NAG SMP Library

Tuned and Enhanced Routines in the NAG SMP Library

The following sections list the user-callable routines that have been parallelised, or otherwise optimized.

**Note:** on some implementations, the equivalent vendor library routines may be substituted for some of the following list – consult the Users’ Note for your implementation for further information.

1 Tuned Routines

C06FKF Circular convolution or correlation of two real vectors, extra workspace for greater speed
C06FPF Multiple one-dimensional real discrete Fourier transforms
C06FQF Multiple one-dimensional Hermitian discrete Fourier transforms
C06FRF Multiple one-dimensional complex discrete Fourier transforms
C06FU F Two-dimensional complex discrete Fourier transform
C06FXF Three-dimensional complex discrete Fourier transform
C06HAF Discrete sine transform
C06HBF Discrete cosine transform
C06HCF Discrete quarter-wave sine transform
C06HDF Discrete quarter-wave cosine transform
C06PAF Single one-dimensional real and Hermitian complex discrete Fourier transform, using complex data format for Hermitian sequences
C06PFF One-dimensional complex discrete Fourier transform of multi-dimensional data (using complex data type)
C06PJF Multi-dimensional complex discrete Fourier transform of multi-dimensional data (using complex data type)
C06PKF Circular convolution or correlation of two complex vectors
C06PQF Multiple one-dimensional real and Hermitian complex discrete Fourier transforms, using complex data format for Hermitian sequences
C06PQF Multiple one-dimensional real and Hermitian complex discrete Fourier transforms, using complex data format for Hermitian sequences
C06PRF Multi-dimensional complex discrete Fourier transforms using complex data format
C06PSF Multi-dimensional complex discrete Fourier transforms using complex data format and sequences stored as columns
C06PUF Two-dimensional complex discrete Fourier transform, complex data format
C06PXF Three-dimensional complex discrete Fourier transform, complex data format
C06RAF Discrete sine transform (easy-to-use)
C06RBF Discrete cosine transform (easy-to-use)
C06RCF Discrete quarter-wave sine transform (easy-to-use)
C06RDF Discrete quarter-wave cosine transform (easy-to-use)
F04AFF Solution of real symmetric positive-definite simultaneous linear equations using iterative refinement (coefficient matrix already factorized by F03AEF)
F04AGF Solution of real symmetric positive-definite simultaneous linear equations (coefficient matrix already factorized by F03AEF)
F04AHF Solution of real simultaneous linear equations using iterative refinement (coefficient matrix already factorized by F03AEF)
F04AJF Solution of real simultaneous linear equations (coefficient matrix already factorized by F03AEF)
F07ADF LU factorization of real $m$ by $n$ matrix
F07AEF Solution of real system of linear equations, multiple right-hand sides, matrix already factorized by F07ADF (DGTRF)
F07AHF Refined solution with error bounds of real system of linear equations, multiple right-hand sides
F07ARF LU factorization of complex $m$ by $n$ matrix
F07ASF Solution of complex system of linear equations, multiple right-hand sides, matrix already factorized by F07ARF (ZGTRF)
F07AVF Refined solution with error bounds of complex system of linear equations, multiple right-hand sides
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F07TVF Error bounds for solution of complex triangular system of linear equations, multiple right-hand sides
F07UEF Solution of real triangular system of linear equations, multiple right-hand sides, packed storage
F07UHF Error bounds for solution of real triangular system of linear equations, multiple right-hand sides, packed storage
F07USF Solution of complex triangular system of linear equations, multiple right-hand sides, packed storage
F07UVF Error bounds for solution of complex triangular system of linear equations, multiple right-hand sides, packed storage
F07VEF Solution of real band triangular system of linear equations, multiple right-hand sides
F07VHF Error bounds for solution of real band triangular system of linear equations, multiple right-hand sides
F07VSF Solution of complex band triangular system of linear equations, multiple right-hand sides
F07VVF Error bounds for solution of complex band triangular system of linear equations, multiple right-hand sides
F08AEF QR factorization of real general rectangular matrix
F08AFF Form all or part of orthogonal $Q$ from $QR$ factorization determined by F08AEF (DGEQRF) or F08BEF (DGEQPF)
F08AGF Apply orthogonal transformation determined by F08AEF (DGEQRF) or F08BEF (DGEQPF)
F08ASF $QR$ factorization of complex general rectangular matrix
F08ATF Form all or part of unitary $Q$ from $QR$ factorization determined by F08ASF (ZGEQRF) or F08BSF (ZGEQPF)
F08AUF Apply unitary transformation determined by F08ASF (ZGEQRF) or F08BSF (ZGEQPF)
F08FEF Orthogonal reduction of real symmetric matrix to symmetric tridiagonal form
F08FFF Generate orthogonal transformation matrix from reduction to tridiagonal form determined by F08FEF (DSYTRD)
F08FSF Unitary reduction of complex Hermitian matrix to real symmetric tridiagonal form
F08FTF Generate unitary transformation matrix from reduction to tridiagonal form determined by F08FSF (ZHETRD)
F08GFF Generate orthogonal transformation matrix from reduction to tridiagonal form determined by F08FEF (DSYTRD)
F08GTF Generate unitary transformation matrix from reduction to tridiagonal form determined by F08GFF (ZHPTRD)
F08HEF Orthogonal reduction of real symmetric band matrix to symmetric tridiagonal form
F08HSF Unitary reduction of complex Hermitian band matrix to real symmetric tridiagonal form
F08JEF All eigenvalues and eigenvectors of real symmetric tridiagonal matrix, reduced from real symmetric matrix using implicit $QL$ or $QR$
F08JGF Selected eigenvalues of real symmetric tridiagonal matrix by bisection
F08JKF Selected eigenvectors of real symmetric tridiagonal matrix by inverse iteration, storing eigenvectors in real array
F08JSF All eigenvalues and eigenvectors of real symmetric tridiagonal matrix, reduced from complex Hermitian matrix, using implicit $QL$ or $QR$
F08JXF Selected eigenvectors of real symmetric tridiagonal matrix by inverse iteration, storing eigenvectors in complex array
F08KEF Orthogonal reduction of real general rectangular matrix to bidiagonal form
F08KSF Unitary reduction of complex general rectangular matrix to bidiagonal form
F08MEF SVD of real bidiagonal matrix reduced from real general matrix
F08MUF SVD of real bidiagonal matrix reduced from complex general matrix
F08PEF Eigenvalues and Schur factorization of real upper Hessenberg matrix reduced from real general matrix
F08PKF Selected right and/or left eigenvectors of real upper Hessenberg matrix by inverse iteration
F08PSF Eigenvalues and Schur factorization of complex upper Hessenberg matrix reduced from complex general matrix
F08PXF Selected right and/or left eigenvectors of complex upper Hessenberg matrix by inverse iteration
F08TAF Computes all the eigenvalues, and optionally, the eigenvectors of a real generalized symmetric-definite eigenproblem, packed storage
F08TBF Computes selected eigenvalues, and optionally, the eigenvectors of a real generalized symmetric-definite eigenproblem, packed storage

