32070 C 6 \$qadrat (\$quadrature) computes the \$definite \$integral of a \$function of one variable over a finite interval.

The first ten characters ("32070 C 6") of each abstract are a code to locate the procedure, while the remaining characters until a period comprise a short description of the program (its name, what it does, and how it does it), only "important" words (preceded by a \$ in the above example) are used as key words in the kwic index.

The first appearance of our above example abstract in the kwic index is:

t (quadrature) computes the definite integral of a function of one variable over a finite interval. 32070 C 6

If this program (qadrat) is of interest, you can locate it as follows: the first five digits give the number of the object code procedure in the library file "NUMAL3". The next letter is to locate the documentation file: "A" corresponds to file "NUMAL3DOCUMENTA", "B" to file "NUMAL3DOCU MENTB" etc.. The final number specifies the number of records to be skipped on the documentation file in order to locate the documentation of the particular program.

In case an entry in the kwic index is not completely readable (i.e., truncated at an end of the line), you can find a complete listing (by code number) of all the abstracts following the kwic index.

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                                                                                                                                       33130 D 38
                                AUTONOMOUS SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS, BY AN IMPLICIT, EXPONENTIALLY FITTED, SECON
                                                                                                                                       33131 D 38
L VALUE PROBLEMS, GIVEN AS AN
                                                                                                                                       34210 D 30
                LINEMIN IS AN
                                AUXILIARY PROCEDURE FOR OPTIMIZATION.
                                                                                                                                       34211 0 30
                RNK1UPD IS AN
                                AUXILIARY PROCEDURE FOR OPTIMIZATION.
                                                                                                                                       34212 D 30
                DAVUPO IS AN
                                AUXILIARY PROCEDURE FOR OPTIMIZATION.
                                                                                                                                       34213 D 30
                                AUXILIARY PROCEDURE FOR OPTIMIZATION
                FLEUPD 13 AN
                                                                                                                                       35053 E 14
                                AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
                 IXGFIX IS AN
                 IXPFIX IS AN
                                AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
                                                                                                                                       35054 E 14
                                                                                                                                       35055 E 14
                                AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
                FORWARD IS AN
                                                                                                                                       35056 E 14
               BACKWARD IS AN
                                AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
                                                                                                                                       36020 E 18
                    INI IS AN
                                AUXILIARY PROCEDURE FOR MINIMAX APPROXIMATION.
                                                                                                                                       34242 E 22
                                AUXILIARY PROCEDURE FOR THE SOLUTION OF LINEAR EQUATION WITH AN UPPER BOUND FOR THE ERROR.
                 GSSERS IS AN
                                                                                                                                       34252 € 22
                                AUXILIARY PROCEDURE FOR THE ITERATIVELY REFINED SOLUTION OF A SYSTEM OF LINEAR EQUATIONS.
                 GSSNR! IS AN
                               AUXILIARY PROCEDURE FOR THE COMPUTATION OF COMPLEX EIGENVECTORS OF A REAL MATRIX.
                                                                                                                                       34193 F 10
                COMSCL IS AN
                                BACKWARD IS AN AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
                                                                                                                                       35056 E 14
                                BACK TRANSFORMATION CORRESPONDING TO THE HOUSEHOLDERS TRANSFORMATION AS PERFORMED BY TEMSYMTRI2.
                                                                                                                                       34141 0 34
      BAKSYMTRIZ PERFORMS THE
      BAKSYMTRI1 PERFORMS THE
                                BACK TRANSFORMATION CORRESPONDING TO THE HOUSEHOLDERS TRANSFORMATION AS PERFORMED BY TEMSYMTRIA.
                                                                                                                                       34144 D 34
                                                                                                                                       34174 F 12
                                BACK TRANSFORMATION CORRESPONDING TO THE EQUILIBRATION AS PERFORMED BY EQILBR.
          BAKLBR PERFORMS THE
                                BACK TRANSFORMATION CORRESPONDING TO THE WILKINSON TRANSFORMATION AS PERFORMED BY TEMPERAHES, ON A VE
                                                                                                                                      341/1 F 14
      BAKREAMEST PERFORMS THE
                                BACK TRANSFORMATION CORRESPONDING TO THE WILKINSON TRANSFORMATION AS PERFORMED BY TEMREAHES, ON THE
                                                                                                                                       341/2 F 14
      BAKREAHES2 PERFORMS THE
                                                                                                                                       34365 G 4
       BAKHRHTRI PERFORMS THE
                                BACK TRANSFORMATION CORRESPONDING TO HSHHRMTR',
                                                                                                                                       34367 G 14
       BAKCOMHES PERFORMS THE
                                BACK TRANSFORMATION CORRESPONDING TO HEHCOMHES.
                               BACK TRANSFORMATION CORRESPONDING TO THE EQUILIBRATION AS PERFORMED BY EQILBROOM,
                                                                                                                                       34362 G 16
       BAKLBROOM PERFORMS THE
                                BAKCOMHES PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO HSHCOMHES.
                                                                                                                                       34367 G 14
                                BAKHRMTR! PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO HISHHRMTR!
                                                                                                                                       34365 G 4
                                BAKLBROOM PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE EQUILIBRATION AS PERFORMED BY EQUILBR
                                                                                                                                       34362 G 16
