

**stichting
mathematisch
centrum**



AFDELING NUMERIEKE WISKUNDE
(DEPARTMENT OF NUMERICAL MATHEMATICS)

NW 33/76

SEPTEMBER

J. KOK (EDITOR)

SYSTEMATIC INDEX OF NUMPAS,
A LIBRARY OF NUMERICAL PROCEDURES IN PASCAL

2e boerhaavestraat 49 amsterdam

BIBLIOTHEEK MATHEMATISCH CENTRUM
—AMSTERDAM—

Printed at the Mathematical Centre, 49, 2e Boerhaavestraat, Amsterdam.

The Mathematical Centre, founded the 11-th of February 1946, is a non-profit institution aiming at the promotion of pure mathematics and its applications. It is sponsored by the Netherlands Government through the Netherlands Organization for the Advancement of Pure Research (Z.W.O), by the Municipality of Amsterdam, by the University of Amsterdam, by the Free University at Amsterdam, and by industries.

Systematic index of NUMPAS, a library of numerical procedures in PASCAL

edited by

J. Kok

ABSTRACT

The index contains information about available numerical mathematics procedures which can be used in PASCAL programs. In particular a list is given of PASCAL procedures from NUMPAS and of several useful FORTRAN subroutines from the well-known libraries IMSL (International Mathematical and Statistical Libraries) and NAG (Numerical Algorithms Group). In addition, directions are given for the use of these subroutines in PASCAL programs for the CYBER 73-28 computer of the Academic Computer Centre Amsterdam (SARA).

KEY WORDS & PHRASES: *Numerical mathematics, procedure libraries, PASCAL.*

PREFACE

The library of numerical procedures in PASCAL, NUMPAS, is being developed by the NUMPAS Project Group of the Numerical Mathematics Department of the Mathematical Centre. The project was initiated by a request of the Wiskundig Seminarium of the Free University at Amsterdam, who participated in the costs involved.

The aim is, to make available reliable PASCAL procedures and their documentation for solving numerical mathematics problems. PASCAL programs using these procedures can be run in the PASCAL 6000-3.4 system available on the Control Data CYBER 73-28 computer of the Academic Computer Centre Amsterdam (SARA).

The project group has two main activities:

1. to program and document PASCAL procedures, where the existing library of numerical mathematics procedures in ALGOL 60, NUMAL, is used as a guide line.
2. to make available FORTRAN subroutines which can be called in PASCAL programs.

The here presented systematic index contains sufficient information about the available PASCAL procedures and FORTRAN subroutines.

In view of the continuous development of the library of PASCAL procedures, we intend to update this index regularly.

The NUMPAS project group is formed by: J. Blom, F. Groen, J. Kok and M. Louter-Nool. Former members were: R.R. de Graaf and J.K. Petiet.

REFERENCES

- IMSL, *Library 3 Reference Manual*,
International Mathematical and Statistical Libraries, Inc (1975).
- NAG, *Library Manual*,
Numerical Algorithms Group, Nottingham (1975).
- NUMAL, *A library of numerical procedures in ALGOL 60*.
Mathematisch Centrum, Amsterdam (1976).

INTRODUCTION.

THE INDEX CONTAINS THE FOLLOWING INFORMATION:

- 1 A SUBDIVISION OF THE COMPLETE AREA OF NUMERICAL MATHEMATICS
- 2 SUB 'PROCEDURE';
THE NAME OF THE PROCEDURE OR FUNCTION
- 3 SUB 'DESCRIPTION FILENAME' (AND 'RECNR');
THE NAME OF THE PERMANENT FILE (AND THE NUMBER OF THE
RECORD) WHERE THE DOCUMENTATION CAN BE FOUND
- 4 SUB 'USE';
IF 'USE' = PROLOG, THEN USE THE SO-CALLED PREPROCESSOR FOR
CONSTRUCTING A FILE OF EXTERNAL PROCEDURES; ELSE USE AS
LIBRARY THE FILE(S) MENTIONED (NMP = NUMPAS, PASCLIB CAN BE
OMITTED)
- 5 SUB 'EXT REF';
THE WAY OF REFERENCING THE EXTERNAL PROCEDURE.

THE FOLLOWING SETS OF PROCEDURES ARE AVAILABLE :

A. PASCAL PROCEDURES.

PROCEDURES AND FUNCTIONS IN PASCAL, WHOSE DESCRIPTIONS ARE GIVEN IN THE NUMPAS MANUAL (TO APPEAR) AND ON FILES WITH PERMANENT FILE NAMES NUMPASDOCUMENT# (# = 1, 2, ..) AND IDENTIFICATION ID=NUMPAS. RECNR GIVES THE NUMBER OF THE RECORD OF SUCH A FILE CONTAINING THE DOCUMENTATION, THE NEXT RECORD CONTAINS THE SOURCE TEXT(S) OF THE PROCEDURE(S) DOCUMENTED.

IN USER PROGRAMS REFERENCES TO THESE PROCEDURES ARE MADE AS FOLLOWS:

< PROCEDURE / FUNCTION HEADING > ; EXTERN; .

THE NUMPAS PROCEDURES ARE DIVIDED IN TWO SETS, DEPENDING ON THE PROPERTY WHETHER THEY ARE PRECOMPILED OR NOT.

A.1. PRECOMPILED NUMPAS PROCEDURES.

PRECOMPILED PROCEDURES ARE AVAILABLE ON THE PERMANENT FILE NUMPAS, ID=NUMPAS. COMPILED PROGRAMS (ON LGO) CAN BE EXECUTED IN THE FOLLOWING WAYS:

LIBRARY, NUMPAS. OR : LDSET, LIB=NUMPAS,
LGO.

A.2. OTHER NUMPAS PROCEDURES.

ALL NUMPAS PROCEDURES WHICH USE ARRAYS WITH USER-DEFINED BOUNDS CANNOT BE PRECOMPILED. THE PROCEDURES REQUESTED MUST BE COMPILED WITH THE SAME ENVIRONMENT OF TYPE DEFINITIONS FOR ARRAY PARAMETERS AS EXISTS IN THE USER PROGRAM. FOR SUCH USER PROGRAMS A PREPROCESSOR IS AVAILABLE, WHICH CONSTRUCTS A PASCAL PROGRAM CONTAINING ALL REQUESTED NUMPAS PROCEDURES AND THEIR AUXILIARY PROCEDURES IN THE DESIRED ENVIRONMENT OF TYPE DEFINITIONS.

THE PREPROCESSOR IS AVAILABLE ON THE PERMANENT FILE PROLOG, ID=NUMPAS, AND IS USED TOGETHER WITH TWO AUXILIARY FILES PASINFO, ID=NUMPAS AND SOURCETEXTS, ID=NUMPAS. FULL INFORMATION ABOUT THE USE OF PROLOG IS GIVEN ON THE PERMANENT FILE PROLOGDOC, ID=NUMPAS.

