NAG Fortran Library

Mark 20 Library Contents

A00 – Library Identification

A00AAF Prints details of the NAG Fortran Library implementation

A02 – Complex Arithmetic

A02AAF Square root of complex number
A02ABF Modulus of complex number
A02ACF Quotient of two complex numbers

C02 – Zeros of Polynomials

C02AFF All zeros of complex polynomial, modified Laguerre method
C02AGF All zeros of real polynomial, modified Laguerre method
C02AHF All zeros of complex quadratic equation
C02AJF All zeros of real quadratic equation
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

C05 – Roots of One or More Transcendental Equations

C05ADF Zero of continuous function in given interval, Bus and Dekker algorithm
C05AGF Zero of continuous function, Bus and Dekker algorithm, from given starting value, binary search for interval
C05AJF Zero of continuous function, continuation method, from a given starting value
C05AVF Binary search for interval containing zero of continuous function (reverse communication)
C05AXF Zero of continuous function by continuation method, from given starting value (reverse communication)
C05AZF Zero in given interval of continuous function by Bus and Dekker algorithm (reverse communication)
C05NBF Solution of system of nonlinear equations using function values only (easy-to-use)
C05NCF Solution of system of nonlinear equations using function values only (comprehensive)
C05NDF Solution of system of nonlinear equations using function values only (reverse communication)
C05PBF Solution of system of nonlinear equations using first derivatives (easy-to-use)
C05PCF Solution of system of nonlinear equations using first derivatives (comprehensive)
C05PDF Solution of system of nonlinear equations using first derivatives (reverse communication)
C05ZAF Check user's routine for calculating first derivatives

C06 – Summation of Series

C06BAF Acceleration of convergence of sequence, Shanks' transformation and epsilon algorithm
C06DBF Sum of a Chebyshev series
C06EAF Single one-dimensional real discrete Fourier transform, no extra workspace
C06EBF Single one-dimensional Hermitian discrete Fourier transform, no extra workspace
C06ECF Single one-dimensional complex discrete Fourier transform, no extra workspace
C06EKF Circular convolution or correlation of two real vectors, no extra workspace
C06FAF Single one-dimensional real discrete Fourier transform, extra workspace for greater speed
C06FBF Single one-dimensional Hermitian discrete Fourier transform, extra workspace for greater speed
C06FCF Single one-dimensional complex discrete Fourier transform, extra workspace for greater speed
C06FFF One-dimensional complex discrete Fourier transform of multi-dimensional data
C06FJF Multi-dimensional complex discrete Fourier transform of multi-dimensional data
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
C06FUF Two-dimensional complex discrete Fourier transform
C06FXF Three-dimensional complex discrete Fourier transform
C06GBF Complex conjugate of Hermitian sequence
C06GCF Complex conjugate of complex sequence
C06GQF Complex conjugate of multiple Hermitian sequences
C06GSF Convert Hermitian sequences to general complex sequences
C06HAF Discrete sine transform
C06HBF Discrete cosine transform
C06HCF Discrete quarter-wave sine transform
C06HDF Discrete quarter-wave cosine transform
C06LAF Inverse Laplace transform, Crump's method
C06LBF Inverse Laplace transform, modified Weeks' method
C06LCF Evaluate inverse Laplace transform as computed by C06LBF
C06PAF Single one-dimensional real and Hermitian complex discrete Fourier transform, using complex data format for Hermitian sequences
C06PCF Single one-dimensional complex discrete Fourier transform, complex data format
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
C06PPF 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 Multiple one-dimensional complex discrete Fourier transforms using complex data format
C06PSF Multiple one-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)

D01 – Quadrature

D01AHF One-dimensional quadrature, adaptive, finite interval, strategy due to Patterson, suitable for well-behaved integrands
D01AJF One-dimensional quadrature, adaptive, finite interval, strategy due to Piessens and de Doncker, allowing for badly-behaved integrands
D01AKF One-dimensional quadrature, adaptive, finite interval, method suitable for oscillating functions
D01ALF One-dimensional quadrature, adaptive, finite interval, allowing for singularities at user-specified break-points
D01AMF One-dimensional quadrature, adaptive, infinite or semi-infinite interval
D01ANF One-dimensional quadrature, adaptive, finite interval, weight function $\cos(\omega x)$ or $\sin(\omega x)$
D01APF One-dimensional quadrature, adaptive, finite interval, weight function with end-point singularities of algebraico-logarithmic type
D01AQF One-dimensional quadrature, adaptive, finite interval, weight function $1/(x-c)$, Cauchy principal value (Hilbert transform)
D01ARF One-dimensional quadrature, non-adaptive, finite interval with provision for indefinite integrals
D01ASF One-dimensional quadrature, adaptive, semi-infinite interval, weight function $\cos(\omega x)$ or $\sin(\omega x)$
D01ATF One-dimensional quadrature, adaptive, finite interval, variant of D01AJF efficient on vector machines
D01AUF One-dimensional quadrature, adaptive, finite interval, variant of D01AKF efficient on vector machines
D01BAF One-dimensional Gaussian quadrature

D01BBF Pre-computed weights and abscissae for Gaussian quadrature rules, restricted choice of rule
D01BCF Calculation of weights and abscissae for Gaussian quadrature rules, general choice of rule
D01BDF One-dimensional quadrature, non-adaptive, finite interval
D01DAF Two-dimensional quadrature, finite region
D01EAF Multi-dimensional adaptive quadrature over hyper-rectangle, multiple integrands
D01FBF Multi-dimensional Gaussian quadrature over hyper-rectangle
D01FCF Multi-dimensional adaptive quadrature over hyper-rectangle
D01FDF Multi-dimensional quadrature, Sag–Szekeres method, general product region or n-sphere
D01GAF One-dimensional quadrature, integration of function defined by data values, Gill–Miller method
D01GBF Multi-dimensional quadrature over hyper-rectangle, Monte Carlo method
D01GCF Multi-dimensional quadrature, general product region, number-theoretic method
D01GDF Multi-dimensional quadrature, general product region, number-theoretic method, variant of D01GCF efficient on vector machines
D01GYF Korobov optimal coefficients for use in D01GCF or D01GDF, when number of points is prime
D01GZF Korobov optimal coefficients for use in D01GCF or D01GDF, when number of points is product of two primes
D01JAF Multi-dimensional quadrature over an n-sphere, allowing for badly-behaved integrands
D01PAF Multi-dimensional quadrature over an n-simplex