                                                                                                                                       34174 F 12
                                BAKLBR PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE EQUILIBRATION AS PERFORMED BY EQILBR,
                                BAKREAHEST PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE WILKINSON TRANSFORMATION AS PERFORM
                                                                                                                                       34171 F 14
                                BAKREAMES2 PERFORMS THE BACK TRANSFORMATION COPRESPONDING TO THE WILKINSON TRANSFORMATION AS PERFORM
                                                                                                                                       34172 F 14
                                BAKSYMTRIT PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE HOUSEHOLDERS TRANSFORMATION AS PERF
                                                                                                                                       34144 D 34
                                BAKSYMTRIZ PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE HOUSEHOLDERS TRANSFORMATION AS PERF
                                                                                                                                      34141 D 34
COMPUTES THE DETERMINANT OF A
                                BAND MATRIX, WHICH HAS BEEN DECOMPOSED BY DECEND,
                                                                                                                                       34321 E 2
STEM OF LINEAR EQUATIONS WITH
                                BAND MATRIX, WHICH IS DECOMPOSED BY DECBND.
                                                                                                                                       34071 E 4
                                BAND MATRIX, WHICH HAS BEEN DECOMPOSED BY CHLDECHND.
                                                                                                                                       34332 E 10
H SYMMETRIC POSITIVE DEFINITE
A SYMMETRIC POSITIVE DEFINITE BAND MATRIX AND SOLVES THE SYSTEM OF LINEAR EQUATIONS BY THE CHOLESKY METHOD.
                                                                                                                                       34333 E 10
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34320 E 0 TRIANGULAR DECOMPOSITION OF A BAND MATRIX BY GAUSSIAN ELIMINATION, BAND MATRIX BY GAUSSIAN ELIMINATION AND SOLVES THE SYSTEM OF LINEAR EQUATIONS. 34322 E 4 RFORMS THE DECOMPOSITION OF A BASHFORTH METHOD; WITH AUTOMATIC STEP AND ORDER CONTROL AND SUITABLE FOR THE INTEGRATION OF STIFF DI , ADAMS - MOULTON, OR ADAMS -33080 C 30 BEST LEAST SQUARES SULUTION OF A UNDERDETERMINED SYSTEM OF LINEAR EQUATIONS, PROVIDED THAT THE SINGU 34282 H 2 SOLSYDUND CALCULATES THE BEST LEAST SQUARES SOLUTION OF A UNDERDETERMINED SYSTEM OF LINEAR EQUATIONS BY MEANS OF SINGULAR VAL 34283 H 2 SOLUND CALCULATES THE 35050 E 14 BETA FUNCTION I(X,P,Q),9<=X<=1,P>0,Q>0. CBETA COMPUTES THE INCOMPLETE BETA FUNCTION I(X,P+N,Q),0<=X<=1,P>0,Q>0, FOR N=0(1)NMAX, 35051 E 14 PLUSH COMPUTES THE INCOMPLETE BETA FUNCTION I(X,P,Q+N),0<=X<=1,P>0,Q>0, FOR N=0(1)NMAX. 35052 E 14 PLUSH COMPUTES THE INCOMPLETE BIDIAGONAL DECOMPOSITION IS GIVEN, BY MEANS OF AN IMPLICIT GRATTERATION. 34271 H 10 N OF A REAL MATRIX OF WHICH A 34260 H 8 BIDIAGONAL FORM BY MEANS OF HOUSEHOLDER TRANSFORMATION, TRANSFORMS A REAL MATRIX INTO 34261 H 8 ID TO TRANSFORM A MATRIX INTO BID!AGONAL FORM. 34262 H B ID TO TRANSFORM A MATRIX INTO BIDIAGONAL FORM, THE SINGULAR VALUES OF A REAL BIDIAGONAL MATRIX BY MEANS OF IMPLICIT QREITERATION. 34270 H 10 BOUNDARY) VALUE PROBLEM, GIVEN AS A SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS, BY A ONE-STEP TAY 33040 C 26 ED TAYLOR SOLVES AN INITIAL (BOUNDARY) VALUE PROBLET, GIVEN AS A SYSTEM OF FIRST ORDER (NON-LINEAR) DIFFERENTIAL EQUATIONS, BY 33060 C 28 NGE KUTTA SOLVES AN INITIAL (UATIONS AND COMPUTES AN UPPER BOUND FOR ITS ERROR. 34243 E 26 34244 E 28 ERSE OF A MATRIX AND AN UPPER BOUND FOR ITS ERROR. BOUND FOR ITS ERROR, OF A SYSTEM OF LINEAR EQUATIONS, OF WHICH THE TRIANGULARLY DECOMPOSED FORM OF T 34253 E 30 REFINED SOLUTION AND AN UPPER ERBELM COMPUTES AN UPPER BOUND FOR THE ERROR IN THE SOLUTION OF A SYSTEM OF LINEAR EQUATIONS. 34241 E 22 CARPOL TRANSFORMS A COMPLEX NUMBER GIVEN IN CARTESIAN COORDINATES INTO POLAR COORDINATES. 34344 D 18 RMS A COMPLEX NUMBER GIVEN IN CARTESIAN COORDINATES INTO POLAR COORDINATES. 34344 D 18 CHLDEC1 (LINEAR EQUATIONS) COMPUTES THE CHOLESKY DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MA 34311 F 0 CHLDEC2 (LINEAR EQUATIONS) COMPUTES THE CHOLESKY DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MA 34310 F CHEDECAND PERFORMS THE TRIANGULAR DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX BY THE CHOLE 34330 E 6 CHLDECINV1 COMPUTES, BY THE CHOLESKY METHOD, THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX, ST CHLDECINV2 COMPUTES, BY THE CHOLESKY METHOD, THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX, ST. 34402 F CHLDECSCL1 SOLVES A SYMMETRIC POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS BY THE CHOLESKY METHOD, T 34393 F 4 CHLDECSCL2 SOLVES A SYMMETRIC POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS BY THE CHOLESKY METHOD, T 34392 F 4 CHIDECSCLAND PERFORMS THE DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE BAND MATRIX AND SOLVES THE 34333 E 10 CHIDETERM1 COMPUTES THE DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMPOS 34313 F 2 CHIDETERMO COMPUTES THE DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMPOS 34312 F CHLDETERMBND COMPUTES THE DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMP 34331 E CHLINVI COMPUTES THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX WHICH HAS BEEN DECOMPOSED BY CH 34401 F 6 CHLIDVE COMPUTES THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX WHICH HAS BEEN DECOMPOSED BY CH. 34400 F CHLSOL1 SOLVES A SYMMETRIC POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS, THE MATRIX BEING DECOMPOSED 34391 F CHLSOL2 SOLVES A SYMMETRIC POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS, THE MATRIX BEING DECOMPOSED 34390 F 4 CHLSOLEND SOLVES A SYSTEM OF LINEAR EQUATIONS WITH SYMMETRIC POSITIVE DEFINITE BAND MATRIX, WHICH HA 34332 E 10 CHOLESKY DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED IN A TWO-DIMENSIONAL ARRAY. 34310 F 0 NEAR EQUATIONS) COMPUTES THE CHOLESKY DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED COLUMNWISE IN A ONE-DIMENSION 34311 F 0 NEAR EQUATIONS) COMPUTES THE 34330 E 6 SITIVE DEFINITE MATRIX BY THE CHOLESKY METHOD. 34333 E 10 EM OF LINEAR EQUATIONS BY THE CHOLESKY METHOD. CHOLESKY METHOD, THE MATRIX BEING STORED IN A TWO-DIMENSIONAL ARRAY. 34392 F 4 EM OF LINEAR EQUATIONS BY THE 34393 F 4 EM OF LINEAR EQUATIONS BY THE CHOLESKY METHOD, THE MATRIX BEING STORED IN A ONE-DIMENSIONAL ARRAY. CHOLESKY METHOD, THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED IN A TWO-DIMENSIONAL AR 34402 F CHLDECINV2 COMPUTES, BY THE CHOLESKY METHOD, THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED IN A ONE-DIMENSIONAL AR 34403 F CHLDECINVI COMPUTES, BY THE CODIAGONAL ELEMENTS OF A HERMITIAN TRIDIAGONAL MATRIX WHICH IS UNITARY SIMILAR TO A GIVEN HERMITIAN 34364 G L ELEMENTS AND SQUARES OF THE CODIAGONAL OF A SYMMETRIC MATRIX WITH A CONSTANT. 31013 D 0 INISYMD INITIALIZES A 31012 D 0 CODIAGONAL WITH A CONSTANT. LIZES (PART OF) A DIAGONAL OR 34345 D 24 ADRATIC EQUATION WITH COMPLEX COEFFICIENTS. COEFFICIENTS OF THE NEWTON INTERPOLATION POLYNOMIAL FOR GIVEN ARGUMENTS AND FUNCTION VALUES, 36010 C 44 NEWTON DETERMINES THE COEFFICIENTS OF THE POLYNOMIAL (IN GRUNERT FORM) THAT APPROXIMATES A FUNCTION GIVEN FOR DISCRETE ARG 36022 C 46 MINMAXPOL DETERMINES THE COLCST MULTIPLIES A COLUMN VECTOR BY A SCALAR, 31131 D 4 34014 D 6 TES THE SCALAR PRODUCT OF TWO COLUMN VECTORS. 34031 D 10 INTERCHANGES ELEMENTS OF TWO COLUMN VECTORS. ARY ROTATION OPERATION ON TWO COLUMN VECTORS. 34040 D 12 34013 D 6 R PRODUCT OF A ROW VECTOR AND COLUMN VECTOR. 34033 D 10 COLUMN VECTOR. ELEMENTS OF A ROW VECTOR AND 34012 D 6 PUTES THE SCALAR PRODUCT OF A COLUMN VECTOR AND VECTOR.