Introduction
Tuned and Enhanced Routines in the NAG SMP Library
F08TCF Computes all the eigenvalues, and optionally, the eigenvectors of a real generalized symmetric-definite eigenproblem, packed storage (divide-and-conquer)
F08TNF Computes all the eigenvalues, and optionally, the eigenvectors of a complex generalized Hermitian-definite eigenproblem, packed storage
F08TPF Computes selected eigenvalues, and optionally, the eigenvectors of a complex generalized Hermitian-definite eigenproblem, packed storage
F08TQF Computes selected eigenvalues, and optionally, the eigenvectors of a complex generalized Hermitian-definite eigenproblem, packed storage (divide-and-conquer)
F11BEF Real sparse nonsymmetric linear systems, preconditioned RGMRES, CGS, Bi-CGSTAB or TFQMR method
F11BSF Complex sparse non-Hermitian linear systems, preconditioned RGMRES, CGS, Bi-CGSTAB or TFQMR method
F11GEF Real sparse symmetric linear systems, preconditioned conjugate gradient or Lanczos
F11GSF Complex sparse Hermitian linear systems, preconditioned conjugate gradient or Lanczos
F11MEF LU factorization of real sparse matrix
F11MFF Solution of real sparse simultaneous linear equations (coefficient matrix already factorized)
F11MFF Refined solution with error bounds of real system of linear equations, multiple right-hand sides
F11MKF Real sparse nonsymmetric matrix matrix multiply, compressed column storage
F11XAF Real sparse nonsymmetric matrix vector multiply
F11XEF Real sparse symmetric matrix vector multiply
F11XNF Complex sparse non-Hermitian matrix vector multiply
F11XSF Complex sparse Hermitian matrix vector multiply
F12ABF Implements a reverse communication interface for the Implicitly Restarted Arnoldi iteration for computing selected eigenvalues and, optionally, eigenvectors of a real nonsymmetric sparse (standard or generalized) eigenproblem
F12AGF Computes approximations to selected eigenvalues of a real nonsymmetric banded (standard or generalized) eigenproblem and, optionally, the corresponding approximate eigenvectors and/or an orthonormal basis for the associated approximate invariant subspace