D02 – Ordinary Differential Equations

D02AGF ODEs, boundary value problem, shooting and matching technique, allowing interior matching point, general parameters to be determined
D02BGF ODEs, IVP, Runge–Kutta–Merson method, until a component attains given value (simple driver)
D02BHF ODEs, IVP, Runge–Kutta–Merson method, until function of solution is zero (simple driver)
D02BJF ODEs, IVP, Runge–Kutta method, until function of solution is zero, integration over range with intermediate output (simple driver)
D02CJF ODEs, IVP, Adams method, until function of solution is zero, intermediate output (simple driver)
D02EJF ODEs, stiff IVP, BDF method, until function of solution is zero, intermediate output (simple driver)
D02GAF ODEs, boundary value problem, finite difference technique with deferred correction, simple nonlinear problem
D02GBF ODEs, boundary value problem, finite difference technique with deferred correction, general linear problem
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
D02JAF ODEs, boundary value problem, collocation and least-squares, single nth-order linear equation
D02JBF ODEs, boundary value problem, collocation and least-squares, system of first-order linear equations
D02KAF Second-order Sturm–Liouville problem, regular system, finite range, eigenvalue only
D02KDF Second-order Sturm–Liouville problem, regular/singular system, finite/infinite range, eigenvalue only, user-specified break-points
D02KEF Second-order Sturm–Liouville problem, regular/singular system, finite/infinite range, eigenvalue and eigenfunction, user-specified break-points
D02LAF Second-order ODEs, IVP, Runge–Kutta–Nystrom method
D02LXF Second-order ODEs, IVP, setup for D02LAF
D02LYF Second-order ODEs, IVP, diagnostics for D02LAF
D02LZF Second-order ODEs, IVP, interpolation for D02LAF
D02MVF ODEs, IVP, DASSL method, setup for D02M–N routines
D02MZF ODEs, IVP, interpolation for D02M–N routines, natural interpolant
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)
D02NJF 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)

D02NRF ODEs, IVP, for use with D02M–N routines, sparse Jacobian, enquiry routine
D02NSF ODEs, IVP, for use with D02M–N routines, full Jacobian, linear algebra set up
D02NTF ODEs, IVP, for use with D02M–N routines, banded Jacobian, linear algebra set up
D02NUF ODEs, IVP, for use with D02M–N routines, sparse Jacobian, linear algebra set up
D02NVF ODEs, IVP, BDF method, setup for D02M–N routines
D02NWF ODEs, IVP, Blend method, setup for D02M–N routines
D02NXF ODEs, IVP, sparse Jacobian, linear algebra diagnostics, for use with D02M–N routines
D02NYF ODEs, IVP, integrator diagnostics, for use with D02M–N routines
D02NZF ODEs, IVP, setup for continuation calls to integrator, for use with D02M–N routines
D02PCF ODEs, IVP, Runge–Kutta method, integration over range with output
D02PDF ODEs, IVP, Runge–Kutta method, integration over one step
D02PVF ODEs, IVP, setup for D02PCF and D02PDF
D02PWF ODEs, IVP, resets end of range for D02PDF
D02PXF ODEs, IVP, interpolation for D02PDF
D02PYF ODEs, IVP, integration diagnostics for D02PCF and D02PDF
D02PZF ODEs, IVP, error assessment diagnostics for D02PCF and D02PDF
D02QFF ODEs, IVP, Adams method with root-finding (forward communication, comprehensive)
D02QGF ODEs, IVP, Adams method with root-finding (reverse communication, comprehensive)
D02QWF ODEs, IVP, setup for D02QFF and D02QGF
D02QXF ODEs, IVP, diagnostics for D02QFF and D02QGF
D02QYF ODEs, IVP, root-finding diagnostics for D02QFF and D02QGF
D02QZF ODEs, IVP, interpolation for D02QFF or D02QGF
D02RAF ODEs, general nonlinear boundary value problem, finite difference technique with deferred correction, continuation facility
D02SAF ODEs, boundary value problem, shooting and matching technique, subject to extra algebraic equations, general parameters to be determined
D02TGF nth-order linear ODEs, boundary value problem, collocation and least-squares
D02TKF ODEs, general nonlinear boundary value problem, collocation technique
D02TVF ODEs, general nonlinear boundary value problem, setup for D02TKF
D02TXF ODEs, general nonlinear boundary value problem, continuation facility for D02TKF
D02TYF ODEs, general nonlinear boundary value problem, interpolation for D02TKF
D02TZF ODEs, general nonlinear boundary value problem, diagnostics for D02TKF
D02XJF ODEs, IVP, interpolation for D02M–N routines, natural interpolant
D02XKF ODEs, IVP, interpolation for D02M–N routines, C_1 interpolant
D02ZAF ODEs, IVP, weighted norm of local error estimate for D02M–N routines

D03 – Partial Differential Equations

D03EAF Elliptic PDE, Laplace's equation, two-dimensional arbitrary domain
D03EBF Elliptic PDE, solution of finite difference equations by SIP, five-point two-dimensional molecule, iterate to convergence
D03ECF Elliptic PDE, solution of finite difference equations by SIP for seven-point three-dimensional molecule, iterate to convergence
D03EDF Elliptic PDE, solution of finite difference equations by a multigrid technique
D03EEF Discretize a second-order elliptic PDE on a rectangle
D03FAF Elliptic PDE, Helmholtz equation, three-dimensional Cartesian co-ordinates
D03MAF Triangulation of plane region
D03NCF Finite difference solution of the Black–Scholes equations
D03NDF Analytic solution of the Black–Scholes equations
D03NEF Compute average values for D03NDF
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
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
D03PUF Roe's approximate Riemann solver for Euler equations in conservative form, for use with D03PFF, D03PLF and D03PSF
D03PVF Osher's approximate Riemann solver for Euler equations in conservative form, for use with D03PFF, D03PLF and D03PSF
D03PWF Modified HLL Riemann solver for Euler equations in conservative form, for use with D03PFF, D03PLF and D03PSF
D03PXF Exact Riemann Solver for Euler equations in conservative form, for use with D03PFF, D03PLF and D03PSF
D03PYF PDEs, spatial interpolation with D03PDF/D03PDA or D03PJF/D03PJA
D03PZF PDEs, spatial interpolation with D03PCF/D03PCA, D03PEF, D03PFF, D03PHF/D03PHA, D03PKF, D03PLF, D03PPF/D03PPA, D03PRF or D03PSF
D03RAF General system of second-order PDEs, method of lines, finite differences, remeshing, two space variables, rectangular region
D03RBF General system of second-order PDEs, method of lines, finite differences, remeshing, two space variables, rectilinear region
D03RYF Check initial grid data in D03RBF
D03RZF Extract grid data from D03RBF
D03UAF Elliptic PDE, solution of finite difference equations by SIP, five-point two-dimensional molecule, one iteration
D03UBF Elliptic PDE, solution of finite difference equations by SIP, seven-point three-dimensional molecule, one iteration

D04 – Numerical Differentiation

D04AAF Numerical differentiation, derivatives up to order 14, function of one real variable

D05 – Integral Equations

D05AAF Linear non-singular Fredholm integral equation, second kind, split kernel
D05ABF Linear non-singular Fredholm integral equation, second kind, smooth kernel
D05BAF Nonlinear Volterra convolution equation, second kind
D05BDF Nonlinear convolution Volterra–Abel equation, second kind, weakly singular
D05BEF Nonlinear convolution Volterra–Abel equation, first kind, weakly singular
D05BWF Generate weights for use in solving Volterra equations
D05BYF Generate weights for use in solving weakly singular Abel-type equations

D06 – Mesh Generation

D06AAF Generates a two-dimensional mesh using a simple incremental method
D06ABF Generates a two-dimensional mesh using a Delaunay–Voronoi process
D06ACF Generates a two-dimensional mesh using an Advancing-front method
D06BAF Generates a boundary mesh
D06CAF Uses a barycentering technique to smooth a given mesh