B. FORTRAN SUBROUTINES.

SUBROUTINES WRITTEN IN FORTRAN AND AVAILABLE IN FORTRAN SUBROUTINE LIBRARIES CAN BE CALLED IN PASCAL PROGRAMS WITH CERTAIN RESTRICTIONS (E.G. ONLY THOSE SUBROUTINES WHICH DO NOT EXPECT A PROCEDURE OR FUNCTION IN THE USER'S PROGRAM AS A PARAMETER).

REFERENCES ARE MADE IN THE FOLLOWING WAY:

< PROCEDURE / FUNCTION HEADING > ; FORTRAN; .

FOR INFORMATION ABOUT THE USE OF FORTRAN SUBROUTINES, SEE: J. KOK & M. LOUWER - NOOL; THE USE OF FORTRAN SUBROUTINES IN PASCAL PROGRAMS (TO APPEAR).

ENTRIES TO FORTRAN SUBROUTINES ARE INCORPORATED IN THIS INDEX ONLY IF NO APPROPRIATE PASCAL PROCEDURE IS AVAILABLE. A LARGE SET OF SUBROUTINES CAN BE CALLED VIA AN INTERFACE SUBROUTINE (SEE B.3.), THUS AVOIDING CONFUSING RULES FOR PARAMETER SUBSTITUTION. FOR INFORMATION ABOUT THESE SUBROUTINES ONE IS REFERRED TO THE PERMANENT FILE NUMPASFTNDOC, ID=NUMPAS.

B.1. THE FORTRAN SYSTEM LIBRARY.

FORTRAN SYSTEM FUNCTIONS AND SUBROUTINES CAN BE CALLED WHEN THE SYSTEM LIBRARY IS GIVEN IN THE FOLLOWING WAY:

LIBRARY, FORTRAN. OR: LDSET, LIB=FORTRAN.

B.2. MATHEMATICAL LIBRARIES.

B.2.1. IMSL.

IMSL (INTERNATIONAL MATHEMATICAL AND STATISTICAL LIBRARIES) LIBRARY 3 IMPLEMENTATION FOR CDC CYBER 70 SERIES.

WAY OF USE:

LIBRARY, NUMPAS, IMSL. OR: LDSET, LIB=NUMPAS/IMSL.

IF NO INTERFACE SUBROUTINE WILL BE USED, THEN:

LIBRARY, IMSL. OR: LDSET, LIB=IMSL.

ONE IS WARNED, HOWEVER, THAT THE INTERFACE SHOULD BE USED IN THE CASE THAT AN IMSL SUBROUTINE CAN BE EXPECTED TO WRITE A MESSAGE ON THE FILE OUTPUT.

B.2.2. NAG.

NAG (NUMERICAL ALGORITHMS GROUP) CDC CYBER 70 SERIES IMPLEMENTATION, WAY OF USE :

LIBRARY, NAGF. OR: LDSET, LIB=NAGF.
 OR (IN THE CASE OF AN INTERFACE SUBROUTINE):
 LIBRARY, NUMPAS, NAGF. OR: LDSET, LIB=NUMPAS/NAGF.
 ALL NAG SUBROUTINES SHOULD BE CALLED WITH THE SOFT FAILURE OPTION (IFAIL = 1).

B.3. THE FORTRAN PASCAL INTERFACE.

INTERFACE SUBROUTINES ARE WRITTEN FOR ALL USEFUL FORTRAN SUBROUTINES OPERATING WITH TWO-DIMENSIONAL ARRAYS. IN THIS CASE ARRAYS OUGHT TO BE TRANSPOSED DUE TO THE DIFFERENT STORING OF ARRAYS IN PASCAL AND FORTRAN. WITH THE INTERFACE SUBROUTINES, ONE CAN USE THE DIRECTIONS OF USE IN THE RESPECTIVE LIBRARY MANUALS DISREGARDING THIS PECULIARITY. ONE ONLY HAS TO REMEMBER THAT IF A PARAMETER IS REQUIRED CONTAINING THE LENGTH OF THE COLUMNS OF AN ARRAY ONE MUST GIVE THE LENGTH OF THE ROWS INSTEAD. THE PERFORMANCE OF AN INTERFACE SUBROUTINE CONSISTS OF THE APPROPRIATE TRANSFORMATIONS OF THE PARAMETERS AND OF A CALL OF THE INTENDED SUBROUTINE.

FOR ALL INTERFACE SUBROUTINES THE LETTER P IS PRECEDING THE NAME OF THE ORIGINAL SUBROUTINE. IN A FEW CASES, HOWEVER, AN EXTRA PARAMETER IS NECESSARY, INDICATING THE LENGTH OF THE ROWS OF A SECOND ARRAY TO BE TRANSPOSED, THIS CONCERNS THE SUBROUTINES:

PICSFKU (SECTION 7.1.2.3.2.1.),
 PZX1LP, PZX2LP (SECTION 5.1.4.1.).

THE INTERFACE ALSO CONTAINS THE SUBROUTINES FOR TRANSPOSING REAL OR COMPLEX ARRAYS, AND A SUBROUTINE THAT AVOIDS THE PRINTING OF MESSAGES BY IMSL SUBROUTINES ON UNASSIGNED FILES.

ALL INTERFACE SUBROUTINES ARE CONTAINED IN THE PERMANENT FILE NUMPAS, ID=NUMPAS (SEE A.1.).

C.

OTHER PROCEDURES.

IN THE PASCAL SYSTEM LIBRARY SOME NUMERICAL PROCEDURES ARE AVAILABLE WHICH CAN BE USED IN PASCAL PROGRAMS. THIS CONCERNS THE PROCEDURES PI, RANDOM AND RANDSET. REFERENCES ARE MADE BY:

FUNCTION PI : REAL; EXTERN;
 FUNCTION RANDOM : REAL; EXTERN;
 PROCEDURE RANDSET(X : REAL); EXTERN;

SUPERVISION.

ALL COMMENTS, COMPLAINTS, AND REQUESTS FOR FURTHER
INFORMATION SHOULD BE ADDRESSED TO :

NUNPAS PROJECT GROUP
MATHEMATISCH CENTRUM
THEEDE BOERHAAVE STRAAT 49
AMSTERDAM - 1005.

DATE : 760901.