2 Enhanced Routines

C02AKF All zeros of real cubic equation
C02ALF All zeros of real quartic equation
C02AMF All zeros of complex cubic equation
C02ANF All zeros of complex quartic equation
D01PAF Multi-dimensional quadrature over an n-simplex
D02AGF ODEs, boundary value problem, shooting and matching technique, allowing interior matching point, general parameters to be determined
D02EJF ODEs, stiff IVP, BDF method, until function of solution is zero, intermediate output (simple driver)
D02HAF ODEs, boundary value problem, shooting and matching, boundary values to be determined
D02HBF ODEs, boundary value problem, shooting and matching, general parameters to be determined
D02NBF Explicit ODEs, stiff IVP, full Jacobian (comprehensive)
D02NCF Explicit ODEs, stiff IVP, banded Jacobian (comprehensive)
D02NDF Explicit ODEs, stiff IVP, sparse Jacobian (comprehensive)
D02NGF Implicit/algebraic ODEs, stiff IVP, full Jacobian (comprehensive)
D02NHF Implicit/algebraic ODEs, stiff IVP, banded Jacobian (comprehensive)
D02NJJ Implicit/algebraic ODEs, stiff IVP, sparse Jacobian (comprehensive)
D02NMF Explicit ODEs, stiff IVP (reverse communication, comprehensive)
D02NNF Implicit/algebraic ODEs, stiff IVP (reverse communication, comprehensive)
D02SAF ODEs, boundary value problem, shooting and matching technique, subject to extra algebraic equations, general parameters to be determined
D02TKF ODEs, general nonlinear boundary value problem, collocation technique
D03FAF Elliptic PDE, Helmholtz equation, three-dimensional Cartesian co-ordinates
D03NCF Finite difference solution of the Black–Scholes equations
D03PCF General system of parabolic PDEs, method of lines, finite differences, one space variable
D03PDF General system of parabolic PDEs, method of lines, Chebyshev $C^0$ collocation, one space variable
### Tuned and Enhanced Routines in the NAG SMP Library