D06CBF Generates a sparsity pattern of a Finite Element matrix associated with a given mesh
D06CCF Renumbers a given mesh using Gibbs method
D06DAF Generates a mesh resulting from an affine transformation of a given mesh
D06DBF Joins together two given adjacent (possibly overlapping) meshes

E01 – Interpolation

E01AAF Interpolated values, Aitken's technique, unequally spaced data, one variable
E01ABF Interpolated values, Everett's formula, equally spaced data, one variable
E01AEF Interpolating functions, polynomial interpolant, data may include derivative values, one variable
E01BAF Interpolating functions, cubic spline interpolant, one variable
E01BEF Interpolating functions, monotonicity-preserving, piecewise cubic Hermite, one variable
E01BFF Interpolated values, interpolant computed by E01BEF, function only, one variable
E01BGF Interpolated values, interpolant computed by E01BEF, function and first derivative, one variable
E01BHF Interpolated values, interpolant computed by E01BEF, definite integral, one variable
E01DAF Interpolating functions, fitting bicubic spline, data on rectangular grid
E01RAF Interpolating functions, rational interpolant, one variable
E01RBF Interpolated values, evaluate rational interpolant computed by E01RAF, one variable
E01SAF Interpolating functions, method of Renka and Cline, two variables
E01SBF Interpolated values, evaluate interpolant computed by E01SAF, two variables
E01SGF Interpolating functions, modified Shepard's method, two variables
E01SHF Interpolated values, evaluate interpolant computed by E01SGF, function and first derivatives, two variables
E01TGF Interpolating functions, modified Shepard's method, three variables
E01THF Interpolated values, evaluate interpolant computed by E01TGF, function and first derivatives, three variables

E02 – Curve and Surface Fitting

E02ACF Minimax curve fit by polynomials
E02ADF Least-squares curve fit, by polynomials, arbitrary data points
E02AEF Evaluation of fitted polynomial in one variable from Chebyshev series form (simplified parameter list)
E02AFF Least-squares polynomial fit, special data points (including interpolation)
E02AGF Least-squares polynomial fit, values and derivatives may be constrained, arbitrary data points
E02AHF Derivative of fitted polynomial in Chebyshev series form
E02AJF Integral of fitted polynomial in Chebyshev series form
E02AKF Evaluation of fitted polynomial in one variable from Chebyshev series form
E02BAF Least-squares curve cubic spline fit (including interpolation)
E02BBF Evaluation of fitted cubic spline, function only
E02BCF Evaluation of fitted cubic spline, function and derivatives
E02BDF Evaluation of fitted cubic spline, definite integral
E02BEF Least-squares cubic spline curve fit, automatic knot placement
E02CAF Least-squares surface fit by polynomials, data on lines
E02CBF Evaluation of fitted polynomial in two variables
E02DAF Least-squares surface fit, bicubic splines
E02DCF Least-squares surface fit by bicubic splines with automatic knot placement, data on rectangular grid
E02DDF Least-squares surface fit by bicubic splines with automatic knot placement, scattered data
E02DEF Evaluation of fitted bicubic spline at a vector of points
E02DFF Evaluation of fitted bicubic spline at a mesh of points
E02GAF L_1-approximation by general linear function
E02GBF L_1-approximation by general linear function subject to linear inequality constraints
E02GCF L_∞-approximation by general linear function
E02RAF Padé-approximants
E02RBF Evaluation of fitted rational function as computed by E02RAF
E02ZAF Sort two-dimensional data into panels for fitting bicubic splines

E04 – Minimizing or Maximizing a Function

E04ABF Minimum, function of one variable using function values only
E04BBF Minimum, function of one variable, using first derivative
E04CCF Unconstrained minimum, simplex algorithm, function of several variables using function values only (comprehensive)
E04DGF Unconstrained minimum, preconditioned conjugate gradient algorithm, function of several variables using first derivatives (comprehensive)
E04DJF Read optional parameter values for E04DGF/E04DGA from external file
E04DKF Supply optional parameter values to E04DGF/E04DGA
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)
E04HCF Check user's routine for calculating first derivatives of function
E04HDF Check user's routine for calculating second derivatives of function
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)
E04JYF Minimum, function of several variables, quasi-Newton algorithm, simple bounds, using function values only (easy-to-use)
E04KDF Minimum, function of several variables, modified Newton algorithm, simple bounds, using first derivatives (comprehensive)
E04KYF Minimum, function of several variables, quasi-Newton algorithm, simple bounds, using first derivatives (easy-to-use)
E04KZF Minimum, function of several variables, modified Newton algorithm, simple bounds, using first derivatives (easy-to-use)
E04LBF Minimum, function of several variables, modified Newton algorithm, simple bounds, using first and second derivatives (comprehensive)
E04LYF Minimum, function of several variables, modified Newton algorithm, simple bounds, using first and second derivatives (easy-to-use)
E04MFF LP problem (dense)
E04MGF Read optional parameter values for E04MFF/E04MFA from external file
E04MHF Supply optional parameter values to E04MFF/E04MFA
E04MZF Converts MPSX data file defining LP or QP problem to format required by E04NKF/E04NKA
E04NCF Convex QP problem or linearly-constrained linear least-squares problem (dense)
E04NDF Read optional parameter values for E04NCF/E04NCA from external file
E04NEF Supply optional parameter values to E04NCF/E04NCA
E04NFF QP problem (dense)
E04NGF Read optional parameter values for E04NFF/E04NFA from external file
E04NHF Supply optional parameter values to E04NFF/E04NFA
E04NKF LP or QP problem (sparse)
E04NLF Read optional parameter values for E04NKF/E04NKA from external file
E04NMF Supply optional parameter values to E04NKF/E04NKA
E04UCF Minimum, function of several variables, sequential QP method, nonlinear constraints, using function values and optionally first derivatives (forward communication, comprehensive)
E04UDF Read optional parameter values for E04UCF/E04UCA or E04UFF/E04UFA from external file
E04UEF Supply optional parameter values to E04UCF/E04UCA or E04UFF/E04UFA
E04UFF Minimum, function of several variables, sequential QP method, nonlinear constraints, using function values and optionally first derivatives (reverse communication, comprehensive)

E04UGF NLP problem (sparse)
E04UHF Read optional parameter values for E04UGF/E04UGA from external file
E04UJF Supply optional parameter values to E04UGF/E04UGA
E04UNF Minimum of a sum of squares, nonlinear constraints, sequential QP method, using function values and optionally first derivatives (comprehensive)
E04UQF Read optional parameter values for E04USF/E04USA from external file
E04URF Supply optional parameter values to E04USF/E04USA
E04USF Minimum of a sum of squares, nonlinear constraints, sequential QP method, using function values and optionally first derivatives (comprehensive)
E04WBF Initialization routine for E04DGA, E04MFA, E04NCA, E04NFA, E04NKA, E04UCA, E04UFA, E04UGA and E04USA
E04XAF Estimate (using numerical differentiation) gradient and/or Hessian of a function
E04YAF Check user's routine for calculating Jacobian of first derivatives
E04YBF Check user's routine for calculating Hessian of a sum of squares
E04YCF Covariance matrix for nonlinear least-squares problem (unconstrained)
E04ZCF Check user's routines for calculating first derivatives of function and constraints