1. ELEMENTARY PROCEDURES
1. REAL VECT AND MAT OPERATIONS
1. INITIALIZATION

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
INIVEC	NUMPASDOCUMENT1	1	PROLOG	EXTERN
INIMAT	NUMPASDOCUMENT1	1	PROLOG	EXTERN
INIMATD	NUMPASDOCUMENT1	1	PROLOG	EXTERN
INISYND	NUMPASDOCUMENT1	1	PROLOG	EXTERN
INISYHROW	NUMPASDOCUMENT1	1	PROLOG	EXTERN
DUPVEC	NUMPASDOCUMENT1	5	PROLOG	EXTERN
DUPVECROW	NUMPASDOCUMENT1	3	PROLOG	EXTERN
DUPROWVEC	NUMPASDOCUMENT1	3	PROLOG	EXTERN
DUPVECCOL	NUMPASDOCUMENT1	3	PROLOG	EXTERN
DUPCOLVEC	NUMPASDOCUMENT1	3	PROLOG	EXTERN
DUPMAT	NUMPASDOCUMENT1	3	PROLOG	EXTERN
MULVEC	NUMPASDOCUMENT1	5	PROLOG	EXTERN
MULROW	NUMPASDOCUMENT1	5	PROLOG	EXTERN
MULCOL	NUMPASDOCUMENT1	5	PROLOG	EXTERN
COLCST	NUMPASDOCUMENT1	5	PROLOG	EXTERN
ROWCST	NUMPASDOCUMENT1	5	PROLOG	EXTERN
VECVEC	NUMPASDOCUMENT1	7	PROLOG	EXTERN
MATVEC	NUMPASDOCUMENT1	7	PROLOG	EXTERN
TAMVEC	NUMPASDOCUMENT1	7	PROLOG	EXTERN
MATMAT	NUMPASDOCUMENT1	7	PROLOG	EXTERN
TAMMAT	NUMPASDOCUMENT1	7	PROLOG	EXTERN
MATTAM	NUMPASDOCUMENT1	7	PROLOG	EXTERN
SEQVEC	NUMPASDOCUMENT1	7	PROLOG	EXTERN
SCAPRC1	NUMPASDOCUMENT1	7	PROLOG	EXTERN
SYMMATVEC	NUMPASDOCUMENT1	7	PROLOG	EXTERN
FULMATVEC	NUMPASDOCUMENT1	9	PROLOG	EXTERN
FULTAMVEC	NUMPASDOCUMENT1	9	PROLOG	EXTERN
FULSYMMATVEC	NUMPASDOCUMENT1	9	PROLOG	EXTERN
RESVEC	NUMPASDOCUMENT1	9	PROLOG	EXTERN
SYMRESVEC	NUMPASDOCUMENT1	9	PROLOG	EXTERN
HSHVECMAT	NUMPASDOCUMENT1	11	PROLOG	EXTERN
HSHCOLMAT	NUMPASDOCUMENT1	11	PROLOG	EXTERN
HSHROWMAT	NUMPASDOCUMENT1	11	PROLOG	EXTERN
HSHVECTAM	NUMPASDOCUMENT1	11	PROLOG	EXTERN
HSHCOLTAM	NUMPASDOCUMENT1	11	PROLOG	EXTERN
HSHROWTAM	NUMPASDOCUMENT1	11	PROLOG	EXTERN
ELMVEC	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ELMCOL	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ELMROW	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ELMVECCOL	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ELMCOLVEC	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ELMVECROW	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ELMROWVEC	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ELMCOLROW	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ELMROWCOL	NUMPASDOCUMENT1	13	PROLOG	EXTERN

1. 1. 5.

4. SCALAR PRODUCTS
1. VECTOR VECTOR PRODUCTS

2. MATRIX VECTOR PRODUCTS

3. MATRIX MATRIX PRODUCTS

5. ELIMINATION

1. 1. 5.
6. INTERCHANGING

7. ROTATION

8. HORNS

9. SCALING

10. STORAGE MODE CONVERSION

2. COMPL VECT AND MAT OPERATIONS

1.
2.
3. MULTIPLICATION

4. SCALAR PRODUCTS

5. ELIMINATION

6. INTERCHANGING
7. ROTATION

1. 2. 8.
8. HORNS

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF.
MAXELMROW	NUMPASDOCUMENT1	13	PROLOG	EXTERN
ICHVEC	NUMPASDOCUMENT1	15	PROLOG	EXTERN
ICHCOL	NUMPASDOCUMENT1	15	PROLOG	EXTERN
ICHROW	NUMPASDOCUMENT1	15	PROLOG	EXTERN
ICHROWCOL	NUMPASDOCUMENT1	15	PROLOG	EXTERN
ICHSEQVEC	NUMPASDOCUMENT1	15	PROLOG	EXTERN
ICHSEQ	NUMPASDOCUMENT1	15	PROLOG	EXTERN
ROTCOL	NUMPASDOCUMENT1	17	PROLOG	EXTERN
ROTROW	NUMPASDOCUMENT1	17	PROLOG	EXTERN
INFIRMVEC	NUMPASDOCUMENT1	19	PROLOG	EXTERN
INFIRMROW	NUMPASDOCUMENT1	19	PROLOG	EXTERN
INFIRMCOL	NUMPASDOCUMENT1	19	PROLOG	EXTERN
INFIRMAT	NUMPASDOCUMENT1	19	PROLOG	EXTERN
ONENRMVEC	NUMPASDOCUMENT1	19	PROLOG	EXTERN
ONENRMROW	NUMPASDOCUMENT1	19	PROLOG	EXTERN
ONENRMCOL	NUMPASDOCUMENT1	19	PROLOG	EXTERN
ONENRMAT	NUMPASDOCUMENT1	19	PROLOG	EXTERN
ABSHAXMAT	NUMPASDOCUMENT1	19	PROLOG	EXTERN
REASCL	NOT YET AVAILABLE			
PVCVTBF	NUMPASFINDDOC		NMP,IMSL	FORTRAN
PVCVTFB	NUMPASFINDDOC		NMP,IMSL	FORTRAN
PVCVTFO	NUMPASFINDDOC		NMP,IMSL	FORTRAN
PVCVTFS	NUMPASFINDDOC		NMP,IMSL	FORTRAN
PVCVTQF	NUMPASFINDDOC		NMP,IMSL	FORTRAN
PVCVTGS	NUMPASFINDDOC		NMP,IMSL	FORTRAN
PVCVTSF	NUMPASFINDDOC		NMP,IMSL	FORTRAN
PVCVTSQ	NUMPASFINDDOC		NMP,IMSL	FORTRAN
SP1	NUMPASFINDDOC		NUMPAS	FORTRAN
SP2	NUMPASFINDDOC		NUMPAS	FORTRAN
COMCOLCST	NUMPASDOCUMENT3	1	PROLOG	EXTERN
COMROWCST	NUMPASDOCUMENT3	1	PROLOG	EXTERN
COMNATVEC	NUMPASDOCUMENT3	3	PROLOG	EXTERN
HSHCCOL	NUMPASDOCUMENT3	3	PROLOG	EXTERN
HSHCPRD	NUMPASDOCUMENT3	3	PROLOG	EXTERN
ELHCVECCOL	NUMPASDOCUMENT3	5	PROLOG	EXTERN
ELMCCOL	NUMPASDOCUMENT3	5	PROLOG	EXTERN
ELMCROWVEC	NUMPASDOCUMENT3	5	PROLOG	EXTERN
ROTCOL	NUMPASDOCUMENT3	7	PROLOG	EXTERN
ROTROW	NUMPASDOCUMENT3	7	PROLOG	EXTERN
CHSH2	NOT YET AVAILABLE			
COMECUNRM	NUMPASDOCUMENT3	9	PROLOG	EXTERN