31022 D 4

31131 D 4

COLUMN VECTOR BY A SCALAR.

COLUMN VECTOR BY A SCALAR.

MULCOL MULTIPLIES A

COLCST MULTIPLIES A

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34352 6 6
OMCOLOST MULTIPLIES A COMPLEX COLUMN VECTOR BY A COMPLEX NUMBER,
                                                                                                                                    31033 D 2
 DUPVECCOL COPIES (PART OF) A
                               COLUMN VECTOR TO A VECTOR.
                               COLUMN VECTOR TO ANOTHER COLUMN VECTOR,
                                                                                                                                    34023 D 8
 ELMCOL ADDS A SCALAR TIMES A
                               COLUMN VECTOR TO A VECTOR.
                                                                                                                                    34021 D 8
MVECCOL ADDS A SCALAR TIMES A
                               COLUMN VECTOR TO A ROW VECTOR.
                                                                                                                                    34028 D 8
MROWCOL ADDS A SCALAR TIMES A
                               COMABS COMPUTES THE HODULUS OF A COMPLEX NUMBER.
                                                                                                                                    34340 D 14
                               CONCOLOST MULTIPLIES A COMPLEX COLUMN VECTOR BY A COMPLEX NUMBER.
                                                                                                                                    34352 G 6
                               COMDIV COMPUTES THE QUOTIENT OF TWO COMPLEX NUMBERS.
                                                                                                                                    34342 0 22
                               CONEUCNRM COMPUTES THE EUCLIDEAN NORM OF A COMPLEX MATRIX.
                                                                                                                                    34359 6 26
                                COMMAND COMPUTES THE ROOTS OF A QUADRATIC EQUATION WITH COMPLEX COEFFICIENTS.
                                                                                                                                    34345 D 24
                               COMMATVEC COMPUTES THE SCALAR PRODUCT OF A COMPLEX ROW VECTOR AND A COMPLEX VECTOR.
                                                                                                                                    34354 6 18
                                COMMUL MULTIPLIES TWO COMPLEX NUMBERS.
                                                                                                                                    34341 D 20
                               COMPLEMENTARY ERROR FUNCTION FOR A REAL ARGUMENT; THESE FUNCTIONS ARE RELATED TO THE NORMAL OR GAUSS
                                                                                                                                    35020 C 38
MPUTES THE ERROR FUNCTION AND
                               COMPLETE PIVOTING.
                                                                                                                                    34231 E 22
ION WITH COMBINED PARTIAL AND
ION WITH COMBINED PARTIAL AND
                               COMPLETE PIVOTING.
                                                                                                                                    34232 E 26
                               COMPLEX COEFFICIENTS.
                                                                                                                                    34345 D 24
 OF A QUADRATIC EQUATION WITH
ADDS A COMPLEX NUMBER TIMES A
                               COMPLEX COLUMN VECTOR TO A COMPLEX VECTOR.
                                                                                                                                    34376 6 0
                               COMPLEX COLUMN VECTOR TO ANOTHER COMPLEX COLUMN VECTOR.
                                                                                                                                    34377 G 0
ADDS A COMPLEX NUMBER TIMES A
                                                                                                                                    34357 G 2
OL PERFORMS A ROTATION ON TWO
                               COMPLEX COLUMN VECTORS.
       COMCOLOST FULTIPLIES A
                               COMPLEX COLUMN VECTOR BY A COMPLEX NUMBER.
                                                                                                                                    34352 6 6
                                                                                                                                    34356 G 24
PLIES A COMPLEX MATRIX WITH A
                               COMPLEX HOUSEHOLDER MATRIX.
                                                                                                                                    34374 G 10
                               COMPLEX MATRIX.
COMPUTES ALL EIGENVALUES OF A
                                                                                                                                    34375 G 10
                               COMPLEX MATRIX.
NVECTORS AND EIGENVALUES OF A
                                                                                                                                    34359 G 28
PUTES THE EUCLIDEAN NORF OF A
                               COMPLEX MATRIX.
                                                                                                                                    34360 6 22
M NORMALIZES THE COLUMNS OF A
                               COMPLEX MATRIX.
       HISHCOMMES TRANSFORPS A COMPLEX MATRIX INTO A SIMILAR UNITARY UPPER HESSENBERG MATRIX WITH A REAL NON-NEGATIVE SUBDIAGONAL.
                                                                                                                                    34366 G 14
                               COMPLEX MATRIX INTO A SIMILAR EQUILIBRATED COMPLEX MATRIX.
                                                                                                                                    34361 G 16
       EDILBPCOM TRANSFORMS A
                                                                                                                                    34341 D 20
       COMMUL MULTIPLIES TWO
                               COMPLEX NUMBERS.
 COMPUTES THE QUOTIENT OF TWO COMPLEX NUMBERS.
                                                                                                                                    34342 D 22
                                                                                                                                    34340 D 14
ABS COMPUTES THE MODULUS OF A
                             COMPLEX NUMBER.
COMPUTES THE SQUARE ROOT OF A COMPLEX NUMBER.
                                                                                                                                    34343 D 16
                                                                                                                                    34344 D 18
          CAPPOL TRANSFORMS A COMPLEX NUMBER GIVEN IN CARTESIAN COORDINATES INTO POLAR COORDINATES.
         ELECOMVECCOL ADDS A COMPLEX NUMBER TIMES A COMPLEX COLUMN VECTOR TO A COMPLEX VECTOR,
                                                                                                                                    34376 G D
            ELECOMCOL ADDS A COMPLEX NUMBER TIMES / COMPLEX COLUMN VECTOR TO ANOTHER COMPLEX COLUMN VECTOR.
                                                                                                                                    34377 G 0
         ELMCOMROWVEC ADDS A COMPLEX NUMBER TIMES / COMPLEX VECTOR TO A COMPLEX ROW VECTOR,
                                                                                                                                    343/8 G 0
                                                                                                                                    34358 G 2
                               COMPLEX PO" VECTORS.
OW PERFORMS A ROTATION ON TWO
       COMPONEST FULTIPLIES A COMPLEX ROW VECTOR BY A COMPLEX NUMBER.
                                                                                                                                    34353 G 6
                                                                                                                                    34354 6 18
PUTES THE SCALAR PRODUCT OF A COMPLEX ROW VECTOR AND A COMPLEX VECTOR.
                               COMPLEX UPPER HESSENBERG MATRIX WITH A REAL SUBDIAGONAL,
                                                                                                                                    34372 G 12
COMPUTES ALL EIGENVALUES OF A
                               COMPLEX UPPER HESSENDERG MATRIX WITH A REAL SUBDIAGONAL.
                                                                                                                                    34373 G 12
NVECTORS AND EIGENVALUES OF A
                                                                                                                                    34378 G 0
ADDS A COMPLEX NUMBER TIMES A
                               COMPLEX VECTOR TO A COMPLEX ROW VECTOR.
                              COMPLEX VECTOR INTO A VECTOR PROPORTIONAL TO A UNIT VECTOR.
                                                                                                                                    34355 G 24
       HSHCOMCOL TRANSFORMS A
                                                                                                                                    34353 G 6
                               COMPROMEST MULTIPLIES 4 COMPLEX ROW VECTOR BY A COMPLEX NUMBER.
                               COMSCL IS AN AUXILIARY PROCEDURE FOR THE COMPUTATION OF COMPLEX EIGENVECTORS OF A PEAL MATRIX.
                                                                                                                                    34193 F 10
                               COMSORT COMPUTES THE SQUARE ROOT OF A COMPLEX NUMBER,
                                                                                                                                    34343 D 16