F01 – Matrix Factorizations

F01ABF Inverse of real symmetric positive-definite matrix using iterative refinement
F01ADF Inverse of real symmetric positive-definite matrix
F01BLF Pseudo-inverse and rank of real m by n matrix ($m \geq n$)
F01BRF LU factorization of real sparse matrix
F01BSF LU factorization of real sparse matrix with known sparsity pattern
F01BUF $ULDL^TU^T$ factorization of real symmetric positive-definite band matrix
F01BVF Reduction to standard form, generalized real symmetric-definite banded eigenproblem
F01CKF Matrix multiplication
F01CRF Matrix transposition
F01CTF Sum or difference of two real matrices, optional scaling and transposition
F01CWF Sum or difference of two complex matrices, optional scaling and transposition
F01LEF LU factorization of real tridiagonal matrix
F01LHF LU factorization of real almost block diagonal matrix
F01MCF LDL^T factorization of real symmetric positive-definite variable-bandwidth matrix
F01QGF RQ factorization of real m by n upper trapezoidal matrix ($m \leq n$)
F01QJF RQ factorization of real m by n matrix ($m \leq n$)
F01QKF Operations with orthogonal matrices, form rows of Q, after RQ factorization by F01QJF
F01RGF RQ factorization of complex m by n upper trapezoidal matrix ($m \leq n$)
F01RJF RQ factorization of complex m by n matrix ($m \leq n$)
F01RKF Operations with unitary matrices, form rows of Q, after RQ factorization by F01RJF
F01ZAF Convert real matrix between packed triangular and square storage schemes
F01ZBF Convert complex matrix between packed triangular and square storage schemes
F01ZCF Convert real matrix between packed banded and rectangular storage schemes
F01ZDF Convert complex matrix between packed banded and rectangular storage schemes

F02 – Eigenvalues and Eigenvectors

F02BJF All eigenvalues and optionally eigenvectors of generalized eigenproblem by QZ algorithm, real matrices (Black Box)
F02EAF All eigenvalues and Schur factorization of real general matrix (Black Box)
F02EBF All eigenvalues and eigenvectors of real general matrix (Black Box)
F02ECF Selected eigenvalues and eigenvectors of real nonsymmetric matrix (Black Box)
F02FAF All eigenvalues and eigenvectors of real symmetric matrix (Black Box)
F02FCF Selected eigenvalues and eigenvectors of real symmetric matrix (Black Box)
F02FDF All eigenvalues and eigenvectors of real symmetric-definite generalized problem (Black Box)
F02FHF All eigenvalues of generalized banded real symmetric-definite eigenproblem (Black Box)
F02FJF Selected eigenvalues and eigenvectors of sparse symmetric eigenproblem (Black Box)
F02GAF All eigenvalues and Schur factorization of complex general matrix (Black Box)
F02GBF All eigenvalues and eigenvectors of complex general matrix (Black Box)

F02GCF Selected eigenvalues and eigenvectors of complex nonsymmetric matrix (Black Box)
F02GJF All eigenvalues and optionally eigenvectors of generalized complex eigenproblem by QZ algorithm (Black Box)
F02HAF All eigenvalues and eigenvectors of complex Hermitian matrix (Black Box)
F02HCF Selected eigenvalues and eigenvectors of complex Hermitian matrix (Black Box)
F02HDF All eigenvalues and eigenvectors of complex Hermitian-definite generalized problem (Black Box)
F02SDF Eigenvector of generalized real banded eigenproblem by inverse iteration
F02WDF QR factorization, possibly followed by SVD
F02WEF SVD of real matrix (Black Box)
F02WUF SVD of real upper triangular matrix (Black Box)
F02XEF SVD of complex matrix (Black Box)
F02XUF SVD of complex upper triangular matrix (Black Box)

F03 – Determinants

F03AAF Determinant of real matrix (Black Box)
F03ABF Determinant of real symmetric positive-definite matrix (Black Box)
F03ACF Determinant of real symmetric positive-definite band 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

F04 – Simultaneous Linear Equations

F04AAF Solution of real simultaneous linear equations with multiple right-hand sides (Black Box)
F04ABF Solution of real symmetric positive-definite simultaneous linear equations with multiple right-hand sides using iterative refinement (Black Box)
F04ACF Solution of real symmetric positive-definite banded simultaneous linear equations with multiple right-hand sides (Black Box)
F04ADF Solution of complex simultaneous linear equations with multiple right-hand sides (Black Box)
F04AEF Solution of real simultaneous linear equations with multiple right-hand sides using iterative refinement (Black Box)
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 F03AFF)
F04AJF Solution of real simultaneous linear equations (coefficient matrix already factorized by F03AFF)
F04AMF Least-squares solution of m real equations in n unknowns, rank = n, $m \geq n$ using iterative refinement (Black Box)
F04ARF Solution of real simultaneous linear equations, one right-hand side (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)
F04AXF Solution of real sparse simultaneous linear equations (coefficient matrix already factorized)
F04EAF Solution of real tridiagonal simultaneous linear equations, one right-hand side (Black Box)
F04FAF Solution of real symmetric positive-definite tridiagonal simultaneous linear equations, one right-hand side (Black Box)
F04FEF Solution of the Yule–Walker equations for real symmetric positive-definite Toeplitz matrix, one right-hand side
F04FFF Solution of real symmetric positive-definite Toeplitz system, one right-hand side
F04JAF Minimal least-squares solution of m real equations in n unknowns, rank $\leq n$, $m \geq n$
F04JDF Minimal least-squares solution of m real equations in n unknowns, rank $\leq n$, $m \geq n$
F04JGF Least-squares (if rank = n) or minimal least-squares (if rank $< n$) solution of m real equations in n unknowns, rank $\leq n$, $m \geq n$
F04JLF Real general Gauss–Markov linear model (including weighted least-squares)

F04JMF Equality-constrained real linear least-squares problem
F04KLF Complex general Gauss–Markov linear model (including weighted least-squares)
F04KMF Equality-constrained complex linear least-squares problem
F04LEF Solution of real tridiagonal simultaneous linear equations (coefficient matrix already factorized by F01LEF)
F04LHF Solution of real almost block diagonal simultaneous linear equations (coefficient matrix already factorized by F01LHF)
F04MCF Solution of real symmetric positive-definite variable-bandwidth simultaneous linear equations (coefficient matrix already factorized by F01MCF)
F04MEF Update solution of the Yule–Walker equations for real symmetric positive-definite Toeplitz matrix
F04MFF Update solution of real symmetric positive-definite Toeplitz system
F04QAF Sparse linear least-squares problem, m real equations in n unknowns
F04YAF Covariance matrix for linear least-squares problems, m real equations in n unknowns
F04YCF Norm estimation (for use in condition estimation), real matrix
F04ZCF Norm estimation (for use in condition estimation), complex matrix