1. 2. 9. SCALING

10. STORAGE MODE CONVERSION

3. COMPLEX ARITHMETIC
1. MODIADIC OPERATIONS

2. DYADIC OPERATIONS

4. LONG INTEGER ARITHMETIC

5. LONG REAL ARITHMETIC
1. EVAL. ARITHMETIC OPERATIONS

2. SCALAR PRODUCTS
1. VECTOR VECTOR PRODUCTS

2. MATRIX VECTOR PRODUCTS

2. ALGEBRAIC EVALUATIONS
2. 1. EVAL. OF A FINITE SERIES

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
COMSCL	NOT YET AVAILABLE			
SCLCOM	NOT YET AVAILABLE			
PVCVTCH	NUMPASFTNDOC		NMP,IMSL	FORTRAN
PVCVTHC	NUMPASFTNDOC		NMP,IMSL	FORTRAN
SPC1	NUMPASFTNDOC		NUMPAS	FORTRAN
SPC2	NUMPASFTNDOC		NUMPAS	FORTRAN
COMARS	NUMPASDOCUMENT3	11	NUMPAS	EXTERN
COMSORT	NUMPASDOCUMENT3	11	NUMPAS	EXTERN
CARPOL	NUMPASDOCUMENT3	11	NUMPAS	EXTERN
COMADD	NUMPASDOCUMENT3	13	NUMPAS	EXTERN
COMSUBT	NUMPASDOCUMENT3	13	NUMPAS	EXTERN
COMHUL	NUMPASDOCUMENT3	13	NUMPAS	EXTERN
COMDIV	NUMPASDOCUMENT3	13	NUMPAS	EXTERN
COMPOWER	NUMPASDOCUMENT3	13	NUMPAS	EXTERN
LNGIADD	NUMPASDOCUMENT2	1	PROLOG	EXTERN
LNGISUBTRACT	NUMPASDOCUMENT2	1	PROLOG	EXTERN
LNGISOR	NUMPASDOCUMENT2	1	PROLOG	EXTERN
LNGIMULT	NUMPASDOCUMENT2	1	PROLOG	EXTERN
LNGIDIVIDE	NUMPASDOCUMENT2	1	PROLOG	EXTERN
LNGIPOWER	NUMPASDOCUMENT2	1	PROLOG	EXTERN
DP ADD	NOT YET AVAILABLE			
DP SUB	NOT YET AVAILABLE			
DP MUL	NOT YET AVAILABLE			
DP DIV	NOT YET AVAILABLE			
LNG ADD	NOT YET AVAILABLE			
LNG SUB	NOT YET AVAILABLE			
LNG MUL	NOT YET AVAILABLE			
LNG DIV	NOT YET AVAILABLE			
LNGVECTEC	NOT YET AVAILABLE			
LNGMATVEC	NOT YET AVAILABLE			
LNGTAMVEC	NOT YET AVAILABLE			
LNGMATMAT	NOT YET AVAILABLE			
LNGTAMMAT	NOT YET AVAILABLE			
LNGMATTAH	NOT YET AVAILABLE			
LNGSEQVEC	NOT YET AVAILABLE			
LNGSCAPROD	NOT YET AVAILABLE			
LNGSYMMATVEC	NOT YET AVAILABLE			
LNGFULMATVEC	NOT YET AVAILABLE			
LNGFULTAMVEC	NOT YET AVAILABLE			
LNGFULSYMMATVEC	NOT YET AVAILABLE			
LNGRESVEC	NOT YET AVAILABLE			
LNGSYMMRESVEC	NOT YET AVAILABLE			

2. 2.EVAL. OF POLYNOMIALS
 - 1.EVAL. OF GENERAL POLYNOMIALS
 - 1.POLYNOMIALS IN GRUNERT FORM
- 2.POLYNOMIALS IN NEWTON FORM
- 2.EVAL. OF ORTHOGON. POLYNOMIALS
 - 1.GENERAL ORTHOGON. POLYNOMIALS
- 2.CHEBYSHEV POLYNOMIALS
- 3.EVAL. OF TRIGONON. POLYNOMIALS
 - 1.EVAL. OF FOURIER SERIES
 - SEE ALSO SECTION 2.5.
- 4.EVAL. OF SPLINES
 - 1.1-DIM. SPLINES
 - 2.2-DIM. SPLINES
- 3.EVAL. OF CONTINUED FRACTIONS
- 4.OPERATIONS ON POLYNOMIALS
 - 1.TRANSF. OF REPRESENTATION
- 2.OP. ON GENERAL POLYNOMIALS
- 3.OP. ON ORTHOGONAL POLYNOMIALS
- 5.FAST FOURIER TRANSFORM
 - 1.REVERSE BINARY ORDER CONVERSION
 - 2.TRANSFORM OF REAL VECTOR
 - 3.TRANSFORM OF COMPLEX VECTOR

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
POL	NOT YET AVAILABLE			
TAYPOL	NOT YET AVAILABLE			
NORDERPOL	NOT YET AVAILABLE			
DERPOL	NOT YET AVAILABLE			
NEWPOL	NOT YET AVAILABLE			
ORTPOL	NOT YET AVAILABLE			
ALLORTPOL	NOT YET AVAILABLE			
ORTPOLSER	NOT YET AVAILABLE			
CHEPOL	NOT YET AVAILABLE			
ALLCHEPOL	NOT YET AVAILABLE			
CHEPOLSER	NOT YET AVAILABLE			
SINER	NOT YET AVAILABLE			
COSER	NOT YET AVAILABLE			
FOUSER	NOT YET AVAILABLE			
FOUSER1	NOT YET AVAILABLE			
FOUSER2	NOT YET AVAILABLE			
COMFOUSER	NOT YET AVAILABLE			
COMFOUSER1	NOT YET AVAILABLE			
COMFOUSER2	NOT YET AVAILABLE			
PICSEVU	NUMPASFTNDOC		NMP,IMSL	FORTAN
PIRCEVU	NUMPASFTNDOC		NMP,IMSL	FORTAN
JFRAC	NOT YET AVAILABLE			
NEWGRN	NOT YET AVAILABLE			
POLCHS	NOT YET AVAILABLE			
POMCHS	NOT YET AVAILABLE			
ADDPOL	NOT YET AVAILABLE			
SUBPOL	NOT YET AVAILABLE			
MULPOL	NOT YET AVAILABLE			
DIFPOL	NOT YET AVAILABLE			
INTPOL	NOT YET AVAILABLE			
INTCHS	NOT YET AVAILABLE			
FFRDR2	NUMPASFTNDOC		IMSL	FORTAN
FFTR	NUMPASFTNDOC		IMSL	FORTAN

2. 5. 3.

4. COSINE AND SINE TRANSFORM

3. LINEAR ALGEBRA

1. LINEAR SYSTEMS
 1. FULL MATRICES
 1. SQUARE NON-SINGULAR MATRICES
 1. REAL MATRICES
 1. GENERAL MATRICES
 1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

4. MATRIX INVERSION

5. ITERATIVELY IMPROVED SOLUTION

2. SYMMETRIC POS DEF MATRICES

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. 1. 1. 1. 1. 2. 3.