                               CONVALOR! CALCULATES THE REAL AND COMPLEX EIGENVALUES OF A REAL UPPER HESSENBERG MATRIX BY MEANS OF
                                                                                                                                    34190 F 16
                               COMPECHES CALCULATES THE EIGENVECTOR CORRESPONDING TO A GIVEN COMPLEX EIGENVALUE OF A REAL UPPER HES
                                                                                                                                    34191 F 16
                                                                                                                                     34220 C 16
AR EQUATIONS BY THE METHOD CF
                               CONJUGATE GRADIENTS.
                               CONU GRAD SOLVES A SYMMETRIC AND POSITIVE DEFINITE, SYSTEM OF LINEAR EQUATIONS BY THE METHOD OF CONJ
                                                                                                                                    34220 C 36
                               COUTROL; SUITABLE FOR INTEGRATION OF STIFF DIFFERENTIAL EQUATIONS.
                                                                                                                                     33120 C 32
IAN MATRIX AND AUTOMATIC STEP
                               CONTROL AND SUITABLE FOR THE INTEGRATION OF STIFF DIFFERENTIAL EQUATIONS.
                                                                                                                                     33080 C 30
WITH AUTOMATIC STEP AND ORDER
                                                                                                                                     34344 D 18
TESIAN COORDINATES INTO POLAR
                               COORD NATES.
                                                                                                                                     34344 D 11
                               COORDINATES INTO POLAR COORDINATES,
LEX NUMBER GIVEN IN CARTESIAN
                      DUPVEC COPIES (PART OF) A VECTOR TO A VECTOR,
                                                                                                                                     31030 D ;
                                                                                                                                     31031 D 2
                               COPIES (PART OF) A RUW VECTOR TO A VECTOR,
                   DUPVECROW
                                                                                                                                     31032 D 2
                               COPIES (PART OF) A VECTOR TO A ROW VECTOR.
                   DUPROWVEC
                               COPIES (PART OF) A CULUMN VECTOR TO A VECTOR.
                                                                                                                                    31033 D 2
                   DUPVECCOL
                   DUPCOLVEG COPIES (PART OF) A VECTOR TO A COLUMN VECTOR.
                                                                                                                                    31034 D 2
                               COPIES (PART OF) A MATRIX TO (AN OTHER) MATRIX.
                                                                                                                                    31035 D 2
                      DUPMAT
 DECOMPOSITION OF A MATRIX BY CROUT FACTORIZATION WITH PARTIAL PIVOTING.
                                                                                                                                    34300 E 22
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34301 E 26 CROUT FACTORIZATION WITH PARTIAL PIVOTING. SYSTEM OF LINEAR EQUATIONS BY DAVUPD IS AN AUXILIARY PROCEDURE FOR OPTIMIZATION. 34212 D 30 DECEND PERFORMS THE TRIANGULAR DECOMPOSITION OF A BAND MATRIX BY GAUSSIAN ELIMINATION. 34320 E 0 34302 E 28 DECINY COMPUTES THE INVERSE OF A MATRIX. DECOMPOSITION IS GIVEN. ATRIX, PROVIDED THAT THE UICU 34421 H 22 ECBND PERFORMS THE TRIANGULAR DECOMPOSITION OF A BAND MATRIX BY GAUSSIAN ELIMINATION. 34320 E 0 DECOMPOSITION OF A BAND MATRIX BY GAUSSIAN ELIMINATION AND SOLVES THE SYSTEM OF LINEAR EQUATIONS. 34322 E 4 DECSOLAND PERFORMS THE ECBND PERFORMS THE TRIANGULAR DECCMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX BY THE CHOLESKY METHOD. 34330 E 6 DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE BAND MATRIX AND SOLVES THE SYSTEM OF LINEAR EQUATIONS 34333 E 10 CHLDECSOLBND PERFORMS THE DECOMPOSITION OF A MATRIX BY CROUT FACTORIZATION WITH PARTIAL PIVOTING. 34300 E 22 DEC PERFORMS THE TRIANGULAR DECOMPOSITION OF A MATRIX BY GAUSSIAN ELIMINATION WITH COMBINED PARTIAL AND COMPLETE PIVOTING. 34231 E 22 SSELM PERFORMS THE TRIANGULAR 34310 F 0 TIONS) COMPUTES THE CHOLESKY DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED IN A TWO-DIMENSIONAL ARRAY. DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STOPED COLUMNWISE IN A ONE-DIMENSIONAL ARRAY. 34311 F. O. TIONS) COMPUTES THE CHOLESKY DECOMPOSITION OF A TRIDIAGONAL MATRIX. 34423 H 16 TES, WITHOUT PIVOTING, THE LU 34426 H 16 WITH PARTIAL PIVOTING, THE LU DECOMPOSITION OF A TRIDIAGONAL MATRIX. DECOMPOSITION OF A SYMMETRIC TRIDIAGONAL MATRIX. 34420 H 20 DECSYMTRI CALCULATES THE UIDU DECSOLBND PERFORMS THE DECOMPOSITION OF A BAND MATRIX BY GAUSSIAN ELIMINATION AND SOLVES THE SYSTEM 34322 € 4 DECSOLSYMTRI SOLVES A SYSTEM OF LINEAR EQUATIONS WITH SYMMETRIC TRIDIAGONAL COEFFICIENT MATRIX. 34422 H 22 DECSOLTRIPIV SOLVES WITH PARTIAL PIVOTING A SYSTEM OF LINEAR EQUATIONS WITH TRIDIAGONAL COEFFICIENT 34428 H 18 DECSOLTRI SOLVES A SYSTEM OF LINEAR EQUATIONS WITH TRIDIAGONAL COEFFICIENT MATRIX, 34425 H 18 DECSOL SOLVES A SYSTEM OF LINEAR EQUATIONS BY CROUT FACTORIZATION WITH PARTIAL PIVOTING, 34301 E 26 DECSYMPRI CALCULATES THE UIDU DECOMPOSITION OF A SYMMETRIC TRIDIAGONAL MATRIX. 34420 H 26 DECTRIPIN CALCULATES, WITH PARTIAL PINOTING, THE LU DECOMPOSITION OF A TRIDIAGONAL MATRIX. 34426 H 16 34427 H 18 ECOMPOSITION AS CALCULATED BY DECTRIPIV IS GIVEN. DECTRI CALCULATES, MITHOUT PIVOTING, THE LU DECOMPOSITION OF A TRIDIAGONAL MATRIX. 34423 H 16 DEC PERFORMS THE TRIANGULAR DECOMPOSITION OF A MATRIX BY CROUT FACTORIZATION WITH PARTIAL PIVOTING. 34300 E 22 LVES A SYMMETRIC AND POSITIVE DEFINITE, SYSTEM OF LINEAR EQUATIONS BY THE METHOD OF CONJUGATE GRADIENTS. 34220 C 36 T (QUADRATURE) COMPUTES THE DEFINITE INTEGRAL OF A FUNCTION OF ONE VARIABLE OVER A FINITE INTERVAL. 320/0 C 6 DEFINITE INTEGRAL OF A FUNCTION OF ONE VARIABLE OVER A FINITE OR INFINITE INTERVAL OR OVER A NUMBER 32051 C 48 L (QUADRATURE) COMPUTES THE DETERMEND COMPUTES THE DETERMINANT OF A BAND MATRIX, WHICH HAS BEEN DECOMPOSED BY DECEND, 34321 E 2 34321 E 2 DETERMBND COMPUTES THE DETERMINANT OF A BAND MATRIX, WHICH HAS BEEN DECOMPOSED BY DECEND. DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMPOSED BY CHLDECBND. 34331 E 8 CHLDETERMBND COMPUTES THE DETERMINANT OF A MATRIX PROVIDED THAT THE MATRIX HAS BEEN DECOMPOSED BY DEC OR GSSELM. 34303 E 24 DETERM COMPUTES THE 34312 F 2 DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMPOSED BY CHLDEC2. CHLDETERM2 COMPUTES THE CHLDETERM1 COMPUTES THE DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMPOSED BY CHLDECI. 34313 F 2 DETERM COMPUTES THE DETERMINANT OF A MATRIX PROVIDED THAT THE MATRIX HAS BEEN DECOMPOSED BY DEC OR G. 34303 E 24 DIAGONAL ELEMENTS OF THE INVERSE OF MIM (M COEFFICIENT MATRIX) OF A LINEAR LEAST SQUARES PROBLEM. 34132 E 32 LSODGLINV COMPUTES THE ARES PROBLEM AND COMPUTES THE DIAGONAL ELEMENTS OF THE INVERSE OF MIM (M COEFFICIENT MATRIX). 34135 E 34 DIAGONAL ELEMENTS AND SQUARES OF THE CODIAGONAL ELEMENTS OF A HERMITIAN TRIDIAGONAL MATRIX WHICH IS 34364 G 4 SHHRMTRIVAL DELIVERS THE MAIN IMATO INITIALIZES (PART OF) A 31012 D 0 DIAGONAL OF CODIAGONAL WITH A CONSTANT. 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                                DOUBLE PRECISION THE SCALAR PRODUCT OF TWO VECTORS
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                                DOUBLE PRECISION THE SCALAR PRODUCT OF A ROW VECTOR AND A VECTOR,
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                               DOUBLE PRECISION THE SCALAR PRODUCT OF A COLUMN VECTOR AND A VECTOR
       LNGTAMVEC COMPUTES IN
                                                                                                                                      34413 H 14
                                DOUBLE PRECISION THE SCALAR PRODUCT OF A ROW VECTOR AND A COLUMN VECTOR.
       LNGMATMAT COMPUTES IN
        LNGTAMMAT COMPUTES IN
                                DOUBLE PRECISION THE SCALAR PRODUCT OF TWO COLUMN VECTORS.
                                                                                                                                      34414 H 14
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       LNGMATTAM COMPUTES IN
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                               DOUBLE PRECISION THE SCALAR PRODUCT OF TWO VECTORS.
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                               DOUBLE PRECISION THE SCALAR PRODUCT OF TWO VECTORS.
                               DOUBLE PRECISION THE SCALAR PRODUCT OF A VECTOR AND A ROW IN A SYMMETRIC MATRIX, DUPCOLVEC COPIES (PART OF) A VECTOR TO A COLUMN VECTOR.
                                                                                                                                      34418 H 14
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                                                                                                                                      31034 D 2
                                                                                                                                      31,035 D 2
                                DUPMAT COPIES (PART OF) A MATRIX TO (AN OTHER) MATRIX.
                                                                                                                                      31032 D 2
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                                DUPVECCEL COPIES (PART OF) A COLUMN VECTOR TO A VECTOR.
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                                DUPVECTOR COPIES (PART OF) A ROW VECTOR TO A VECTOR.
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PCL