F05 – Orthogonalisation

F05AAF Gram–Schmidt orthogonalisation of n vectors of order m

F06 – Linear Algebra Support Routines

F06AAF Generate real plane rotation
F06BAF Generate real plane rotation, storing tangent
F06BCF Recover cosine and sine from given real tangent
F06BEF Generate real Jacobi plane rotation
F06BHF Apply real similarity rotation to 2 by 2 symmetric matrix
F06BLF Compute quotient of two real scalars, with overflow flag
F06BMF Compute Euclidean norm from scaled form
F06BNF Compute square root of $(a^2 + b^2)$, real a and b
F06BPF Compute eigenvalue of 2 by 2 real symmetric matrix
F06CAF Generate complex plane rotation, storing tangent, real cosine
F06CBF Generate complex plane rotation, storing tangent, real sine
F06CCF Recover cosine and sine from given complex tangent, real cosine
F06CDF Recover cosine and sine from given complex tangent, real sine
F06CHF Apply complex similarity rotation to 2 by 2 Hermitian matrix
F06CLF Compute quotient of two complex scalars, with overflow flag
F06DBF Broadcast scalar into integer vector
F06DFF Copy integer vector
F06EAF Dot product of two real vectors
F06ECF Add scalar times real vector to real vector
F06EDF Multiply real vector by scalar
F06EFF Copy real vector
F06EGF Swap two real vectors
F06EJF Compute Euclidean norm of real vector
F06EKF Sum absolute values of real vector elements
F06EPF Apply real plane rotation
F06ERF Dot product of two real sparse vectors
F06ETF Add scalar times real sparse vector to real sparse vector
F06EUF Gather real sparse vector
F06EVF Gather and set to zero real sparse vector
F06EWF Scatter real sparse vector
F06EXF Apply plane rotation to two real sparse vectors
F06FAF Compute cosine of angle between two real vectors
F06FBF Broadcast scalar into real vector
F06FCF Multiply real vector by diagonal matrix
F06FDF Multiply real vector by scalar, preserving input vector
F06FGF Negate real vector

F06FJF Update Euclidean norm of real vector in scaled form
F06FKF Compute weighted Euclidean norm of real vector
F06FLF Elements of real vector with largest and smallest absolute value
F06FPF Apply real symmetric plane rotation to two vectors
F06FQF Generate sequence of real plane rotations
F06FRF Generate real elementary reflection, NAG style
F06FSF Generate real elementary reflection, LINPACK style
F06FTF Apply real elementary reflection, NAG style
F06FUF Apply real elementary reflection, LINPACK style
F06GAF Dot product of two complex vectors, unconjugated
F06GBF Dot product of two complex vectors, conjugated
F06GCF Add scalar times complex vector to complex vector
F06GDF Multiply complex vector by complex scalar
F06GFF Copy complex vector
F06GGF Swap two complex vectors
F06GRF Dot product of two complex sparse vector, unconjugated
F06GSF Dot product of two complex sparse vector, conjugated
F06GTF Add scalar times complex sparse vector to complex sparse vector
F06GUF Gather complex sparse vector
F06GVF Gather and set to zero complex sparse vector
F06GWF Scatter complex sparse vector
F06HBF Broadcast scalar into complex vector
F06HCF Multiply complex vector by complex diagonal matrix
F06HDF Multiply complex vector by complex scalar, preserving input vector
F06HGF Negate complex vector
F06HPF Apply complex plane rotation
F06HQF Generate sequence of complex plane rotations
F06HRF Generate complex elementary reflection
F06HTF Apply complex elementary reflection
F06JDF Multiply complex vector by real scalar
F06JJF Compute Euclidean norm of complex vector
F06JKF Sum absolute values of complex vector elements
F06JLF Index, real vector element with largest absolute value
F06JMF Index, complex vector element with largest absolute value
F06KCF Multiply complex vector by real diagonal matrix
F06KDF Multiply complex vector by real scalar, preserving input vector
F06KFF Copy real vector to complex vector
F06KJF Update Euclidean norm of complex vector in scaled form
F06KLF Last non-negligible element of real vector
F06KPF Apply real plane rotation to two complex vectors
F06PAF Matrix-vector product, real rectangular matrix
F06PBF Matrix-vector product, real rectangular band matrix
F06PCF Matrix-vector product, real symmetric matrix
F06PDF Matrix-vector product, real symmetric band matrix
F06PEF Matrix-vector product, real symmetric packed matrix
F06PFF Matrix-vector product, real triangular matrix
F06PGF Matrix-vector product, real triangular band matrix
F06PHF Matrix-vector product, real triangular packed matrix
F06PJF System of equations, real triangular matrix
F06PKF System of equations, real triangular band matrix
F06PLF System of equations, real triangular packed matrix
F06PMF Rank-1 update, real rectangular matrix
F06PPF Rank-1 update, real symmetric matrix
F06PQF Rank-1 update, real symmetric packed matrix
F06PRF Rank-2 update, real symmetric matrix
F06PSF Rank-2 update, real symmetric packed matrix
F06QFF Matrix copy, real rectangular or trapezoidal matrix
F06QHF Matrix initialisation, real rectangular matrix
F06QJF Permute rows or columns, real rectangular matrix, permutations represented by an integer array

F06QKF Permute rows or columns, real rectangular matrix, permutations represented by a real array
F06QMF Orthogonal similarity transformation of real symmetric matrix as a sequence of plane rotations
F06QPF QR factorization by sequence of plane rotations, rank-1 update of real upper triangular matrix
F06QQF QR factorization by sequence of plane rotations, real upper triangular matrix augmented by a full row
F06QRF QR or RQ factorization by sequence of plane rotations, real upper Hessenberg matrix
F06QSF QR or RQ factorization by sequence of plane rotations, real upper spiked matrix
F06QTF QR factorization of UZ or RQ factorization of ZU, U real upper triangular, Z a sequence of plane rotations
F06QVF Compute upper Hessenberg matrix by sequence of plane rotations, real upper triangular matrix
F06QWF Compute upper spiked matrix by sequence of plane rotations, real upper triangular matrix
F06QXF Apply sequence of plane rotations, real rectangular matrix
F06RAF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real general matrix
F06RBF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real band matrix
F06RCF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real symmetric matrix
F06RDF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real symmetric matrix, packed storage
F06REF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real symmetric band matrix
F06RJF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real trapezoidal/triangular matrix
F06RKF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real triangular matrix, packed storage
F06RLF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real triangular band matrix
F06RMF 1-norm, ∞-norm, Frobenius norm, largest absolute element, real Hessenberg matrix
F06SAF Matrix-vector product, complex rectangular matrix
F06SBF Matrix-vector product, complex rectangular band matrix
F06SCF Matrix-vector product, complex Hermitian matrix
F06SDF Matrix-vector product, complex Hermitian band matrix
F06SEF Matrix-vector product, complex Hermitian packed matrix
F06SFF Matrix-vector product, complex triangular matrix
F06SGF Matrix-vector product, complex triangular band matrix
F06SHF Matrix-vector product, complex triangular packed matrix
F06SJF System of equations, complex triangular matrix
F06SKF System of equations, complex triangular band matrix
F06SLF System of equations, complex triangular packed matrix
F06SMF Rank-1 update, complex rectangular matrix, unconjugated vector
F06SNF Rank-1 update, complex rectangular matrix, conjugated vector
F06SPF Rank-1 update, complex Hermitian matrix
F06SQF Rank-1 update, complex Hermitian packed matrix
F06SRF Rank-2 update, complex Hermitian matrix
F06SSF Rank-2 update, complex Hermitian packed matrix
F06TFF Matrix copy, complex rectangular or trapezoidal matrix
F06THF Matrix initialisation, complex rectangular matrix
F06TMF Unitary similarity transformation of Hermitian matrix as a sequence of plane rotations
F06TPF QR factorization by sequence of plane rotations, rank-1 update of complex upper triangular matrix
F06TQF $QR \times k$ factorization by sequence of plane rotations, complex upper triangular matrix augmented by a full row
F06TRF QR or RQ factorization by sequence of plane rotations, complex upper Hessenberg matrix
F06TSF QR or RQ factorization by sequence of plane rotations, complex upper spiked matrix
F06TTF QR factorization of UZ or RQ factorization of ZU, U complex upper triangular, Z a sequence of plane rotations
F06TVF Compute upper Hessenberg matrix by sequence of plane rotations, complex upper triangular matrix
F06TWF Compute upper spiked matrix by sequence of plane rotations, complex upper triangular matrix
F06TXF Apply sequence of plane rotations, complex rectangular matrix, real cosine and complex sine
F06TYF Apply sequence of plane rotations, complex rectangular matrix, complex cosine and real sine
F06UAF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex general matrix
F06UBF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex band matrix
F06UCF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex Hermitian matrix