3. SOLUTION OF LINEAR EQUATIONS

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
FFTP	NUMPASFTNDOC		IMSL	FORTTRAN
FFT2	NUMPASFTNDOC		IMSL	FORTTRAN
FFT2RV	NUMPASFTNDOC		IMSL	FORTTRAN
FFCSIN	NUMPASFTNDOC		IMSL	FORTTRAN
DEC	NUMPASDOCUMENT2	3	PROLOG	EXTERN
GSELM	NOT YET AVAILABLE			
OENRMINV	NOT YET AVAILABLE			
ERBELM	NOT YET AVAILABLE			
GSSERB	NOT YET AVAILABLE			
GSSNRI	NOT YET AVAILABLE			
DETERM	NUMPASDOCUMENT2	5	PROLOG	EXTERN
PLINV3F	NUMPASFTNDOC		NMP,IMSL	FORTTRAN
SOL	NUMPASDOCUMENT2	7	PROLOG	EXTERN
DECSOL	NUMPASDOCUMENT2	7	PROLOG	EXTERN
SOLELM	NOT YET AVAILABLE			
GSSOL	NOT YET AVAILABLE			
GSSOLERB	NOT YET AVAILABLE			
PLINV3F	NUMPASFTNDOC		NMP,IMSL	FORTTRAN
PLEQ1F	NUMPASFTNDOC		NMP,IMSL	FORTTRAN
INV	NOT YET AVAILABLE			
DECINV	NOT YET AVAILABLE			
INV1	NOT YET AVAILABLE			
GSSINV	NOT YET AVAILABLE			
GSSINVERB	NOT YET AVAILABLE			
PLINV1F	NUMPASFTNDOC		NMP,IMSL	FORTTRAN
PLINV2F	NUMPASFTNDOC		NMP,IMSL	FORTTRAN
PLINV3F	NUMPASFTNDOC		NMP,IMSL	FORTTRAN
ITISOL	NOT YET AVAILABLE			
GSSITISOL	NOT YET AVAILABLE			
ITISOLERB	NOT YET AVAILABLE			
GSSITISOLERB	NOT YET AVAILABLE			
PLEQT2F	NUMPASFTNDOC		NMP,IMSL	FORTTRAN
CHLDEC2	NOT YET AVAILABLE	9	PROLOG	EXTERN
CHLDEC1	NUMPASDOCUMENT2			
CHLDETERM2	NOT YET AVAILABLE	11	PROLOG	EXTERN
CHLDETERM1	NUMPASDOCUMENT2			
CHLSOL2	NOT YET AVAILABLE	13	PROLOG	EXTERN
CHLSOL1	NUMPASDOCUMENT2			
CHLDECSOL2	NOT YET AVAILABLE			

3. 1. 1. 1. 2. 3.

4. MATRIX INVERSION

3. GENERAL SYMMETRIC MATRICES
1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

4. MATRIX INVERSION

2. COMPLEX MATRICES

1. GENERAL MATRICES

3. SOLUTION OF LINEAR EQUATIONS

2. FULL RANK OVERDETERM SYSTEMS

1. REAL MATRICES

1. PREPARATORY PROCEDURES

2. LEAST SQUARES SOLUTION

SEE ALSO SECTION 3.1.1.3.1.1.

3. INVERSE MATRIX OF NORMAL EQN.

2. COMPLEX MATRICES

3. OTHER PROBLEMS

1. REAL MATRICES

1. SOLUTION OVERDETERMINED SYST

2. SOLUTION UNDERDETERM SYSTEMS

3. 1. 1. 3. 1. 2.

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
CHLDEC SOL1 PLEQT1P PLEGT2P	NUMPASDOCUMENT2 NUMPASFTNDOC NUMPASFTNDOC	13	PROLOG NMP,IMSL NMP,IMSL	EXTERN FORTRAN FORTRAN
CHLINV2 CHLINV1 CHLDECINV2 CHLDECINV1 PLINV1P PLINV2P	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NUMPASFTNDOC NUMPASFTNDOC		NMP,IMSL NMP,IMSL	FORTRAN FORTRAN
SYNDEC2 SYNDEC1	NOT YET AVAILABLE NOT YET AVAILABLE			
SYNDETERM2 SYNDETERM1	NOT YET AVAILABLE NOT YET AVAILABLE			
SYHSOL2 SYHSOL1 SYNDEC SOL2 SYNDEC SOL1 PLEG1S PLEG2S	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NUMPASFTNDOC NUMPASFTNDOC		NMP,IMSL NMP,IMSL	FORTRAN FORTRAN
SYMINV2 SYMINV1 SYNDECINV2 SYNDECINV1	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE			
PLEGT1C PLEGT2C	NUMPASFTNDOC NUMPASFTNDOC		NMP,IMSL NMP,IMSL	FORTRAN FORTRAN
LSORTDEC LSODGLINV	NUMPASDOCUMENT2 NUMPASDOCUMENT2	15 15	PROLOG PROLOG	EXTERN EXTERN
LSQSOL LSODECSOL	NUMPASDOCUMENT2 NUMPASDOCUMENT2	17 17	PROLOG PROLOG	EXTERN EXTERN
LSQINV	NUMPASDOCUMENT2	19	PROLOG	EXTERN
SOLSVDOVR SOLOVR PLLSQAR	NOT YET AVAILABLE NOT YET AVAILABLE NUMPASFTNDOC		NMP,IMSL	FORTRAN
SOLSVDOUN SOLUND	NOT YET AVAILABLE NOT YET AVAILABLE			

3. 1. 1. 3. 1. 3. SOLUTION HOMOGENEOUS EQUATION

4. PSEUDO-INVERSION

2. COMPLEX MATRICES

1. DIRECT METHODS

1. REAL MATRICES

1. NON-SYMMETRIC MATRICES

1. BAND MATRICES

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

1. PREPARATORY PROCEDURES

2. CALCULATION OF DETERMINANT

3. SOLUTION OF LINEAR EQUATIONS

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
HOMSOLSVD	NOT YET AVAILABLE			
HOMSOL	NOT YET AVAILABLE			
PSDINVSVD	NOT YET AVAILABLE			
PSDINV	NOT YET AVAILABLE			
PLPSDOR	NUMPASFTNDOC		NMP,IMSL	FORTRAN
DEC8ND	NOT YET AVAILABLE			
DETERM8ND	NOT YET AVAILABLE			
SOL8ND	NOT YET AVAILABLE			
DECSOL8ND	NOT YET AVAILABLE			
PLEQT18	NUMPASFTNDOC		NMP,IMSL	FORTRAN
PLEQT28	NUMPASFTNDOC		NMP,IMSL	FORTRAN
DECTRI	NOT YET AVAILABLE			
DECTRIPIV	NOT YET AVAILABLE			
SOLTRI	NOT YET AVAILABLE			
DECSOLTRI	NOT YET AVAILABLE			
SOLTRIPIV	NOT YET AVAILABLE			
DECSOLTRIPIV	NOT YET AVAILABLE			
PFO3AJF	NUMPASFTNDOC		NMP,NAGF	FORTRAN
PFO3AKF	NUMPASFTNDOC		NMP,NAGF	FORTRAN
PFO4APF	NUMPASFTNDOC		NMP,NAGF	FORTRAN
CHLDEC8ND	NOT YET AVAILABLE			
CHLDETERM8ND	NOT YET AVAILABLE			
CHLSOL8ND	NOT YET AVAILABLE			
CHLDEC8ND	NOT YET AVAILABLE			
PLEQ1PB	NUMPASFTNDOC		NMP,IMSL	FORTRAN
PLEQ2PB	NUMPASFTNDOC		NMP,IMSL	FORTRAN
DECSYMTRI	NOT YET AVAILABLE			