Introduction

Tuned and Enhanced Routines in the NAG SMP Library

- D03PEF General system of first-order PDEs, method of lines, Keller box discretisation, one space variable
- D03PFF General system of convection-diffusion PDEs with source terms in conservative form, method of lines, upwind scheme using numerical flux function based on Riemann solver, one space variable
- D03PHF General system of parabolic PDEs, coupled DAEs, method of lines, finite differences, one space variable
- D03PJF General system of parabolic PDEs, coupled DAEs, method of lines, Chebyshev $C^0$ collocation, one space variable
- D03PKF General system of first-order PDEs, coupled DAEs, method of lines, Keller box discretisation, one space variable
- D03PLF General system of convection-diffusion PDEs with source terms in conservative form, coupled DAEs, method of lines, upwind scheme using numerical flux function based on Riemann solver, one space variable
- D03PPF General system of parabolic PDEs, coupled DAEs, method of lines, finite differences, remeshing, one space variable
- D03PRF General system of first-order PDEs, coupled DAEs, method of lines, Keller box discretisation, remeshing, one space variable
- D03PSF General system of convection-diffusion PDEs with source terms in conservative form, coupled DAEs, method of lines, upwind scheme using numerical flux function based on Riemann solver, remeshing, one space variable
- D05AAF Linear non-singular Fredholm integral equation, second kind, split kernel
- D05ABF Linear non-singular Fredholm integral equation, second kind, smooth kernel
- E02RAF Padé approximants
- E04FCF Unconstrained minimum of a sum of squares, combined Gauss–Newton and modified Newton algorithm using function values only (comprehensive)
- E04FYF Unconstrained minimum of a sum of squares, combined Gauss–Newton and modified Newton algorithm using function values only (easy-to-use)
- E04GBF Unconstrained minimum of a sum of squares, combined Gauss–Newton and quasi-Newton algorithm using first derivatives (comprehensive)
- E04GDF Unconstrained minimum of a sum of squares, combined Gauss–Newton and modified Newton algorithm using first derivatives (comprehensive)
- E04GYF Unconstrained minimum of a sum of squares, combined Gauss–Newton and quasi-Newton algorithm, using first derivatives (easy-to-use)
- E04GZF Unconstrained minimum of a sum of squares, combined Gauss–Newton and modified Newton algorithm using first derivatives (easy-to-use)
- E04HEF Unconstrained minimum of a sum of squares, combined Gauss–Newton and modified Newton algorithm using second derivatives (comprehensive)
- E04HYF Unconstrained minimum of a sum of squares, combined Gauss–Newton and modified Newton algorithm, using second derivatives (easy-to-use)
- E04NCF Convex QP problem or linearly-constrained linear least-squares problem (dense)
- E04UFF Minimum, function of several variables, sequential QP method, nonlinear constraints, using function values and optionally first derivatives (reverse communication, comprehensive)
- E04USF Minimum of a sum of squares, nonlinear constraints, sequential QP method, using function values and optionally first derivatives (comprehensive)
- E04VCF Covariance matrix for nonlinear least-squares problem (unconstrained)
- F01ABF Inverse of real symmetric positive-definite matrix using iterative refinement
- F01ADF Inverse of real symmetric positive-definite matrix
- F02ECF Selected eigenvalues and eigenvectors of real nonsymmetric matrix (Black Box)
- F02FJF Selected eigenvalues and eigenvectors of sparse symmetric eigenproblem (Black Box)
- F02GCF Selected eigenvalues and eigenvectors of complex nonsymmetric matrix (Black Box)
- F02WDF QR factorization, possibly followed by SVD
- F02WUF SVD of real upper triangular matrix (Black Box)
- F02XUF SVD of complex upper triangular matrix (Black Box)
- F03AAF Determinant of real matrix (Black Box)
- F03ABF Determinant of real symmetric positive-definite matrix (Black Box)
- F03ADF Determinant of complex matrix (Black Box)
- F03AEF $LL^T$ factorization and determinant of real symmetric positive-definite matrix
F03AFF  LU factorization and determinant of real matrix
F04ABF  Solution of real symmetric positive-definite simultaneous linear equations with multiple right-hand sides using iterative refinement (Black Box)
F04AEF  Solution of real simultaneous linear equations with multiple right-hand sides using iterative refinement (Black Box)
F04ASF  Solution of real symmetric positive-definite simultaneous linear equations, one right-hand side using iterative refinement (Black Box)
F04ATF  Solution of real simultaneous linear equations, one right-hand side using iterative refinement (Black Box)
F04BAF  Computes the solution and error-bound to a real system of linear equations
F04BBF  Computes the solution and error-bound to a real banded system of linear equations
F04BDF  Computes the solution and error-bound to a real symmetric positive-definite system of linear equations
F04BEF  Computes the solution and error-bound to a real symmetric positive-definite system of linear equations, packed storage
F04BFF  Computes the solution and error-bound to a real symmetric positive-definite banded system of linear equations
F04BGP  Computes the solution and error-bound to a real symmetric positive-definite banded system of linear equations, packed storage
F04CAF  Computes the solution and error-bound to a complex system of linear equations