F06UDF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex Hermitian matrix, packed storage
F06UEF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex Hermitian band matrix
F06UFF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex symmetric matrix
F06UGF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex symmetric matrix, packed storage
F06UHF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex symmetric band matrix
F06UJF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex trapezoidal/triangular matrix
F06UKF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex triangular matrix, packed storage
F06ULF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex triangular band matrix
F06UMF 1-norm, ∞-norm, Frobenius norm, largest absolute element, complex Hessenberg matrix
F06VJF Permute rows or columns, complex rectangular matrix, permutations represented by an integer array
F06VKF Permute rows or columns, complex rectangular matrix, permutations represented by a real array
F06VXF Apply sequence of plane rotations, complex rectangular matrix, real cosine and sine
F06YAF Matrix-matrix product, two real rectangular matrices
F06YCF Matrix-matrix product, one real symmetric matrix, one real rectangular matrix
F06YFF Matrix-matrix product, one real triangular matrix, one real rectangular matrix
F06YJF Solves system of equations with multiple right-hand sides, real triangular coefficient matrix
F06YPF Rank-k update of real symmetric matrix
F06YRF Rank-$2k$ update of real symmetric matrix
F06ZAF Matrix-matrix product, two complex rectangular matrices
F06ZCF Matrix-matrix product, one complex Hermitian matrix, one complex rectangular matrix
F06ZFF Matrix-matrix product, one complex triangular matrix, one complex rectangular matrix
F06ZJF Solves system of equations with multiple right-hand sides, complex triangular coefficient matrix
F06ZPF Rank-k update of complex Hermitian matrix
F06ZRF Rank-$2k$ update of complex Hermitian matrix
F06ZTF Matrix-matrix product, one complex symmetric matrix, one complex rectangular matrix
F06ZUF Rank-k update of complex symmetric matrix
F06ZWF Rank-$2k$ update of complex symmetric matrix

F07 – Linear Equations (LAPACK)

A list of the LAPACK equivalent names is included in the F07 Chapter Introduction.
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 (SGETRF/DGETRF)
F07AGF Estimate condition number of real matrix, matrix already factorized by F07ADF (SGETRF/DGETRF)
F07AHF Refined solution with error bounds of real system of linear equations, multiple right-hand sides
F07AJF Inverse of real matrix, matrix already factorized by F07ADF (SGETRF/DGETRF)
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 (CGETRF/ZGETRF)
F07AUF Estimate condition number of complex matrix, matrix already factorized by F07ARF (CGETRF/ZGETRF)
F07AVF Refined solution with error bounds of complex system of linear equations, multiple right-hand sides
F07AWF Inverse of complex matrix, matrix already factorized by F07ARF (CGETRF/ZGETRF)
F07BDF LU factorization of real m by n band matrix
F07BEF Solution of real band system of linear equations, multiple right-hand sides, matrix already factorized by F07BDF (SGBTRF/DGBTRF)
F07BGF Estimate condition number of real band matrix, matrix already factorized by F07BDF (SGBTRF/DGBTRF)
F07BHF Refined solution with error bounds of real band system of linear equations, multiple right-hand sides

F07BRF LU factorization of complex m by n band matrix
F07BSF Solution of complex band system of linear equations, multiple right-hand sides, matrix already factorized by F07BRF (CGBTRF/ZGBTRF)
F07BUF Estimate condition number of complex band matrix, matrix already factorized by F07BRF (CGBTRF/ZGBTRF)
F07BVF Refined solution with error bounds of complex band system of linear equations, multiple right-hand sides
F07FDF Cholesky factorization of real symmetric positive-definite matrix
F07FEF Solution of real symmetric positive-definite system of linear equations, multiple right-hand sides, matrix already factorized by F07FDF (SPOTRF/DPOTRF)
F07FGF Estimate condition number of real symmetric positive-definite matrix, matrix already factorized by F07FDF (SPOTRF/DPOTRF)
F07FHF Refined solution with error bounds of real symmetric positive-definite system of linear equations, multiple right-hand sides
F07FJF Inverse of real symmetric positive-definite matrix, matrix already factorized by F07FDF (SPOTRF/DPOTRF)
F07FRF Cholesky factorization of complex Hermitian positive-definite matrix
F07FSF Solution of complex Hermitian positive-definite system of linear equations, multiple right-hand sides, matrix already factorized by F07FRF (CPOTRF/ZPOTRF)
F07FUF Estimate condition number of complex Hermitian positive-definite matrix, matrix already factorized by F07FRF (CPOTRF/ZPOTRF)
F07FVF Refined solution with error bounds of complex Hermitian positive-definite system of linear equations, multiple right-hand sides
F07FWF Inverse of complex Hermitian positive-definite matrix, matrix already factorized by F07FRF (CPOTRF/ZPOTRF)
F07GDF Cholesky factorization of real symmetric positive-definite matrix, packed storage
F07GEF Solution of real symmetric positive-definite system of linear equations, multiple right-hand sides, matrix already factorized by F07GDF (SPPTRF/DPPTRF), packed storage
F07GGF Estimate condition number of real symmetric positive-definite matrix, matrix already factorized by F07GDF (SPPTRF/DPPTRF), packed storage
F07GHF Refined solution with error bounds of real symmetric positive-definite system of linear equations, multiple right-hand sides, packed storage
F07GJF Inverse of real symmetric positive-definite matrix, matrix already factorized by F07GDF (SPPTRF/DPPTRF), packed storage
F07GRF Cholesky factorization of complex Hermitian positive-definite matrix, packed storage
F07GSF Solution of complex Hermitian positive-definite system of linear equations, multiple right-hand sides, matrix already factorized by F07GRF (CPPTRF/ZPPTRF), packed storage
F07GUF Estimate condition number of complex Hermitian positive-definite matrix, matrix already factorized by F07GRF (CPPTRF/ZPPTRF), packed storage
F07GVF Refined solution with error bounds of complex Hermitian positive-definite system of linear equations, multiple right-hand sides, packed storage
F07GWF Inverse of complex Hermitian positive-definite matrix, matrix already factorized by F07GRF (CPPTRF/ZPPTRF), packed storage
F07HDF Cholesky factorization of real symmetric positive-definite band matrix
F07HEF Solution of real symmetric positive-definite band system of linear equations, multiple right-hand sides, matrix already factorized by F07HDF (SPBTRF/DPBTRF)
F07HGF Estimate condition number of real symmetric positive-definite band matrix, matrix already factorized by F07HDF (SPBTRF/DPBTRF)
F07HHF Refined solution with error bounds of real symmetric positive-definite band system of linear equations, multiple right-hand sides
F07HRF Cholesky factorization of complex Hermitian positive-definite band matrix
F07HSF Solution of complex Hermitian positive-definite band system of linear equations, multiple right-hand sides, matrix already factorized by F07HRF (CPBTRF/ZPBTRF)
F07HUF Estimate condition number of complex Hermitian positive-definite band matrix, matrix already factorized by F07HRF (CPBTRF/ZPBTRF)
F07HVF Refined solution with error bounds of complex Hermitian positive-definite band system of linear equations, multiple right-hand sides
F07MDF Bunch–Kaufman factorization of real symmetric indefinite matrix