3. 1. 2. 1. 2. 3.
 3. BLOCK-TRIAGONAL MATRICES
 2. COMPLEX MATRICES
 2. ITERATIVE METHODS
 1. REAL MATRICES
 2. COMPLEX MATRICES
 1. FULL MATRICES
 2. TRANSFORMATION TO SPECIAL FORM
 1. SIMILARITY TRANSFORMATION'S
 1. EQUILIBRATION
 1. REAL MATRICES
 2. COMPLEX MATRICES
 2. TRANSF TO HESSEMBERG FORM
 1. REAL MATRICES
 1. SYMMETRIC MATRICES
 2. ASYMMETRIC MATRICES
 2. COMPLEX MATRICES
 1. HERMITIAN MATRICES
 2. NON-HERMITIAN MATRICES
 2. OTHER TRANSFORMATIONS
 1. TRANSF TO BIDIAGONAL FORM
 1. REAL MATRICES
 2. COMPLEX MATRICES
 3. THE (ORDINARY) EIGENV PROBLEM
 1. REAL MATRICES
 1. SYMMETRIC MATRICES
 1. TRIAGONAL MATRICES
3. 3. 1. 1. 1.
 - VALSYMTRI
 - VECSYMTRI
 - QPIVALSYMTRI
 - QRISYMTRI
 - RATQRI

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
SOLSYMTRI DECSOLSYMTRI	NOT YET AVAILABLE NOT YET AVAILABLE			
CONJ GRAD CONJ RESI	NOT YET AVAILABLE NOT YET AVAILABLE			
EOILBR BAKLBR	NOT YET AVAILABLE NOT YET AVAILABLE			
EOILBRCOM BAKLBRCOM	NOT YET AVAILABLE NOT YET AVAILABLE			
TFMSYMTRI2 BAKSYMTRI2 TFMPREVEC TFMSYMTRI1 BAKSYMTRI1	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE			
TFMREAHES BAKREAHES1 BAKREAHES2	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE			
HSHRMTRI HSHRMTRIVAL BAKHRMTRI	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE			
HSHCOMHES BAKCOMHES	NOT YET AVAILABLE NOT YET AVAILABLE			
HSHREABID PSTTFMMAT PRETFMMAT	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE			
VALSYMTRI VECSYMTRI QPIVALSYMTRI QRISYMTRI RATQRI	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE			

3.
 4.
 1.
 5. SINGULAR VALUES
 1. REAL MATRICES
 1. BIDIAGONAL MATRICES
 2. FULL MATRICES
 2. COMPLEX MATRICES
 6. ZEROS OF POLYNOMIALS
 1. ZEROS OF GENERAL REAL POLYNOMIAL
 2. ZEROS OF ORTHOGONAL POLYNOMIAL
 3. ZEROS OF COMPLEX POLYNOMIALS
4. ANALYTIC EVALUATIONS
 1. EVAL. OF AN INFINITE SERIES
 2. QUADRATURE
 1. ONE-DIMENSIONAL QUADRATURE
 2. MULTIDIMENSIONAL QUADRATURE
 3. GAUSSIAN WEIGHTS
3. NUMERICAL DIFFERENTIATION
 1. FUNCTIONS OF ONE VARIABLE
 1.
 2. 1-ST & 2-ND DERIV. OF SPLINE
 2. FUNCTIONS OF MORE VARIABLES
 1. CALC. WITH DIFFERENCE FORMULAS
 2. 1. & 2. PART. DER. OF BICUB. SPLINE
5. ANALYTICAL PROBLEMS
 1. ANALYTICAL EQUATIONS
 1.
 1. NON-LINEAR EQUATIONS

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
PEIGZF	NUMPASFTNDOC		NMP,IMSL	FORTRAN
GRISNGVALBID	NOT YET AVAILABLE			
GRISNGVALDECBI0	NOT YET AVAILABLE			
GRISNGVAL	NOT YET AVAILABLE			
GRISNGVALDEC	NOT YET AVAILABLE			
PLSVALR	NUMPASFTNDOC		NMP,IMSL	FORTRAN
POLZEROS	NOT YET AVAILABLE			
ZPOLR	NUMPASFTNDOC		IMSL	FORTRAN
ZCPOLY	NUMPASFTNDOC		IMSL	FORTRAN
ZOADR	NUMPASFTNDOC		IMSL	FORTRAN
ALLZERORTPOL	NOT YET AVAILABLE			
LUPZERORTPOL	NOT YET AVAILABLE			
SELZERORTPOL	NOT YET AVAILABLE			
COMKWD	NOT YET AVAILABLE			
ZCPOLY	NUMPASFTNDOC		IMSL	FORTRAN
ZOADC	NUMPASFTNDOC		IMSL	FORTRAN
EULER	NUMPASDOCUMENT3	15	NUMPAS	EXTERN
SUMPOSSERIES	NUMPASDOCUMENT3	15	NUMPAS	EXTERN
GADRAT	NUMPASDOCUMENT2	21	NUMPAS	EXTERN
INTEGRAL	NUMPASDOCUMENT3	17	NUMPAS	EXTERN
PDCSODU	NUMPASFTNDOC		NMP,IMSL	FORTRAN
TRICUB	NUMPASDOCUMENT3	19	NUMPAS	EXTERN
PDCS2QU	NUMPASFTNDOC		NMP,IMSL	FORTRAN
RECCOF	NOT YET AVAILABLE			
CSSNGT	NOT YET AVAILABLE			
PDCSEVU	NUMPASFTNDOC		NMP,IMSL	FORTRAN
JACOBINF	NOT YET AVAILABLE			
JACOBIMF	NOT YET AVAILABLE			
JACOBIBNDF	NOT YET AVAILABLE			
PDRCEVU	NUMPASFTNDOC		NMP,IMSL	FORTRAN