FUNCTION FOR POSITIVE ARGUMENTS.

FUNCTION ((X,P,Q),0<=X<=1,P>0,Q>0.

FUNCTION : (X,P+N,Q), U<=X<=1,P>0,Q>0, FOR N=0(1)NMAX.

FUNCTION $I(X,P,Q+N), U \leq X \leq 1, P > 0, Q > 0, FOR N=0(1)NMAX,$

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COMPUTES THE INCOMPLETE BETA
COMPUTES THE INCOMPLETE BETA

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35051 E 14 35050 E 14

35052 E 14

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                                                                                                                                       35052 € 14
                                IBOPLUSN COMPUTES THE INCOMPLETE BETA FUNCTION I(X,P,Q+N),0<=x<=1,P>0,Q>0, FOR N=0(1)NMAX.
                                ICHCOL INTERCHANGES ELEMENTS OF TWO COLUMN VECTORS.
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                                ICHROWCOL INTERCHANGES ELEMENTS OF A ROW VECTOR AND COLUMN VECTOR.
                                ICHROW INTERCHANGES ELEMENTS OF TWO ROW VECTORS.
                                                                                                                                       34032 0 10
                                                                                                                                       34034 D 10
                                ICHSEQUEC INTERCHANGES ELEMENTS OF TWO VECTORS.
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                                ICHVEC INTERCHANGES ELEMENTS OF TWO VECTORS.
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                                                                                                                                       33131 0 38
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                                INCRETA COMPUTES THE INCOMPLETE BETA FUNCTION ! (X,P,Q),0<=X<=1,P>0,Q>0.
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                                INCOMEAN COMPUTES THE INCOMPLETE GAMMA FUNCTION BY PADE APPROXIMATIONS.
         INCBETA COMPUTES THE
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                                INCOMPLETE BETA FUNCTION I(X,P,Q), 0<8X<=1,P>0,Q>0.
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                                INCOMPLETE BETA FUNCTION I(X,P+N,Q), 0<4X<81,P>0, 9>0, FOR N=0(1)NMAX.
                                                                                                                                       35051 E 14
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                                INCOMPLETE BETA FUNCTION I(X,P,Q+N),0<0X<=1,P>0,4>0, FOR N=0(1)NMAX.
        IBQPLUSH COMPUTES THE
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                                INCOMPLETE BETA FUNCTION.
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                                INCOMPLETE BETA FUNCTION,
N AUXILIARY PROCEDURE FOR THE
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        INCOMEAN COMPUTES THE
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                                INDICES AND MODULUS OF THAT MATRIX ELEMENT OF MAXIMUM ABSOLUTE VALUE.
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                                INFINITE INTERVAL OR OVER A NUMBER OF CONSECUTIVE INTERVALS,
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                                INFINITY NORM OF A VECTOR AND DELIVERS THE INDEX FOR AN ELEMENT MAXIMAL IN MODULUS.
                                                                                                                                       31060 0 32
       ABSMAXVEC COMPUTES THE
                                INIMATO INITIALIZES (PART OF) A DIAGONAL OR CODIAGONAL WITH A CONSTANT.
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                                INISYMD INITIALIZES A CODIAGONAL OF A SYMMETRIC MATRIX WITH A CONSTANT,
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                                INITIALIZES (PART OF) A VECTOR WITH A CONSTANT.
                                                                                                                                       31010 D
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ROTROW PERFORMS AN ELEMENTARY
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ROW ADDS A SCALAR TIMES A ROW
                                VECTOR TO ANOTHER ROW VECTOR.
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                                VECTOR TO A COLUMN VECTOR.
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MCOLVEC ADDS A SCALAR TIMES A
                               VECTOR TO A COLUMN VECTOR.
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ROW ADDS A SCALAR TIMES A RCW
                                VECTOR TO A ROW VECTOR.
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 DUPROWVEC COPIES (PART OF) A
                                VECTOR TO A ROW VECTUR.
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ROW ADDS A SCALAR TIMES A ROW
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    DUPVEC COPIES (PART OF) A
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                                                                                                                                      31030 D
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                                                                                                                                      31031 D
VECROW COPIES (PART OF) A ROW
                                VECTOR TO A VECTOR.
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COL COPIES (PART OF) A COLUMN
 ADDS A SCALAR TIMES A COLUMN
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                                VECTOR WITH A CONSTANT.
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                                WILKINSON TRANSFORMATION AS PERFORMED BY TEMREAHES, ON A VECTOR.
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                                ZERCIN SEARCHES FOR A ZERO OF A FUNCTION OF ONE VARIABLE IN A GIVEN INTERVAL.
        ZEROIN SEARCHES FOR A
                               ZERO OF A FUNCTION OF ONE VARIABLE IN A GIVEN INTERVAL.
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31010 D 0 INIVEC INITIALIZES (PART OF) A VECTOR WITH A CONSTANT,
           INIMAT INITIALIZES (PART OF) A MATRIX WITH A CONSTANT.
31012 D 0
           INIMATO INITIALIZES (PART OF) A DIAGONAL OR CODIAGONAL WITH A CONSTANT.
           INISYMD INITIALIZES A CODIAGONAL OF A SYMMETRIC MATRIX WITH A CONSTANT,
           INISYMROW INITIALIZES A ROW OF A SYMMETRIC MATRIX WITH A CONSTANT.
31014 D
31020 D
        4 MULVEC MULTIPLIES A VECTOR BY A SCALAR.
31021 D. 4. MULROW MULTIPLIES A ROW VECTOR BY A SCALAR STORING THE RESULT IN ANOTHER VECTOR.
31022 D 4 MULCOL MULTIPLIES A COLUMN VECTOR BY A SCALAR,
31030 D 2 DUPVEC COPIES (PART OF) A VECTOR TO A VECTOR.
31031 D
           DUPVECTOR COPIES (PART OF) A ROW VECTOR TO A VECTOR.
31032 D 2
           DUPROWVEC COPIES (PART OF) A VECTOR TO A ROW VECTOR.
31033 D 2 DUPVECCOL COPIES (PART OF) A COLUMN VECTOR TO A VECTOR
31034 D 2 DUPCOLVEC COPIES (PART OF) A VECTOR TO A COLUMN VECTOR.
31035 D 2 DUPMAT COPIES (PART OF) A MATRIX TO (AN OTHER) MATRIX.
31040 C O POL EVALUATES A POLYNOMIAL GIVEN IN THE GRUNERT FORM BY THE HORNER SCHEME.
31041 C 2 NEWPOL EVALUATES A POLYNOMIAL GIVEN IN THE NEWTON FORM BY THE HORNER SCHEME.
31050 C. 4. NEWGRN TRANSFORMS A POLYNOMIAL REPRESENTATION FROM NEWTON FORM INTO GRUNERT FORM
31060 D 32 ABSMAXVEC COMPUTES THE INFINITY NORM OF A VECTOR AND DELIVERS THE INDEX FOR AN ELEMENT MAXIMAL IN MODULUS.
31131 D 4 COLCST MULTIPLIES A COLUMN VECTOR BY A SCALAR.
31132 D 4 ROWCST MULTIPLIES A ROW VECTOR BY A SCALAR
32010 D 28 EULER COMPUTES THE SUM OF AN ALTERNATING SERIES.
32020 E 16 SUMPOSSERIES COMPUTES THE SUM OF A CONVERGENT SERIES WITH POSITIVE TERMS, USING THE VAN WIJNGAARDEN TRANSFORMATION.
32051 C 48 INTEGRAL ( QUADRATURE ) COMPUTES THE DEFINITE INTEGRAL OF A FUNCTION OF ONE VARIABLE OVER A FINITE OR INFINITE INTERVAL OR OVER A NU
           MBER OF CONSECUTIVE INTERVALS.
32070 C 6 GADRAT ( QUADRATURE ) COMPUTES THE DEFINITE INTEGRAL OF A FUNCTION OF ONE VARIABLE OVER A FINITE INTERVAL.
33010 C 8 RK1 SCLVES A SINGLE FIRST ORDER DIFFERENTIAL EQUATION USING A 5-TH ORDER RUNGE KUTTA METHOD.
33011 C 10 RKIN SOLVES A SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS USING A 5-TH ORDER RUNGE KUTTA METHOD.
33012 C 12 RK2 SOLVES A SECOND ORDER DIFFERENTIAL EQUATION USING A 5mth ORDER RUNGE KUTTA METHOD.
33013 C 14 RK2N SOLVES A SYSTEM OF SECOND ORDER DIFFERENTIAL EQUATIONS USING A D⊕TH ORDER RUNGE KUTTA METHOD.
33014 C 16 RK3 SCLVES A SECOND ORDER DIFFERENTIAL EQUATION USING A 5-TH ORDER RUNGE KUTTA METHOD; NO DERIVATIVES ALLOWED ON RIGHT HAND SIDE.