F04CBF  Computes the solution and error-bound to a complex banded system of linear equations
F04CDF  Computes the solution and error-bound to a complex Hermitian positive-definite system of linear equations
F04CEF  Computes the solution and error-bound to a complex Hermitian positive-definite system of linear equations, packed storage
F04JGF  Least-squares (if rank $= n$) or minimal least-squares (if rank $< n$) solution of $m$ real equations in $n$ unknowns, rank $\leq n$, $m \geq n$
F07AAF  Computes the solution to a real system of linear equations
F07ABF  Uses the $LU$ factorization to compute the solution, error-bound and condition estimate for a real system of linear equations
F07ANF  Computes the solution to a complex system of linear equations
F07APF  Uses the $LU$ factorization to compute the solution, error-bound and condition estimate for a complex system of linear equations
F07BAF  Computes the solution to a real banded system of linear equations
F07BBF  Uses the $LU$ factorization to compute the solution, error-bound and condition estimate for a real banded system of linear equations
F07BNF  Computes the solution to a complex banded system of linear equations
F07BPF  Uses the $LU$ factorization to compute the solution, error-bound and condition estimate for a complex banded system of linear equations
F07CBF  Uses the $LU$ factorization to compute the solution, error-bound and condition estimate for a real tridiagonal system of linear equations
F07CPF  Uses the $LU$ factorization to compute the solution, error-bound and condition estimate for a complex tridiagonal system of linear equations
F07FAF  Computes the solution to a real symmetric positive-definite system of linear equations
F07FBF  Uses the Cholesky factorization to compute the solution, error-bound and condition estimate for a real symmetric positive-definite system of linear equations
F07FNF  Computes the solution to a complex Hermitian positive-definite system of linear equations
F07FPF  Uses the Cholesky factorization to compute the solution, error-bound and condition estimate for a complex Hermitian positive-definite system of linear equations
F07GAF  Computes the solution to a real symmetric positive-definite system of linear equations, packed storage
F07GBF  Uses the Cholesky factorization to compute the solution, error-bound and condition estimate for a real symmetric positive-definite system of linear equations, packed storage
F07GNF  Computes the solution to a complex Hermitian positive-definite system of linear equations, packed storage
F07GPF  Uses the Cholesky factorization to compute the solution, error-bound and condition estimate for a complex Hermitian positive-definite system of linear equations, packed storage
F07HAF  Computes the solution to a real symmetric positive-definite banded system of linear equations
F07HBF  Uses the Cholesky factorization to compute the solution, error-bound and condition estimate for a real symmetric positive-definite banded system of linear equations
F07HNF  Computes the solution to a complex Hermitian positive-definite banded system of linear equations
F07HPF  Uses the Cholesky factorization to compute the solution, error-bound and condition estimate for a complex Hermitian positive-definite banded system of linear equations
F07JBF  Uses the modified Cholesky factorization to compute the solution, error-bound and condition estimate for a real symmetric positive-definite tridiagonal system of linear equations
F07JPF  Uses the modified Cholesky factorization to compute the solution, error-bound and condition estimate for a complex Hermitian positive-definite tridiagonal system of linear equations
F07MBF  Uses the diagonal pivoting factorization to compute the solution to a real symmetric system of linear equations
F07MPF  Uses the diagonal pivoting factorization to compute the solution to a complex Hermitian system of linear equations
F07NPF  Uses the diagonal pivoting factorization to compute the solution to a complex symmetric system of linear equations
F07PBF  Uses the diagonal pivoting factorization to compute the solution to a real symmetric system of linear equations, packed storage
F07PPF  Uses the diagonal pivoting factorization to compute the solution to a complex Hermitian system of linear equations, packed storage
F07QPF  Uses the diagonal pivoting factorization to compute the solution to a complex symmetric system of linear equations, packed storage
F08AAM  Solves an overdetermined or underdetermined real linear system
F08ANF  Solves an overdetermined or underdetermined complex linear system
F08BAM  Computes the minimum-norm solution to a real linear least-squares problem
F08BBF  QR factorization of real general rectangular matrix with column pivoting, using BLAS-3
F08BNF  Computes the minimum-norm solution to a complex linear least-squares problem
F08BTF  QR factorization of complex general rectangular matrix with column pivoting, using BLAS-3
F08FAF  Computes all eigenvalues and, optionally, eigenvectors of a real symmetric matrix
F08FBF  Computes selected eigenvalues and, optionally, eigenvectors of a real symmetric matrix
F08FCF  All eigenvalues and optionally all eigenvectors of real symmetric matrix (divide-and-conquer)
F08FDF  Computes selected eigenvalues and, optionally, eigenvectors of a real symmetric matrix (Relatively Robust Representations)
F08FGF  Apply orthogonal transformation determined by F08FEF (DSYTRD)