F07MEF Solution of real symmetric indefinite system of linear equations, multiple right-hand sides, matrix already factorized by F07MDF (SSYTRF/DSYTRF)
F07MGF Estimate condition number of real symmetric indefinite matrix, matrix already factorized by F07MDF (SSYTRF/DSYTRF)
F07MHF Refined solution with error bounds of real symmetric indefinite system of linear equations, multiple right-hand sides
F07MJF Inverse of real symmetric indefinite matrix, matrix already factorized by F07MDF (SSYTRF/DSYTRF)
F07MRF Bunch–Kaufman factorization of complex Hermitian indefinite matrix
F07MSF Solution of complex Hermitian indefinite system of linear equations, multiple right-hand sides, matrix already factorized by F07MRF (CHETRF/ZHETRF)
F07MUF Estimate condition number of complex Hermitian indefinite matrix, matrix already factorized by F07MRF (CHETRF/ZHETRF)
F07MVF Refined solution with error bounds of complex Hermitian indefinite system of linear equations, multiple right-hand sides
F07MWF Inverse of complex Hermitian indefinite matrix, matrix already factorized by F07MRF (CHETRF/ZHETRF)
F07NRF Bunch–Kaufman factorization of complex symmetric matrix
F07NSF Solution of complex symmetric system of linear equations, multiple right-hand sides, matrix already factorized by F07NRF (CSYTRF/ZSYTRF)
F07NUF Estimate condition number of complex symmetric matrix, matrix already factorized by F07NRF (CSYTRF/ZSYTRF)
F07NVF Refined solution with error bounds of complex symmetric system of linear equations, multiple right-hand sides
F07NWF Inverse of complex symmetric matrix, matrix already factorized by F07NRF (CSYTRF/ZSYTRF)
F07PDF Bunch–Kaufman factorization of real symmetric indefinite matrix, packed storage
F07PEF Solution of real symmetric indefinite system of linear equations, multiple right-hand sides, matrix already factorized by F07PDF (SSPTRF/DSPTRF), packed storage
F07PGF Estimate condition number of real symmetric indefinite matrix, matrix already factorized by F07PDF (SSPTRF/DSPTRF), packed storage
F07PHF Refined solution with error bounds of real symmetric indefinite system of linear equations, multiple right-hand sides, packed storage
F07PJF Inverse of real symmetric indefinite matrix, matrix already factorized by F07PDF (SSPTRF/DSPTRF), packed storage
F07PRF Bunch–Kaufman factorization of complex Hermitian indefinite matrix, packed storage
F07PSF Solution of complex Hermitian indefinite system of linear equations, multiple right-hand sides, matrix already factorized by F07PRF (CHPTRF/ZHPTRF), packed storage
F07PUF Estimate condition number of complex Hermitian indefinite matrix, matrix already factorized by F07PRF (CHPTRF/ZHPTRF), packed storage
F07PVF Refined solution with error bounds of complex Hermitian indefinite system of linear equations, multiple right-hand sides, packed storage
F07PWF Inverse of complex Hermitian indefinite matrix, matrix already factorized by F07PRF (CHPTRF/ZHPTRF), packed storage
F07QRF Bunch–Kaufman factorization of complex symmetric matrix, packed storage
F07QSF Solution of complex symmetric system of linear equations, multiple right-hand sides, matrix already factorized by F07QRF (CSPTRF/ZSPTRF), packed storage
F07QUF Estimate condition number of complex symmetric matrix, matrix already factorized by F07QRF (CSPTRF/ZSPTRF), packed storage
F07QVF Refined solution with error bounds of complex symmetric system of linear equations, multiple right-hand sides, packed storage
F07QWF Inverse of complex symmetric matrix, matrix already factorized by F07QRF (CSPTRF/ZSPTRF), packed storage
F07TEF Solution of real triangular system of linear equations, multiple right-hand sides
F07TGF Estimate condition number of real triangular matrix
F07THF Error bounds for solution of real triangular system of linear equations, multiple right-hand sides
F07TJF Inverse of real triangular matrix
F07TSF Solution of complex triangular system of linear equations, multiple right-hand sides
F07TUF Estimate condition number of complex triangular matrix

F07TVF Error bounds for solution of complex triangular system of linear equations, multiple right-hand sides
F07TWF Inverse of complex triangular matrix
F07UEF Solution of real triangular system of linear equations, multiple right-hand sides, packed storage
F07UGF Estimate condition number of real triangular matrix, packed storage
F07UHF Error bounds for solution of real triangular system of linear equations, multiple right-hand sides, packed storage
F07UJF Inverse of real triangular matrix, packed storage
F07USF Solution of complex triangular system of linear equations, multiple right-hand sides, packed storage
F07UUF Estimate condition number of complex triangular matrix, packed storage
F07UVF Error bounds for solution of complex triangular system of linear equations, multiple right-hand sides, packed storage
F07UWF Inverse of complex triangular matrix, packed storage
F07VEF Solution of real band triangular system of linear equations, multiple right-hand sides
F07VGF Estimate condition number of real band triangular matrix
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
F07VUF Estimate condition number of complex band triangular matrix
F07VVF Error bounds for solution of complex band triangular system of linear equations, multiple right-hand sides

F08 – Least-squares and Eigenvalue Problems (LAPACK)