33015 C 18 RK3N SOLVES A SYSTEM OF SECOND ORDER DIFFERENTIAL EQUATIONS USING A 5-TH ORDER RUNGE KUTTA METHOD; NO DERIVATIVES ALLOWED ON RIGHT H
           AND SIDE.
33016 C 20 RK4A SOLVES A SINGLE DIFFERENTIAL EQUATION BY SOMETIMES USING A DEPENDENT VARIABLE AS INTEGRATION VARIABLE.
33017 C 22 RK4NA SOLVES A SYSTEM OF DIFFERENTIAL EQUATIONS BY SOMETIMES USING THE DEPENDENT VARIABLE AS INTEGRATION VARIABLE.
33018 C 24 RK5NA SOLVES A SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS USING THE ARC LENGTH AS INTEGRATION VARIABLE.
33040 C 26 MODIFIED TAYLOR SOLVES AN INITIAL ( BOUNDARY ) VALUE PROBLEM, GIVEN AS A SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS, BY A ONE-STEP
            TAYLOR METHOD; THIS METHOD IS PARTICULARLY SUITABLE FOR THE INTEGRATION OF LARGE SYSTEMS ARISING FROM PARTIAL DIFFERENTIAL EQUATION
            S, PROVIDED HIGHER CROER DERIVATIVES CAN BE EASILY OBTAINED.
33060 C 28 MODIFIED RUNGE KUTTA SCLVES AN INITIAL ( BOUNDARY ) VALUE PROBLEM, GIVEN AS A SYSTEM OF FIRST ORDER ( NON-LINEAR ) DIFFERENTIAL EQUA
           TIONS, BY A STABILIZED RUNGE KUTTA METHOD WITH LIMITED STORAGE REQUIREMENTS.
33080 C 30 MULTISTEP SOLVES AN INITIAL VALUE PROBLEM, GIVEN AS A SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS, BY ONE OF THE FOLLOWING MULTISTE
           P METHODS: GEARS, ADAMS - MOULTON, OR ADAMS - BASHFORTH METHOD; WITH AUTOMATIC STEP AND ORDER CONTROL AND SUITABLE FOR THE INTEGRAT!
           ON OF STIFF DIFFERENTIAL EQUATIONS.
33120 C 32 EFERK SOLVES INITIAL VALUE PROBLEMS, GIVEN AS AN AUTONOMOUS SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS, BY AN EXPONENTIALLY FITTED
            , EXPLICIT RUNGE KUTTA METHOD WHICH USES THE JACOBIAN MATRIX AND AUTOMATIC STEP CONTROL; SUITABLE FOR INTEGRATION OF STIFF DIFFERENT
           IAL EQUATIONS.
33130 D 38 LINIGER1 SOLVES INITIAL VALUE PROBLEMS, GIVEN AS AN AUTONOMOUS SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS, BY AN IMPLICIT, EXPONEN
           TIALLY FITTED, FIRST ORDER CNE STEP METHOD WITH NO AUTOMATIC STEP CONTROL; SUITABLE FOR INTEGRATION OF STIFF DIFFERENTIAL EQUATIONS.
33131 D 38 LINIGER2 SOLVES INITIAL VALUE PROBLEMS, GIVEN AS AN AUTONOMOUS SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS, BY AN IMPLICIT, EXPONEN
            TIALLY FITTED, SECOND ORDER ONE-STEP METHOD WITH NO AUTOMATIC STEP CONTROL; SUITABLE FOR INTEGRATION OF STIFF DIFFERENTIAL EQUATIONS
33160 C 34 EFSIRK SOLVES INITIAL VALUE PROBLEMS, GIVEN AS AN AUTONOMOUS SYSTEM OF FIRST ORDER DIFFERENTIAL EQUATIONS, BY AN EXPONENTIALLY FITTE
           D, SENT - IMPLICIT RUNGE KUTTA METHOD; SUITABLE FOR INTEGRATION OF STIFF DIFFERENTIAL EQUATIONS.
34010 D 6 VECVEC COMPUTES THE SCALAR PRODUCT OF TWO VECTORS.
34011 D 6 MATVEC COMPUTES THE SCALAR PRODUCT OF A ROW VECTOR AND VECTOR.
34012 D 6 TAMVEC COMPUTES THE SCALAR PRODUCT OF A COLUMN VECTOR AND VECTOR.
34013 D 6 MATMAT COMPUTES THE SCALAR PRODUCT OF A ROW VECTOR AND COLUMN VECTOR.
34014 D 6 TAMMAT COMPUTES THE SCALAR PRODUCT OF TWO COLUMN VECTORS.
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34015 D 6 MATTAM COMPUTES THE SCALAR PRODUCT OF TWO ROW VECTORS,
34016 D 6 SEQVEC COMPUTES THE SCALAR PRODUCT OF TWO VECTORS.
34017 D 6 SCAPROL COMPUTES THE SCALAR PRODUCT OF TWO VECTORS,
34018 D 6 SYMMATVEC COMPUTES THE SCALAR PRODUCT OF A VECTOR AND A ROW OF A SYMMETRIC MATRIX.
34020 D 8 ELMVEC ADDS A SCALAR TIMES A VECTOR TO ANOTHER VECTOR,
        8 ELMVECCOL ADDS A SCALAR TIMES A COLUMN VECTOR TO A VECTOR
34022 D 8 ELMCOLVEC ADDS A SCALAR TIMES A VECTOR TO A COLUMN VECTOR.
34023 D 8 ELMCOL ADDS A SCALAR TIMES A COLUMN VECTOR TO ANOTHER COLUMN VECTOR.
34024 D 8 ELMROW ADDS A SCALAR TIMES A ROW VECTOR TO ANOTHER ROW VECTOR.
34025 D 8 MAXELMROW ADDS A SCALAR TIMES A ROW VECTOR TO A ROW VECTOR, AND RETURNS THE SUBSCRIPT VALUE OF THE NEW ROW ELEMENT OF MAXIMUM ABSOLU
34026 D 8 ELMVECROW ADDS A SCALAR TIMES A ROW VECTOR TO A VECTOR.
34027 D 8 ELMROWVEC ADDS A SCALAR TIMES A VECTOR TO A ROW VECTOR,
34026 D 8 ELMROWCOL ADDS A SCALAR TIMES A COLUMN VECTOR TO A ROW VECTOR,
34029 D 8 ELMCOLROW ADDS A SCALAR TIMES A ROW VECTOR TO A COLUMN VECTOR,
34030 D 10 ICHVEC INTERCHANGES ELEMENTS OF TWO VECTORS.
           ICHCOL INTERCHANGES ELEMENTS OF TWO COLUMN VECTORS.
34031 D 10
34032 D 10
           ICHROW INTERCHANGES ELEMENTS OF TWO ROW VECTORS.
34033 D 10
           ICHROWCOL INTERCHANGES ELEMENTS OF A ROW VECTOR AND COLUMN VECTOR.
           ICHSEQUEC INTERCHANGES ELEMENTS OF TWO VECTORS.
34034 D 10
           ICHSEQ INTERCHANGES ELEMENTS OF TWO VECTORS.
34040 D 12 ROTCOL PERFORMS AN ELEMENTARY ROTATION OPERATION ON TWO COLUMN VECTORS.
34041 D 12 ROTROW PERFORMS AN ELEMENTARY ROTATION OPERATION ON TWO ROW VECTORS.
34051 E 26 SOL SOLVES A SYSTEM OF LINEAR EQUATIONS, OF WHICH THE TRIANGULARLY DECOMPOSED FORM OF THE MATRIX IS GIVEN.
34053 E 28 INV COMPUTES THE INVERSE OF A MATRIX OF WHICH THE TRIANGULARLY DECOMPOSED FORM IS GIVEN.
34061 E 26 SOLELM SOLVES A SYSTEM OF LINEAR EQUATIONS, OF WHICH THE TRIANGULARLY DECOMPOSED FORM OF THE MATRIX IS GIVEN.
34071 E 4 SOLBND SOLVES A SYSTEM OF LINEAR EQUATIONS WITH BAND MATRIX, WHICH IS DECOMPOSED BY DECBND.
34131 E 34 LSQSQL SOLVES A LINEAR LEAST SQUARES PROBLEM, PROVIDED THAT THE COEFFICIENT MATRIX HAS BEEN DECOMPOSED BY LSQORTDEC.
34132 E 32 LSQDGLINV COMPUTES THE DIAGONAL ELEMENTS OF THE INVERSE OF MIM (M COEFFICIENT MATRIX) OF A LINEAR LEAST SQUARES PROBLEM,
34134 E 32 LSGORTDEC PERFORMS THE HOUSEHOLDER TRIANGULARIZATION OF THE COEFFICIENT MATRIX OF A LINEAR LEAST SQUARES PROBLEM.
34135 E 34 USGORTDECSOL SOLVES A LINEAR LEAST SQUARES PROBLEM AND COMPUTES THE PLAGONAL ELEMENTS OF THE INVERSE OF MIM (M COEFFICIENT MATRIX).
34140 D 34 TEMSYMTRIZ TRANSFORMS A REAL SYMMETRIC MATRIX INTO A SIMILAR TRIDIAGONAL ONE BY HOUSEHOLDERS TRANSFORMATION.
34141 D 34 BAKSYMTRIZ PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE HOUSEHOLDERS TRANSFORMATION AS PERFORMED BY TEMSYMTRIZ.
34142 D 34
           TEMPREVEC COMPUTES THE TRANSFORMING MATRIX IN COMBINATION WITH PROCEDURE TEMSYMTRIZ.
           TFMSYMTRI1 TRANSFORMS A REAL SYMMETRIC MATRIX INTO A SIMILAR TRIDIAGONAL ONE BY HOUSEHOLDERS TRANSFORMATION.
34143 D 34
           BAKSYNTRI1 PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE HOUSEHOLDERS TRANSFORMATION AS PERFORMED BY TEMSYNTRI1.
34150 F 18 ZEROIN SEARCHES FOR A ZERO OF A FUNCTION OF ONE VARIABLE IN A GIVEN INTERVAL.
34151 D 36 VALSYMTRI COMPUTES ALL, OR SOME CONSECUTIVE, EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX BY LINEAR INTERPOLATION USING A STURM SEQ
            UENCE.
34152 D 36 VECSYFTRI COMPUTES EIGENVECTORS OF A SYMMETRIC TRIDIAGONAL MATRIX BY INVERSE ITERATION,
34153 E 12 EIGVALSYM2 COMPUTES ALL, OR SOME CONSECUTIVE EIGENVALUES OF A SYMMETRIC MATRIX, STORED IN A TWO-DIMENSIONAL ARRAY, BY LINEAR INTERPO
            LATION USING A STURM SEQUENCE,
34154 E 12 EIGSYN2 COMPUTES ALL, OR SOME CONSECUTIVE EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC MATRIX, WHICH IS STORED IN A TWO-PIMENSIONAL A
            RRAY,
34155 E 12 EIGVALSYM1 COMPUTES ALL, OR SOME CONSECUTIVE EIGENVALUES OF A SYMMETRIC MATRIX, STORED IN A ONE-DIMENSIONAL ARRAY, BY LINEAR INTERPO
            LATION USING A STURM SEQUENCE.
34156 E 12 EIGSYM1 COMPUTES ALL, OR SOME CONSECUTIVE EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC MATRIX, WHICH IS STORED IN A ONE-DIMENSIONAL A
34161 D 36 GRISYFTRI COMPUTES ALL EIGENVECTORS AND EIGENVALUES OF A SYMMETRIC TRIDIAGONAL MATRIX BY QR-ITERATION.
34162 E 12 GRIVALSYM2 COMPUTES ALL EIGENVALUES OF A SYMMETRIC MATRIX, STORED IN A TWO-DIMENSIONAL ARRAY, BY QR-ITERATION.
34163 E 12 GRISYI COMPUTES ALL EIGENVALUES AND EIGENVECTORS OF A SYMMETRIC MATRIX BY OR-ITERATION.
34164 E 12 ORIVALSYM1 COMPUTES ALL EIGENVALUES OF A LYMMETRIC MATRIX, STORED IN A ONE-DIMENSIONAL ARRAY, BY QR-ITERATION.
34165 D 36 VALORISYMTRI COMPUTES ALL EIGENVALUES OF , SYMMETRIC TRIDIAGONAL MATRIX BY OR-ITERATION.
34170 F 14 TEMPEAHES TRANSFORMS A REAL MATRIX INTO A SIMILAR UPPER HESSENBERG MATRIX BY THE WILKINSON TRANSFORMATION.
34171 F 14 BAKREAHES1 PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE WILKINSON TRANSFORMATION AS PERFORMED BY TEMPERHES. ON A VECTOR
34172 F 14 BAKREAHES PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE WILKINSON TRANSFORMATION AS PERFORMED BY TEMREAHES. ON THE COLUMNS
           OF A MATRIX.
34173 F 12 EQILBR TRANSFORMS A MATRIX INTO A SIMILAR EQUILIBRATED MATRIX.
34174 F 12 BAKLBR PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE EQUILIBRATION AS PERFORMED BY EQILBR.
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34180 F 16 REAVALORI CALCULATES THE EIGENVALUES OF A REAL UPPER HESSENBERG MATRIX, PROVIDED THAT ALL EIGENVALUES ARE REAL, BY MEANS OF SINGLE Q