F08FNF  Computes all eigenvalues and, optionally, eigenvectors of a complex Hermitian matrix
F08FPF  Computes selected eigenvalues and, optionally, eigenvectors of a complex Hermitian matrix
F08FQF  All eigenvalues and optionally all eigenvectors of complex Hermitian matrix (divide-and-conquer)
F08FRF  Computes selected eigenvalues and, optionally, eigenvectors of a complex Hermitian matrix (Relatively Robust Representations)
F08FUF  Apply unitary transformation matrix determined by F08FSF (ZHETRD)
F08GAF  Computes all eigenvalues and, optionally, eigenvectors of a real symmetric matrix, packed storage
F08GBF  Computes selected eigenvalues and, optionally, eigenvectors of a real symmetric matrix, packed storage
F08GCF  All eigenvalues and optionally all eigenvectors of real symmetric matrix, packed storage (divide-and-conquer)
F08GNF  Computes all eigenvalues and, optionally, eigenvectors of a complex Hermitian matrix, packed storage
F08GPF  Computes selected eigenvalues and, optionally, eigenvectors of a complex Hermitian matrix, packed storage
F08QQF  All eigenvalues and optionally all eigenvectors of complex Hermitian matrix, packed storage (divide-and-conquer)
F08HAF  Computes all eigenvalues and, optionally, eigenvectors of a real symmetric band matrix
F08HBF  Computes selected eigenvalues and, optionally, eigenvectors of a real symmetric band matrix
F08HCF  All eigenvalues and optionally all eigenvectors of real symmetric band matrix (divide-and-conquer)
F08HNF  Computes all eigenvalues and, optionally, eigenvectors of a complex Hermitian band matrix
F08HPF Computes selected eigenvalues and, optionally, eigenvectors of a complex Hermitian band matrix
F08HQF All eigenvalues and optionally all eigenvectors of complex Hermitian band matrix (divide-and-conquer)
F08JAF Computes all eigenvalues and, optionally, eigenvectors of a real symmetric tridiagonal matrix
F08JBF Computes selected eigenvalues and, optionally, eigenvectors of a real symmetric tridiagonal matrix
F08JCF All eigenvalues and optionally all eigenvectors of real symmetric tridiagonal matrix (divide-and-conquer)
F08JDF Computes selected eigenvalues and, optionally, eigenvectors of a real symmetric tridiagonal matrix (Relatively Robust Representations)
F08JGF All eigenvalues and eigenvectors of real symmetric positive-definite tridiagonal matrix, reduced from real symmetric positive-definite matrix
F08JHF Computes all eigenvalues and, optionally, eigenvectors of a real symmetric tridiagonal matrix or a matrix reduced to this form (divide-and-conquer)
F08JLF Computes all eigenvalues and, optionally, eigenvectors of a real symmetric tridiagonal matrix or a symmetric matrix reduced to this form (Relatively Robust Representations)
F08JUF All eigenvalues and eigenvectors of real symmetric positive-definite tridiagonal matrix, reduced from complex Hermitian positive-definite matrix
F08JVF Computes all eigenvalues and, optionally, eigenvectors of a real symmetric tridiagonal matrix or a complex Hermitian matrix reduced to this form (divide-and-conquer)
F08JYF Computes all eigenvalues and, optionally, eigenvectors of a real symmetric tridiagonal matrix or a complex Hermitian matrix reduced to this form (Relatively Robust Representations)
F08KAF Computes the minimum-norm solution to a real linear least-squares problem using singular value decomposition
F08KBF Computes the singular value decomposition of a real matrix, optionally computing the left and/or right singular vectors
F08KCF Computes the minimum-norm solution to a real linear least-squares problem using singular value decomposition (divide-and-conquer)
F08KDF Computes the singular value decomposition of a real matrix, optionally computing the left and/or right singular vectors (divide-and-conquer)
F08KFF Generate orthogonal transformation matrices from reduction to bidiagonal form determined by F08KEF (DGEBRD)
F08KGF Apply orthogonal transformations from reduction to bidiagonal form determined by F08KEF (DGEBRD)
F08KNF Computes the minimum-norm solution to a complex linear least-squares problem using singular value decomposition
F08KPF Computes the singular value decomposition of a complex matrix, optionally computing the left and/or right singular vectors
F08KQF Computes the minimum-norm solution to a complex linear least-squares problem using singular value decomposition (divide-and-conquer)
F08KRF Computes the singular value decomposition of a complex matrix, optionally computing the left and/or right singular vectors (divide-and-conquer)
F08KTF Generate unitary transformation matrices from reduction to bidiagonal form determined by F08KSF (ZGEBRD)
F08KUF Apply unitary transformations from reduction to bidiagonal form determined by F08KSF (ZGEBRD)
F08MDT Computes the singular value decomposition of a real bidiagonal matrix, optionally computing the singular vectors (divide-and-conquer)
F08NAF Computes all eigenvalues and, optionally, left and/or right eigenvectors of a real nonsymmetric matrix
F08NBF Computes all eigenvalues and, optionally, left and/or right eigenvectors of a real nonsymmetric matrix; also, optionally, the balancing transformation, the reciprocal condition numbers for the eigenvalues and for the right eigenvectors
F08NFF Generate orthogonal transformation matrix from reduction to Hessenberg form determined by F08NEF (DGEHRD)
F08NGF Apply orthogonal transformation matrix from reduction to Hessenberg form determined by F08NEF (DGEHRD)
Introduction