5. 1. 1. 1.A SINGLE EQUATION
 - 1.NO DERIVATIVE AVAILABLE
 - 2.DERIVATIVE AVAILABLE
- 2.A SYSTEM OF EQUATIONS
 - 1.AUXILIARY PROCEDURES
 - 2.JACOBIAN MATRIX NOT AVAILABLE
- 3.JACOBIAN MATRIX AVAILABLE
- 3.POLYNOMIAL EQUATIONS
 - SEE ALSO SECTION 3.6
- 2.UNCONSTRAINED OPTIMIZATION
 - 1.FUNCTIONS OF ONE VARIABLE
 - 1.DERIVATIVE NOT AVAILABLE
 - 2.DERIVATIVE AVAILABLE
 - 2.FUNCTIONS OF MORE VARIABLES
 - 1.AUXILIARY PROCEDURES
 - 2.NO DERIVATIVES AVAILABLE
 - 3.GRAIENT AVAILABLE
 - 4.GRAIENT & JACOBIAN AVAILABLE
 - 3.OVERDETERMINED NONLINEAR SYST.
 - 1.LEAST SQUARES SOLUTIONS
 - SEE ALSO SECTION 7.
 - 1.AUXILIARY PROCEDURES
 - 2.JACOBIAN MATRIX NOT AVAILABLE
 - SEE ALSO SECTION 5.1.2.2.
 - 3.JACOBIAN MATRIX AVAILABLE
 - 4.CONSTRAINED OPTIMIZATION
 - 1.LINEAR PROGRAMMING
 - 2.FUNCTIONAL EQUATIONS
 - 1.DIFFERENTIAL EQUATIONS
 5. 2. 1. 1.INITIAL VALUE PROBLEMS

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
ZERDIN	NUMPASDOCUMENT2	23	NUMPAS	EXTERN
ZERDINRAT	NOT YET AVAILABLE			
ZERDINDER	NOT YET AVAILABLE			
BROWNL	NOT YET AVAILABLE			
QUANEW	NOT YET AVAILABLE			
QUANEW1	NOT YET AVAILABLE			
QUANEWBND	NOT YET AVAILABLE			
QUANEWBND1	NOT YET AVAILABLE			
NEWRAP	NOT YET AVAILABLE			
DAMPED NEWTON	NOT YET AVAILABLE			
MININ	NUMPASDOCUMENT2	25	NUMPAS	EXTERN
MININDER	NUMPASDOCUMENT2	27	NUMPAS	EXTERN
LINEMIN	NOT YET AVAILABLE			
RNK1UPD	NOT YET AVAILABLE			
DAVUPD	NOT YET AVAILABLE			
FLEUPD	NOT YET AVAILABLE			
PRAXIS	NOT YET AVAILABLE			
RNK1MIN	NOT YET AVAILABLE			
FLEMIN	NOT YET AVAILABLE			
NEWTONMIN	NOT YET AVAILABLE			
MARQUARDT	NOT YET AVAILABLE			
GSSNEWTON	NOT YET AVAILABLE			
PZX1LP	NUMPASFTNDOC		NMP,IMSL	FORTRAN
PZX2LP	NUMPASFTNDOC		NMP,IMSL	FORTRAN
PZX3LP	NUMPASFTNDOC		NMP,IMSL	FORTRAN

5. 2. 1. 1. 1. FIRST ORDER ORDINARY D.E.
1. NO DERIVATIVES RHS AVAILABLE
SEE ALSO SECTION 5.2.1.1.1.1.

2. JACOBIAN MATRIX AVAILABLE

- SEE ALSO PROC. MULTISTEP (5.2.1.1.1.1.1)
3. SEVERAL DERIVATIVES AVAILABLE

2. SECOND ORDER ORDINARY D.E.
1. NO DERIVATIVES RHS AVAILABLE
SEE ALSO SECTION 5.2.1.1.2.1.

2. SEVERAL DERIV. RHS AVAILABLE
3. PARTIAL DIFFERENTIAL EQUATIONS

2. BOUNDARY VALUE PROBLEMS
1. TWO POINT B.V.P.
1. SHOOTING METHODS
SEE ALSO SECTION 5.2.1.3.1
2. LINEAR GLOBAL METHODS
1. SECOND ORDER TPBVP
1. SELF ADJOINT TPBVP

2. SKEW ADJOINT TPBVP
2. FOURTH ORDER TPBVP
1. SELF ADJOINT TPBVP

2. SKEW ADJOINT TPBVP
3. NON-LINEAR GLOBAL METHODS
2. TWO-DIMENSIONAL B.V.P.
1. ELLIPTIC B.V.P.'S
1. DISCRETIZATION PROCEDURES
2. SPECIAL LINEAR SYSTEMS

5. 2. 1. 2. 1. SEE ALSO SECTION 3.1.2

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
RK1	NOT YET AVAILABLE	29	PROLOG	EXTERN
RKE	NUNPASDOCUMENT2			
RK4A	NOT YET AVAILABLE			
RK4NA	NOT YET AVAILABLE			
RK5NA	NOT YET AVAILABLE			
MULTISTEP	NOT YET AVAILABLE			
DIFFSYS	NOT YET AVAILABLE			
ARK	NOT YET AVAILABLE			
EFRK	NOT YET AVAILABLE			
EFSRK	NOT YET AVAILABLE			
EFERK	NOT YET AVAILABLE			
LINIGER1VS	NOT YET AVAILABLE			
LINIGER2	NOT YET AVAILABLE			
IMPEX	NOT YET AVAILABLE			
GHS	NOT YET AVAILABLE			
MODIFIED TAYLOR EXPONENTIALLY FITTED	NOT YET AVAILABLE NOT YET AVAILABLE			
RK2	NOT YET AVAILABLE			
RK2H	NOT YET AVAILABLE			
RK3	NOT YET AVAILABLE			
RK3N	NOT YET AVAILABLE			
FEM LAG	NOT YET AVAILABLE			
FEM LAG SYM	NOT YET AVAILABLE			
FEM LAG SKEN	NOT YET AVAILABLE			
FEM HERM SYM	NOT YET AVAILABLE			
RICHARDSON ELIMINATION	NOT YET AVAILABLE NOT YET AVAILABLE			

6. GAMMA FUNCTION, ETC.

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
GAMMA	NOT YET AVAILABLE			
RECIP GAMMA	NOT YET AVAILABLE			
LOG GAMMA	NOT YET AVAILABLE			
INCOMGAM	NOT YET AVAILABLE			
INCBETA	NOT YET AVAILABLE			
IBPPLUSN	NOT YET AVAILABLE			
IBQPLUSN	NOT YET AVAILABLE			
IXRFX	NOT YET AVAILABLE			
IXPFX	NOT YET AVAILABLE			
FORWARD	NOT YET AVAILABLE			
BACKWARD	NOT YET AVAILABLE			
MOBETA	NUMPASFTNDOC		IMSL	FORTRAN
MOBETI	NUMPASFTNDOC		IMSL	FORTRAN
MOGAM	NUMPASFTNDOC		IMSL	FORTRAN
MOGAMA	NUMPASFTNDOC		IMSL	FORTRAN
HLGAMA	NUMPASFTNDOC		IMSL	FORTRAN

7. ERROR FUNCTION, ETC.

ERRORFUNCTION	NOT YET AVAILABLE			
NONEXPERFC	NOT YET AVAILABLE			
INVERSE ERROR FUNCTI	NOT YET AVAILABLE			
FRESNEL	NOT YET AVAILABLE			
FG	NOT YET AVAILABLE			
MERF	NUMPASFTNDOC		IMSL	FORTRAN
MERFC	NUMPASFTNDOC		IMSL	FORTRAN
MERFI	NUMPASFTNDOC		IMSL	FORTRAN
MERFCI	NUMPASFTNDOC		IMSL	FORTRAN
MDNRIS	NUMPASFTNDOC		IMSL	FORTRAN
MDAM	NUMPASFTNDOC		IMSL	FORTRAN
S20AAF	NUMPASFTNDOC		NAGF	FORTRAN
S20ABF	NUMPASFTNDOC		NAGF	FORTRAN