34181 F 16 REAVECHES CALCULATES THE EIGENVECTOR CORRESPONDING TO A GIVEN REAL EIGENVALUE OF A REAL UPPER HESSENBERG MATRIX, BY MEANS OF INVERSE ITERATION 34183 F 8 REASCL NORMALIZES THE COLUMNS OF A TWO-DIMENSIONAL ARRAY. 34186 F 16 REAGRI CALCULATES THE EIGENVALUES AND EIGENVECTORS OF A REAL UPPER HESSENBERG MATRIX, PROVIDED THAT ALL EIGENVALUES ARE REAL, BY MEA NS OF SINGLE QR-ITERATION. 34190 F 16 COMVALORI CALCULATES THE REAL AND COMPLEX EIGENVALUES OF A REAL UPPER HESSENBERG MATRIX BY MEANS OF DOUBLE OR-ITERATION, 34191 F 16 COMVECHES CALCULATES THE EIGENVECTOR CORRESPONDING TO A GIVEN COMPLEX EIGENVALUE OF A REAL UPPER HESSENBERG MATRIX BY MEANS OF INVER 34193 F 10 COMSCL IS AN AUXILIARY PROCEDURE FOR THE COMPUTATION OF COMPLEX EIGENVECTORS OF A REAL MATRIX. 34210 D 30 LINEMIN IS AN AUXILIARY PROCEDURE FOR OPTIMIZATION. 34211 D 30 RNK1UPD IS) AN AUXILIARY PROCEDURE FOR OPTIMIZATION. 34212 D 39 DAVUPD IS AN AUXILIARY PROCEDURE FOR OPTIMIZATION. 34213 D 30 FLEUPD IS AN AUXILIARY PROCEDURE FOR OPTIMIZATION. RNK1MIN (OPTIMIZATION) MINIMIZES A GIVEN DIFFERENTIABLE FUNCTION OF SEVERAL VARIABLES BY A VARIABLE METRIC METHOD. 34214 P 30 34215 D 30 FLEMIN (OPTIMIZATION) MINIMIZES A GIVEN DIFFERENTIABLE FUNCTION OF SEVERAL VARIABLES BY A VARIABLE METRIC METHOD. 34220 C 36 CONJ GRAD SOLVES A SYMMETRIC AND POSITIVE DEFINITE, SYSTEM OF LINEAR EQUATIONS BY THE METHOD OF CONJUGATE GRADIENTS. 34230 D 26 MAXMAT FINDS THE INDICES AND MODULUS OF THAT MATRIX ELEMENT OF MAXIMUM ABSOLUTE VALUE. 34231 E 22 GSSELM PERFORMS THE TRIANGULAR DECOMPOSITION OF A MATRIX BY GAUSSIAN ELIMINATION WITH COMBINED PARTIAL AND COMPLETE PIVOTING, 34232 E 26 GSSSOL SOLVES A SYSTEM OF LINEAR EQUATIONS BY GAUSSIAN ELIMINATION WITH COMBINED PARTIAL AND COMPLETE PIVOTING. 34235 E 28 INV1 COMPUTES THE INVERSE OF A MATRIX OF WHICH THE TRIANGULARLY DECOMPOSED FORM IS GIVEN. GSSINY COMPUTES THE INVERSE OF A MATRIX. 34236 E 28 ONENRMINY COMPUTES THE 1-NORM OF THE INVERSE OF A MATRIX, WHICH IS TRIANGULARLY DECOMPOSED. 34240 E 22 34241 E 22 ERBELM COMPUTES AN UPPER BOUND FOR THE ERROR IN THE SOLUTION OF A SYSTEM OF LINEAR EQUATIONS. 34242 E 22 GSSERB IS AN AUXILIARY PROCEDURE FOR THE SOLUTION OF LINEAR EQUATION WITH AN UPPER BOUND FOR THE ERROR. 34243 E 26 GSSSOLERB SOLVES A SYSTEM OF LINEAR EQUATIONS AND COMPUTES AN UPPER BOUND FOR ITS ERROR. 34244 E 28 GSSINVERB COMPUTES THE INVERSE OF A MATRIX AND AN UPPER BOUND FOR ITS ERROR. 34250 E 30 ITISOL COMPUTES AN ITERATIVELY REFINED SOLUTION OF A SYSTEM OF LINEAR EQUATIONS, THE MATRIX OF WHICH IS GIVEN IN ITS TRIANGULARLY DE COMPOSED FORM. 34251 E 30 GSSITISOL COMPUTES AN ITERATIVELY REFINED SOLUTION OF A SYSTEM OF LINEAR EQUATIONS. 34252 E 22 GSSNRI IS AN AUXILIARY PROCEDURE FOR THE ITERATIVELY REFINED SOLUTION OF A SYSTEM OF LINEAR EQUATIONS, 34253 E 30 ITISOLERB COMPUTES AN ITERATIVELY REFINED SOLUTION AND AN UPPER BOUND FOR ITS ERROR, OF A SYSTEM OF LINEAR EQUATIONS, OF WHICH THE T RIANGULARLY DECOMPOSED FORM OF THE MATRIX IS GIVEN. 34254 E 30 GSSITISOLERB COMPUTES AN ITERATIVELY REFINED SOLUTION OF A SYSTEM OF LINEAR EQUATIONS. 34260 H 8 HISHREABID TRANSFORMS A REAL MATRIX INTO BIDIAGONAL FORM BY MEANS OF HOUSEHOLDER TRANSFORMATION. 34261 H 8 PSTTFMMAT CALCULATES THE POSTMULTIPLYING MATRIX USED BY HSHREABID TO TRANSFORM A MATRIX INTO BIDIAGONAL FORM. 34262 H 8 PRETEMMAT CALCULATES THE PREMULTIPLYING MATRIX USED BY HSHREABID TO TRANSFORM A MATRIX INTO SIDIAGONAL FORM. 34270 H 10 GRISNGVALBID CALCULATES THE SINGULAR VALUES OF A REAL BIDIAGONAL MATRIX BY MEANS OF IMPLICIT QR-ITERATION. 34271 H 19 GRISNGVALDECTID CALCULATES THE SINGULAR VALUE DECOMPOSITION OF A REAL MATRIX OF WHICH A BIDIAGONAL DECOMPOSITION IS GIVEN, BY MEANS OF AN IMPLICIT GRAITERATION. 34272 H 12 GRISNGVAL CALCULATES THE SINGULAR VALUES OF A REAL MATRIX BY MEANS OF AN IMPLICIT GRAITERATION. 34273 H 12 ORISNGVALDEC CALCULATES THE SINGULAR VALUE DECOMPOSITION OF A REAL MATRIX BY MEANS OF AN IMPLICIT OR-ITERATION. 34280 H 0 SOLSVDOVE CALCULATES THE LEAST SQUARES SOLUTION OF A OVERDETERMINED SYSTEM OF LINEAR EQUATIONS, PROVIDED THAT THE SINGULAR VALUE DEC OMPOSITION OF THE COEFFICIENT MATRIX IS GIVEN. 34281 H 0 SOLOVE CALCULATES THE LEAST SQUARES SOLUTION OF A OVERDETERMINED SYSTEM OF LINEAR EQUATIONS BY MEANS OF SINGULAR VALUE DECOMPOSITION 34282 H 2 SOLSVOUND CALCULATES THE BEST LEAST SQUARES SOLUTION OF A UNDERDETERMINED SYSTEM OF LINEAR EQUATIONS, PROVIDED THAT THE SINGULAR VAL UE DECOMPOSITION OF THE COEFFICIENT MATRIX IS GIVEN. 34283 H 2 SOLUND CALCULATES THE BEST LEAST SQUARES SOLUTION OF A UNDERDETERMINED SYSTEM OF LINEAR EQUATIONS BY MEANS OF SINGULAR VALUE DECOMPO SITION 34284 H 4 HOMSOLSVD SOLVES A HOMOGENEOUS SYSTEM OF LIMEAR EQUATIONS, PROVIDED THAT THE SINGULAR VALUE DECOMPOSITION OF THE CCEFFICIENT MATRIX 34285 H 4 HOMSOL SOLVES A HOMCGENEOUS SYSTEM OF LINEAR EQUATIONS BY MEANS OF SINGULAR VALUE DECOMPOSITION, 34286 H 6 PSDINVSYD CALCULATES THE PSEUDO INVERSE OF A MATRIX, PROVIDED THAT THE SINGULAR VALUE DECOMPOSITION IS GIVEN. 34287 H 6 PSDINV CALCULATES THE PSEUDC INVERSE OF A MATRIX BY MEANS OF THE SINGULAR VALUE DECOMPOSITION. 34300 E 22 DEC PERFORMS THE TRIANGULAR DECOMPOSITION OF A MATRIX BY CROUT FACTORIZATION WITH PARTIAL PIVOTING. 34301 E 26 DECSOL SOLVES A SYSTEM OF LINEAR EQUATIONS BY CROUT FACTORIZATION WITH PARTIAL PIVOTING. 34302 E 28 DECINY COMPUTES THE INVERSE OF A MATRIX.