Tuned and Enhanced Routines in the NAG SMP Library

F08NNF Computes all eigenvalues and, optionally, left and/or right eigenvectors of a complex nonsymmetric matrix
F08NPF Computes all eigenvalues and, optionally, left and/or right eigenvectors of a complex nonsymmetric matrix; also, optionally, the balancing transformation, the reciprocal condition numbers for the eigenvalues and for the right eigenvectors
F08NTF Generate unitary transformation matrix from reduction to Hessenberg form determined by F08NSF (ZGEHRD)
F08NUF Apply unitary transformation matrix from reduction to Hessenberg form determined by F08NSF (ZGEHRD)
F08PAF Computes for real square nonsymmetric matrix, the eigenvalues, the real Schur form, and, optionally, the matrix of Schur vectors
F08PBF Computes for real square nonsymmetric matrix, the eigenvalues, the real Schur form, and, optionally, the matrix of Schur vectors; also, optionally, computes reciprocal condition numbers for selected eigenvalues
F08PNF Computes for complex square nonsymmetric matrix, the eigenvalues, the Schur form, and, optionally, the matrix of Schur vectors
F08PPF Computes for real square nonsymmetric matrix, the eigenvalues, the Schur form, and, optionally, the matrix of Schur vectors; also, optionally, computes reciprocal condition numbers for selected eigenvalues
F08SAF Computes all the eigenvalues, and optionally, the eigenvectors of a real generalized symmetric-definite eigenproblem
F08SBF Computes selected eigenvalues, and optionally, the eigenvectors of a real generalized symmetric-definite eigenproblem
F08SCF Computes all the eigenvalues, and optionally, the eigenvectors of a real generalized symmetric-definite eigenproblem (divide-and-conquer)
F08SNF Computes all the eigenvalues, and optionally, the eigenvectors of a complex generalized Hermitian-definite eigenproblem
F08SPF Computes selected eigenvalues, and optionally, the eigenvectors of a complex generalized Hermitian-definite eigenproblem
F08SQF Computes all the eigenvalues, and optionally, the eigenvectors of a complex generalized Hermitian-definite eigenproblem (divide-and-conquer)
F08UAF Computes all the eigenvalues, and optionally, the eigenvectors of a real banded generalized symmetric-definite eigenproblem
F08UBF Computes selected eigenvalues, and optionally, the eigenvectors of a real banded generalized symmetric-definite eigenproblem
F08UCF Computes all the eigenvalues, and optionally, the eigenvectors of a real banded generalized symmetric-definite eigenproblem (divide-and-conquer)
F08UNF Computes all the eigenvalues, and optionally, the eigenvectors of a complex banded generalized Hermitian-definite eigenproblem
F08UPF Computes selected eigenvalues, and optionally, the eigenvectors of a complex banded generalized Hermitian-definite eigenproblem
F08UQF Computes all the eigenvalues, and optionally, the eigenvectors of a complex banded generalized Hermitian-definite eigenproblem (divide-and-conquer)
F08WAF Computes, for a real nonsymmetric matrix pair, the generalized eigenvalues, and optionally, the left and/or right generalized eigenvectors
F08WBF Computes, for a real nonsymmetric matrix pair, the generalized eigenvalues, and optionally, the left and/or right generalized eigenvectors; also, optionally, the balancing transformation, the reciprocal condition numbers for the eigenvalues and for the right eigenvectors
F08WNF Computes, for a complex nonsymmetric matrix pair, the generalized eigenvalues, and optionally, the left and/or right generalized eigenvectors
F08WPF Computes, for a complex nonsymmetric matrix pair, the generalized eigenvalues, and optionally, the left and/or right generalized eigenvectors; also, optionally, the balancing transformation, the reciprocal condition numbers for the eigenvalues and for the right eigenvectors
F08XAF Computes, for a real nonsymmetric matrix pair, the generalized eigenvalues, the generalized real Schur form and, optionally, the left and/or right matrices of Schur vectors
F08XBF Computes, for a real nonsymmetric matrix pair, the generalized eigenvalues, the generalized real Schur form and, optionally, the left and/or right matrices of Schur vectors; also, optionally, computes reciprocal condition numbers for selected eigenvalues
F08XNF Computes, for a complex nonsymmetric matrix pair, the generalized eigenvalues, the
geneneralized Schur form and, optionally, the left and/or right matrices of Schur vectors
F08XPF Computes, for a complex nonsymmetric matrix pair, the generalized eigenvalues, the
geneneralized complex Schur form and, optionally, the left and/or right matrices of Schur
vectors; also, optionally, computes reciprocal condition numbers for selected eigenvalues
F08ZAF Solves the real linear equality-constrained least-squares (LSE) problem
F08ZBF Solves a real general Gauss–Markov linear model (GLM) problem
F08ZEF Computes a generalized QR factorization of a real matrix pair
F08ZFF Computes a generalized RQ factorization of a real matrix pair
F08ZNF Computes a generalized QR factorization of a complex matrix pair
F08ZPF Computes a generalized RQ factorization of a complex matrix pair
F08ZSF Computes a generalized QR factorization of a complex matrix pair
F11DCF Solution of real sparse nonsymmetric linear system, RGMRES, CGS, Bi-CGSTAB or TFQMR
method, preconditioner computed by F11DAF
F11DEF Solution of real sparse nonsymmetric linear system, RGMRES, CGS, Bi-CGSTAB, or
TFQMR method, Jacobi or SSOR preconditioner (Black Box)
F11DKF Real sparse nonsymmetric linear systems, line Jacobi preconditioner
F11DQF Solution of complex sparse non-Hermitian linear system, RGMRES, CGS, Bi-CGSTAB or
TFQMR method, preconditioner computed by F11DNF (Black Box)
F11DSF Solution of complex sparse non-Hermitian linear system, RGMRES, CGS, Bi-CGSTAB or
TFQMR method, Jacobi or SSOR preconditioner Black Box
F11DXF Complex sparse nonsymmetric linear systems, line Jacobi preconditioner
F11JCF Solution of real sparse symmetric linear system, conjugate gradient/Lanczos method,
preconditioner computed by F11JAF (Black Box)
F11JEF Solution of real sparse symmetric linear system, conjugate gradient/Lanczos method, Jacobi or
SSOR preconditioner (Black Box)
F11JQF Solution of complex sparse Hermitian linear system, conjugate gradient/Lanczos method,
preconditioner computed by F11JNF (Black Box)
F11JSF Solution of complex sparse Hermitian linear system, conjugate gradient/Lanczos method,
Jacobi or SSOR preconditioner (Black Box)
F12FCF Returns the converged approximations (as determined by F12ABF) to eigenvalues of a real
symmetric sparse (standard or generalized) eigenproblem and, optionally, the corresponding
approximate eigenvectors and/or an orthonormal basis for the associated approximate invariant
subspace
F12FGF Computes approximations to selected eigenvalues of a real symmetric banded (standard or
generalized) eigenproblem and, optionally, the corresponding approximate eigenvectors and/or
an orthonormal basis for the associated approximate invariant subspace
G01HBF Computes probabilities for the multivariate Normal distribution
G02BYF Computes partial correlation/variance-covariance matrix from correlation/variance-covariance
matrix computed by G02BXF
G02CGF Multiple linear regression, from correlation coefficients, with constant term
G02CHF Multiple linear regression, from correlation-like coefficients, without constant term
G02DAF Fits a general (multiple) linear regression model
G02DDF Estimates of linear parameters and general linear regression model from updated model
G02DEF Add a new independent variable to a general linear regression model
G02DGF Fits a general linear regression model to new dependent variable
G02DKF Estimates and standard errors of parameters of a general linear regression model for given
constraints
G02EAF Computes residual sums of squares for all possible linear regressions for a set of independent
variables
G02EEF Fits a linear regression model by forward selection
G02GAF Fits a generalized linear model with Normal errors
G02GBF Fits a generalized linear model with binomial errors
G02GCF Fits a generalized linear model with Poisson errors
G02GDF Fits a generalized linear model with gamma errors
G02GKF Estimates and standard errors of parameters of a general linear model for given constraints
G02HAF Robust regression, standard M-estimates
G02HDF Robust regression, compute regression with user-supplied functions and weights
Introduction