8. LEGENDRE FUNCTIONS
9. BESSEL FUNCTIONS OF INT. ORDER
1. BESSEL FUNCTIONS J AND Y

BESS J0	NOT YET AVAILABLE			
BESS J1	NOT YET AVAILABLE			
BESS J	NOT YET AVAILABLE			
BESS Y01	NOT YET AVAILABLE			
BESS Y	NOT YET AVAILABLE			
BESS PQ0	NOT YET AVAILABLE			
BESS PQ1	NOT YET AVAILABLE			
S17AAF	NUMPASFTNDOC		NAGF	FORTRAN
S17ABF	NUMPASFTNDOC		NAGF	FORTRAN
S17ACF	NUMPASFTNDOC		NAGF	FORTRAN
BESS I0	NOT YET AVAILABLE			
BESS I1	NOT YET AVAILABLE			
BESS I	NOT YET AVAILABLE			
BESS K01	NOT YET AVAILABLE			
BESS K	NOT YET AVAILABLE			
NONEXP BESS I0	NOT YET AVAILABLE			
NONEXP BESS I1	NOT YET AVAILABLE			
NONEXP BESS I	NOT YET AVAILABLE			
NONEXP BESS K01	NOT YET AVAILABLE			
NONEXP BESS K	NOT YET AVAILABLE			

2. BESSEL FUNCTIONS I AND K

6. 9. 2.

3. KELVIN FUNCTIONS

10. BESSEL FUNCTIONS OF REAL ORDER

1. BESSEL FUNCTIONS J AND Y

2. BESSEL FUNCTIONS I AND K

3. SPHERICAL BESSEL FUNCTIONS

4. AIRY FUNCTIONS

7. INTERPOLATION & APPROXIMATION

1. REAL DATA IN ONE DIMENSION

1. INTERPOLATION, WITH

1. POLYNOMIALS

1. GENERAL POLYNOMIALS

2. ORTHOGONAL POLYNOMIALS

2. SPLINES

1. GENERAL SPLINES

2. NATURAL SPLINES

3. TRIGONOMETRIC SERIES

SEE ALSO SECTION 2.5.4.

1. FOURIER SERIES

2. SINE SERIES

3. COSINE SERIES

4. RATIONAL FUNCTIONS

5. EXPONENTIAL FUNCTIONS

2. APPROXIMATION IN 2-NORM, WITH

1. GENERAL FUNCTIONS

SEE ALSO SECTION 5.1.3.1

7. 1. 2.

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
S1BAAF	NUMPASFTNDOC		NAGF	FORTAN
S1BABF	NUMPASFTNDOC		NAGF	FORTAN
S1BACF	NUMPASFTNDOC		NAGF	FORTAN
S1BADF	NUMPASFTNDOC		NAGF	FORTAN
MMKELD	NUMPASFTNDOC		IMSL	FORTAN
MMKELO	NUMPASFTNDOC		IMSL	FORTAN
MMKELI	NUMPASFTNDOC		IMSL	FORTAN
BESS JAPLUSN	NOT YET AVAILABLE			
BESS YAO1	NOT YET AVAILABLE			
BESS YAPLUSN	NOT YET AVAILABLE			
BESS POA01	NOT YET AVAILABLE			
S17ADF	NUMPASFTNDOC		NAGF	FORTAN
BESS IAPLUSN	NOT YET AVAILABLE			
BESS KAO1	NOT YET AVAILABLE			
BESS KAPLUSN	NOT YET AVAILABLE			
NONEXP BESS IAPLUSN	NOT YET AVAILABLE			
NONEXP BESS KAO1	NOT YET AVAILABLE			
NONEXP BESS KAPLUSN	NOT YET AVAILABLE			
SPHER BESS J	NOT YET AVAILABLE			
SPHER BESS Y	NOT YET AVAILABLE			
SPHER BESS I	NOT YET AVAILABLE			
SPHER BESS K	NOT YET AVAILABLE			
NONEXP SPHER BESS I	NOT YET AVAILABLE			
NONEXP SPHER BESS K	NOT YET AVAILABLE			
AIRY	NOT YET AVAILABLE			
AIRYZEROS	NOT YET AVAILABLE			
NEWTON	NOT YET AVAILABLE			
E01AAF	NUMPASFTNDOC		NAGF	FORTAN
E01ABF	NUMPASFTNDOC		NAGF	FORTAN
PICSICU	NUMPASFTNDOC		NHP,IMSL	FORTAN

7. 1. 2. POLYNOMIALS
 1. GENERAL POLYNOMIALS
 2. ORTHOGONAL POLYNOMIALS
3. SPLINES
 1. GENERAL SPLINES
 2. NATURAL SPLINES

SEE ALSO SECTION 2.2.4.
1. WITH FIXED KNOTS
2. WITH VARIABLE KNOTS
4. TRIGONOMETRIC POLYNOMIALS

SEE ALSO SECTION 2.5.4.
5. RATIONAL FUNCTIONS
6. EXPONENTIAL FUNCTIONS
7. SPECIAL FUNCTIONS
3. APPROXIMATION IN L^p -NORM, WITH
 1. GENERAL FUNCTIONS
 2. POLYNOMIALS
 1. GENERAL POLYNOMIALS
2. ORTHOGONAL POLYNOMIALS
3. TRIGONOMETRIC POLYNOMIALS

SEE ALSO SECTION 2.5.4.
4. RATIONAL FUNCTIONS
4. APPROXIMATION IN L^p -NORM, WITH
 1. GENERAL FUNCTIONS
 2. POLYNOMIALS
5. SMOOTHING, BY
 1. SPLINES
2. REAL DATA IN MORE DIMENSIONS
 1. INTERPOLATION, WITH
 1. SPLINES

SEE ALSO SECTION 2.2.4.
3. REAL FUNCTIONS IN 1 DIMENSION
 1. POLYNOMIALS
8. NUMBER THEORY
9. TABLE HANDLING

PROCEDURE	DESCRIPTION FILENAME	REC NR	USE	EXT REF
RLFOTM RLFOTM	NUMPASFTNDOC NUMPASFTNDOC		IMSL IMSL	FORTRAN FORTRAN
PICSFKU PICSVKU	NUMPASFTNDOC NUMPASFTNDOC		NMP,IMSL NMP,IMSL	FORTRAN FORTRAN
PRSMITZ	NOT YET AVAILABLE			
INI SNDRENEZ MINMAXPOL	NOT YET AVAILABLE NOT YET AVAILABLE NOT YET AVAILABLE			
E02ACF	NUMPASFTNDOC		NAGF	FORTRAN
PICSSCU	NUMPASFTNDOC		NMP,IMSL	FORTRAN
PIBCICU PIBCIEU	NUMPASFTNDOC NUMPASFTNDOC		NMP,IMSL NMP,IMSL	FORTRAN FORTRAN