34310 F 0 CHLDEC2 (LINEAR EQUATIONS) COMPUTES THE CHOLESKY DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED IN A TWO-DIMENSIONA

34303 E 24 DETERM COMPUTES THE DETERMINANT OF A MATRIX PROVIDED THAT THE MATRIX HAS BEEN DECOMPOSED BY DEC OR GSSELM.

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34311 F 0 CHLDEC1 ( LINEAR EQUATIONS ) COMPUTES THE CHOLESKY DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED COLUMNWISE IN A ONE
            -DIMENSIONAL ARRAY
34312 F 2 CHLDETERM2 COMPUTES THE DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMPOSED BY CHLDEC2.
34313 F 2 CHLDETERM1 COMPUTES THE DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMPOSED BY CHLDEC1.
34320 E 0 DECBND PERFORMS THE TRIANGULAR DECOMPOSITION OF A BAND MATRIX BY GAUSSIAN ELIMINATION.
34321 E 2 DETERMBND COMPUTES THE DETERMINANT OF A BAND MATRIX, WHICH HAS BEEN DECOMPOSED BY DECEND.
34322 E 4 DECSOLAND PERFORMS THE DECOMPOSITION OF A BAND MATRIX BY GAUSSIAN ELIMINATION AND SOLVES THE SYSTEM OF LINEAR EGUATIONS.
34330 E 6 CHLDECHNO PERFORMS THE TRIANGULAR DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE MATRIX BY THE CHOLESKY METHOD.
34331 E 8 CHLDETERMBND COMPUTES THE DETERMINANT OF A SYMMETRIC POSITIVE DEFINITE MATRIX, WHICH HAS BEEN DECOMPOSED BY CHLDECEND.
34332 E 10 CHLSOLBND SOLVES A SYSTEM OF LINEAR EQUATIONS WITH SYMMETRIC POSITIVE DEFINITE BAND MATRIX, WHICH HAS BEEN DECOMPOSED BY CHLDECBND,
34333 E 10 CHLDECSOLBND PERFORMS THE DECOMPOSITION OF A SYMMETRIC POSITIVE DEFINITE BAND MATRIX AND SOLVES THE SYSTEM OF LINEAR EQUATIONS BY TH
            E CHOLESKY METHOD.
34340 D 14 COMABS COMPUTES THE MODULUS OF A COMPLEX NUMBER.
34341 D 20 COMMUL MULTIPLIES TWO COMPLEX NUMBERS.
34342 D 22 COMDIV COMPUTES THE QUOTIENT OF TWO COMPLEX NUMBERS,
34343 D 16 COMPORT COMPUTES THE SQUARE ROOT OF A COMPLEX NUMBER.
34344 D 18 CARPOL TRANSFORMS A COMPLEX NUMBER GIVEN IN CARTESIAN COORDINATES INTO POLAR COORDINATES.
34345 D 24 COMKWD COMPUTES THE ROOTS OF A QUADRATIC EQUATION WITH COMPLEX COEFFICIENTS.
34352 G 6 COMCOLOST MULTIPLIES A COMPLEX COLUMN VECTOR BY A COMPLEX NUMBER.
34353 G 6 COMROWEST MULTIPLIES A COMPLEX ROW VECTOR BY A COMPLEX NUMBER.
34354 G 18 COMMATVEC COMPUTES THE SCALAR PRODUCT OF A COMPLEX ROW VECTOR AND A COMPLEX VECTOR.
34355 G 24 HISHCOMCOL TRANSFORMS A COMPLEX VECTOR HITO A VECTOR PROPORTIONAL TO A UNIT VECTOR.
34356 G 24 HSHCOMPRO PREMULTIPLIES A COMPLEX MATRIX WITH A COMPLEX HOUSEHOLDER MATRIX.
34357 G 2 ROTCOHOLD PERFORMS A ROTATION ON TWO COMPLEX COLUMN VECTORS.
34358 G 2 ROTCOMROW PERFORMS A ROTATION ON TWO COMPLEX ROW VECTORS.
34359 G 20 COMEUCARM COMPUTES THE EUCLIDEAN NORM OF A COMPLEX MATRIX.
34360 G 22 SCLCOM NORMALIZES THE COLUMNS OF A COMPLEX MATRIX.
34361 G 16 EQILBROOM TRANSFORMS A COMPLEX MATRIX INTO A SIMILAR EQUILIBRATED COMPLEX MATRIX.
34362 G 16 BAKLBROOM PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO THE EQUILIBRATION AS PERFORMED BY EQILBROOM,
34363 G 4 HISHHRMTRE TRANSFORMS A HERMITIAN MATRIX INTO A SIMILAR REAL SYMMETRIC TRIDIAGONAL MATRIX.
34364 G 4 HISHHRMITRIVAL DELIVERS THE MAIN DIAGONAL ELEMENTS AND SQUARES OF THE CODIAGONAL ELEMENTS OF A HERMITIAN TRIDIAGONAL MATRIX WHICH IS U
            NITARY SIMILAR TO A GIVEN HERMITIAN MATRIX.
34365 G 4 BAKHRMTRI PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO BESHRMTRI,
34366 G 14 HISHCOPHES TRANSFORMS A COMPLEX MATRIX PATE A SIMILAR UNITARY UPPER HESSENBERG MATRIX WITH A REAL NON-NEGATIVE SUBDIAGONAL,
34367 G 14 BAKCOMHES PERFORMS THE BACK TRANSFORMATION CORRESPONDING TO HISHCOMHES.
34368 G B EIGVALHRY COMPUTES ALL EIGENVALUES OF A HER LITIAN MATRIX.
34369 G 8 EIGHRM COMPUTES ALL EIGENVECTORS AND EIGENVALUES OF A HERMITIAN MATRIX.
34370 G 8 ORIVALHRM COMPUTES ALL EIGENVALUES OF A HER TITIAN MATRIX.
34371 G 8 QRIHRN COMPUTES ALL EIGENVECTORS AND EIGENVALUES OF A HERMITIAN MATRIX.
34372 G 12 VALORICOM COMPUTES ALL EIGENVALUES OF A COMPLEX UPPER HESSENBERG MATRIX WITH A REAL SUBDIAGONAL.
34373 G 12 - GRICOM COMPUTES ALL EIGENVECTORS AND EIGENVALUES OF A COMPLEX UPPER HESSENBERG MATRIX WITH A REAL SUBDIAGONAL.
34374 G 10 EIGVALCOM COMPUTES ALL EIGENVALUES OF A COMPLEX MATRIX,
34375 G 10 EIGCOM COMPUTES ALL EIGENVECTORS AND EIGENVALUES OF A COMPLEX MATRIX,
34376 G - 0 - ELMCOPVECCOL ADDS A COMPLEX NUMBER TIMES A COMPLEX COLUMN VECTOR TO A COMPLEX VECTOR
34377 G 0 ELMCOMOOL ADDS A COMPLEX NUMBER TIMES A COMPLEX COLUMN VECTOR TO ANOTHER COMPLEX COLUMN VECTOR.
34378 G 0 ELMCOMROWYEC ADDS A COMPLEX NUMBER TIMES A COMPLEX VECTOR TO A COMPLEX ROW VECTOR.
34390 F. 4. CHLSOL2 SOLVES A SYMMETRIC POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS, THE MATRIX BEING DECOMPOSED BY CHLDEC2.
34391 F 4 CHLSOL1 SOLVES A SYMMETRIC POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS, THE MATRIX BEING DECOMPOSED BY CHLDEC1.
34392 F 4 CHLDECSOL2 Solves A SYMMETRIC POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS BY THE CHOLESKY METHOD, THE MATRIX BEING STORED IN A TWO-
            DIMENSIONAL ARRAY.
34393 F 4 CHLDECSOL1 SOLVES A SYMMETRIC POSITIVE DEFINITE SYSTEM OF LINEAR EQUATIONS BY THE CHOLESKY METHOD, THE MATRIX BEING STORED IN A ONE,
            DIMENSIONAL ARRAY.
34400 F 6 CHLINY2 COMPUTES THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX WHICH HAS BEEN DECOMPOSED BY CHIDEC2.
34401 F 6 CHLINV1 COMPUTES THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX WHICH HAS BEEN DECOMPOSED BY CHIDEC1.
34402 F 6 CHLDECINV2 COMPUTES, BY THE CHOLESKY METHOD, THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED IN A TWO-DIMENSIONAL ARRAY.
34403 F 6 CHLDECINV1 COMPUTES, BY THE CHOLESKY METHOD, THE INVERSE OF A SYMMETRIC POSITIVE DEFINITE MATRIX, STORED IN A ONE-DIMENSIONAL ARRAY.
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34410 H 14 LNGVECVEC COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF TWO VECTORS.

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34411 H 14 LINGMATVEC COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF A ROW VECTOR AND A VECTOR
34412 H 14 LINGTAMVEC COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF A COLUMN VECTOR AND A VECTOR
34413 H 14 LINGMATMAT COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF A ROW VECTOR AND A COLUMN VECTOR.
34414 H 14 LNGTAMMAT COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF TWO COLUMN VECTORS,
34415 H 14 LINGMATTAN COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF TWO ROW VECTORS.
34416 H 14 LNGSEGVEC COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF TWO VECTORS.
            LNGSCAPRD1 COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF TWO VECTORS.
34417 H 14
34418 H 14 UNGSYMMATVEC COMPUTES IN DOUBLE PRECISION THE SCALAR PRODUCT OF A VECTOR AND A ROW IN A SYMMETRIC MATRIX.
34420 H 20 DECSYMTRI CALCULATES THE UIDU DECOMPOSITION OF A SYMMETRIC TRIDIAGONAL MATRIX.
34421 H 22 SOLSYMTRI SOLVES A SYSTEM OF LINEAR EQUATIONS WITH SYMMETRIC TRIDIAGONAL COEFFICIENT MATRIX, PROVIDED THAT THE UIDU DECOMPOSITION IS
             GIVEN.
            DECSOLSYMTRI SOLVES A SYSTEM OF LINEAR EQUATIONS WITH SYMMETRIC TRIDIAGONAL COEFFICIENT MATRIX.
34422 H 22
34423 H 16 DECTRI CALCULATES, WITHOUT PIVOTING, THE LU DECOMPOSITION OF A TRIDIAGONAL MATRIX.
34424 H 18 SOLTRI SOLVES A SYSTEM OF LINEAR EQUATIONS WITH TRIDIAGONAL COEFFICIENT MATRIX, PROVIDED THAT THE LU DECOMPOSITION IS GIVEN.
34425 H 18 DECSOLTRI SOLVES A SYSTEM OF LINEAR EQUATIONS WITH TRIDIAGONAL COEFFICIENT MATRIX.
34426 H 16 DECTRIPIV CALCULATES, WITH PARTIAL PIVOTING, THE LU DECOMPOSITION OF A TRIDIAGONAL MATRIX.
34427 H 18 SOLTRIPIV SOLVES A SYSTEM OF LINEAR EQUATIONS WITH TRIDIAGONAL COEFFICIENT MATRIX, PROVIDED THAT THE LU DECOMPOSITION AS CALCULATED
            BY DECTRIPIV IS GIVEN
34428 H 18 DECSOLTRIPIV SOLVES WITH PARTIAL PIVOTING A SYSTEM OF LINEAR EQUATIONS WITH TRIDIAGONAL COEFFICIENT MATRIX.
35020 C 38 ERF COMPUTES THE ERROR FUNCTION AND COMPLEMENTARY ERROR FUNCTION FOR A REAL ARGUMENT, THESE FUNCTIONS ARE RELATED TO THE NORMAL OR G
            AUSSIAN PROBABILITY FUNCTION.
35030 C 40 INCOMEAM COMPUTES THE INCOMPLETE GAMMA FUNCTION BY PADE APPROXIMATIONS,
35050 E 14 INCBETA COMPUTES THE INCOMPLETE BETA FUNCTION I(X,P,Q),0<px<=1,P>0,Q>0.
35051 E 14 IBPPLUSN COMPUTES THE INCOMPLETE BETA FUNCTION (X,P+N,Q),0<=X<=1,P>0,Q>0, FOR N=0(1)NMAX.
35052 E 14 IBOPLUSN COMPUTES THE INCOMPLETE BETA FUNCTION I(X,P,Q+N),0<=X<=1,P>0,Q>0, FOR N=0(1)NMAX.
35053 E 14 IXQFIX IS AN AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
35054 E 14 IXPFIX IS AN AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
35055 E 14 FORWARD IS AN AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
35056 E 14 BACKWARD IS AN AUXILIARY PROCEDURE FOR THE INCOMPLETE BETA FUNCTION.
35060 C 42 RECIP GAMMA COMPUTES THE RECIPROCAL OF THE GAMMA FUNCTION FOR ARGUMENTS IN THE RANGE [1/2,3/2]; ODD AND EVEN PARTS ARE ALSO DELIVERE
35061 C 42 GAMMA COMPUTES THE GAMMA FUNCTION FOR A REAL ARGUMENT,
35062 C 42 LOG GAMMA COMPUTES THE NATURAL LOGARITHM OF THE GAMMA FUNCTION FOR POSITIVE ARGUMENTS.
36010 C 44 NEWTON DETERMINES THE COEFFICIENTS OF THE NEWTON INTERPOLATION POLYNOMIAL FOR GIVEN ARGUMENTS AND FUNCTION VALUES.
36020 E 18 INT IS AN AUXILIARY PROCEDURE FOR MINIMAX APPROXIMATION.
36021 E 20 SNDREHEZ (SECOND REMEZ ALGORITHM) EXCHANGES NUMBERS WITH NUMBERS OUT OF A REFERENCE SET.
36022 C 46 GINMAXPOL DETERMINES THE COEFFICIENTS OF THE POLYNOMIAL (IN GRUNERT FORM) THAT APPROXIMATES A FUNCTION GIVEN FOR DISCRETE ARGUMENTS;
             THE SECOND REMEZ EXCHANGE ALGORITHM IS USED FOR THIS MINIMAX POLYNOMIAL APPROXIMATION.
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