Tuned and Enhanced Routines in the NAG SMP Library

G02HFF Robust regression, variance-covariance matrix following G02HDF
G02JAF Linear mixed effects regression using Restricted Maximum Likelihood (REML)
G03AAF Performs principal component analysis
G03ACF Performs canonical variate analysis
G03ADF Performs canonical correlation analysis
G03BAF Computes orthogonal rotations for loading matrix, generalized orthomax criterion
G03BCF Computes Procrustes rotations
G03CAF Computes maximum likelihood estimates of the parameters of a factor analysis model, factor loadings, communalities and residual correlations
G03DAF Computes test statistic for equality of within-group covariance matrices and matrices for discriminant analysis
G04BCF Analysis of variance, general row and column design, treatment means and standard errors
G05PCF Generates a realisation of a multivariate time series from a VARMA model
G11CAF Returns parameter estimates for the conditional analysis of stratified data
G11SAF Contingency table, latent variable model for binary data
G12BAF Fits Cox’s proportional hazard model
G13ADF Univariate time series, preliminary estimation, seasonal ARIMA model
G13AEF Univariate time series, estimation, seasonal ARIMA model (comprehensive)
G13AFF Univariate time series, estimation, seasonal ARIMA model (easy-to-use)
G13AJF Univariate time series, state set and forecasts, from fully specified seasonal ARIMA model
G13ASF Univariate time series, diagnostic checking of residuals, following G13AEF or G13AFF
G13BAF Multivariate time series, filtering (pre-whitening) by an ARIMA model
G13BBF Multivariate time series, filtering by a transfer function model
G13BDF Multivariate time series, preliminary estimation of transfer function model
G13BEF Multivariate time series, estimation of multi-input model
G13BJF Multivariate time series, state set and forecasts from fully specified multi-input model
G13BDF Multivariate time series, multiple squared partial autocorrelations
G13DCF Multivariate time series, estimation of VARMA model
G13DJF Multivariate time series, forecasts and their standard errors
G13DNF Multivariate time series, sample partial lag correlation matrices, χ² statistics and significance levels
G13DPF Multivariate time series, partial autoregression matrices
G13DSF Multivariate time series, diagnostic checking of residuals, following G13DCF
G13DXF Calculates the zeros of a vector autoregressive (or moving average) operator
G13EBF Combined measurement and time update, one iteration of Kalman filter, time-invariant, square root covariance filter
G13FAF Univariate time series, parameter estimation for either a symmetric GARCH process or a GARCH process with asymmetry of the form (ε_{t-1} + γ)^2
G13FCF Univariate time series, parameter estimation for a GARCH process with asymmetry of the form ((|ε_{t-1}| + γε_{t-1})^2
G13FEF Univariate time series, parameter estimation for an asymmetric Glosten, Jagannathan and Runkle (GJR) GARCH process
G13FGF Univariate time series, parameter estimation for an exponential GARCH (EGARCH) process