A list of the LAPACK equivalent names is included in the F08 Chapter Introduction.
F08AEF QR factorization of real general rectangular matrix
F08AFF Form all or part of orthogonal Q from QR factorization determined by F08AEF (SGEQRF/DGEQRF) or F08BEF (SGEQPF/DGEQPF)
F08AGF Apply orthogonal transformation determined by F08AEF (SGEQRF/DGEQRF) or F08BEF (SGEQPF/DGEQPF)
F08AHF LQ factorization of real general rectangular matrix
F08AJF Form all or part of orthogonal Q from LQ factorization determined by F08AHF (SGELQF/DGELQF)
F08AKF Apply orthogonal transformation determined by F08AHF (SGELQF/DGELQF)
F08ASF QR factorization of complex general rectangular matrix
F08ATF Form all or part of unitary Q from QR factorization determined by F08ASF (CGEQRF/ZGEQRF) or F08BSF (CGEQPF/ZGEQPF)
F08AUF Apply unitary transformation determined by F08ASF (CGEQRF/ZGEQRF) or F08BSF (CGEQPF/ZGEQPF)
F08AVF LQ factorization of complex general rectangular matrix
F08AWF Form all or part of unitary Q from LQ factorization determined by F08AVF (CGELQF/ZGELQF)
F08AXF Apply unitary transformation determined by F08AVF (CGELQF/ZGELQF)
F08BEF QR factorization of real general rectangular matrix with column pivoting
F08BSF QR factorization of complex general rectangular matrix with column pivoting
F08FCF All eigenvalues and optionally all eigenvectors of real symmetric matrix, using divide and conquer
F08FEF Orthogonal reduction of real symmetric matrix to symmetric tridiagonal form
F08FFF Generate orthogonal transformation matrix from reduction to tridiagonal form determined by F08FEF (SSYTRD/DSYTRD)
F08FGF Apply orthogonal transformation determined by F08FEF (SSYTRD/DSYTRD)
F08FQF All eigenvalues and optionally all eigenvectors of complex Hermitian matrix, using divide and conquer
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 (CHETRD/ZHETRD)
F08FUF Apply unitary transformation matrix determined by F08FSF (CHETRD/ZHETRD)

`F08GCF` All eigenvalues and optionally all eigenvectors of real symmetric matrix, packed storage, using divide and conquer
`F08GEF` Orthogonal reduction of real symmetric matrix to symmetric tridiagonal form, packed storage
`F08GFF` Generate orthogonal transformation matrix from reduction to tridiagonal form determined by F08GEF (SSPTRD/DSPTRD)
`F08GGF` Apply orthogonal transformation determined by F08GEF (SSPTRD/DSPTRD)
`F08GQF` All eigenvalues and optionally all eigenvectors of complex Hermitian matrix, packed storage, using divide and conquer
`F08GSF` Unitary reduction of complex Hermitian matrix to real symmetric tridiagonal form, packed storage
`F08GTF` Generate unitary transformation matrix from reduction to tridiagonal form determined by F08GSF (CHPTRD/ZHPTRD)
`F08GUF` Apply unitary transformation matrix determined by F08GSF (CHPTRD/ZHPTRD)
`F08HCF` All eigenvalues and optionally all eigenvectors of real symmetric band matrix, using divide and conquer
`F08HEF` Orthogonal reduction of real symmetric band matrix to symmetric tridiagonal form
`F08HQF` All eigenvalues and optionally all eigenvectors of complex Hermitian band matrix, using divide and conquer
`F08HSF` Unitary reduction of complex Hermitian band matrix to real symmetric tridiagonal form
`F08JCF` All eigenvalues and optionally all eigenvectors of real symmetric tridiagonal matrix, using divide and conquer
`F08JEF` All eigenvalues and eigenvectors of real symmetric tridiagonal matrix, reduced from real symmetric matrix using implicit QL or QR
`F08JFF` All eigenvalues of real symmetric tridiagonal matrix, root-free variant of QL or QR
`F08JGF` All eigenvalues and eigenvectors of real symmetric positive-definite tridiagonal matrix, reduced from real symmetric positive-definite matrix
`F08JJF` 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
`F08JUF` All eigenvalues and eigenvectors of real symmetric positive-definite tridiagonal matrix, reduced from complex Hermitian positive-definite matrix
`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
`F08KFF` Generate orthogonal transformation matrices from reduction to bidiagonal form determined by F08KEF (SGEBRD/DGEBRD)
`F08KGF` Apply orthogonal transformations from reduction to bidiagonal form determined by F08KEF (SGEBRD/DGEBRD)
`F08KSF` Unitary reduction of complex general rectangular matrix to bidiagonal form
`F08KTF` Generate unitary transformation matrices from reduction to bidiagonal form determined by F08KSF (CGEBRD/ZGEBRD)
`F08KUF` Apply unitary transformations from reduction to bidiagonal form determined by F08KSF (CGEBRD/ZGEBRD)
`F08LEF` Reduction of real rectangular band matrix to upper bidiagonal form
`F08LSF` Reduction of complex rectangular band matrix to upper bidiagonal form
`F08MEF` SVD of real bidiagonal matrix reduced from real general matrix
`F08MSF` SVD of real bidiagonal matrix reduced from complex general matrix
`F08NEF` Orthogonal reduction of real general matrix to upper Hessenberg form
`F08NFF` Generate orthogonal transformation matrix from reduction to Hessenberg form determined by F08NEF (SGEHRD/DGEHRD)
`F08NGF` Apply orthogonal transformation matrix from reduction to Hessenberg form determined by F08NEF (SGEHRD/DGEHRD)
`F08NHF` Balance real general matrix
`F08NJF` Transform eigenvectors of real balanced matrix to those of original matrix supplied to F08NHF (SGEBAL/DGEBAL)
`F08NSF` Unitary reduction of complex general matrix to upper Hessenberg form

F08NTF Generate unitary transformation matrix from reduction to Hessenberg form determined by F08NSF (CGEHRD/ZGEHRD)
F08NUF Apply unitary transformation matrix from reduction to Hessenberg form determined by F08NSF (CGEHRD/ZGEHRD)
F08NVF Balance complex general matrix
F08NWF Transform eigenvectors of complex balanced matrix to those of original matrix supplied to F08NVF (CGEBAL/ZGEBAL)
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
F08QFF Reorder Schur factorization of real matrix using orthogonal similarity transformation
F08QGF Reorder Schur factorization of real matrix, form orthonormal basis of right invariant subspace for selected eigenvalues, with estimates of sensitivities
F08QHF Solve real Sylvester matrix equation $AX + XB = C$, A and B are upper quasi-triangular or transposes
F08QKF Left and right eigenvectors of real upper quasi-triangular matrix
F08QLF Estimates of sensitivities of selected eigenvalues and eigenvectors of real upper quasi-triangular matrix
F08QTF Reorder Schur factorization of complex matrix using unitary similarity transformation
F08QUF Reorder Schur factorization of complex matrix, form orthonormal basis of right invariant subspace for selected eigenvalues, with estimates of sensitivities
F08QVF Solve complex Sylvester matrix equation $AX + XB = C$, A and B are upper triangular or conjugate-transposes
F08QXF Left and right eigenvectors of complex upper triangular matrix
F08QYF Estimates of sensitivities of selected eigenvalues and eigenvectors of complex upper triangular matrix
F08SEF Reduction to standard form of real symmetric-definite generalized eigenproblem $Ax = \lambda Bx$, $ABx = \lambda x$ or $BAx = \lambda x$, B factorized by F07FDF (SPOTRF/DPOTRF)
F08SSF Reduction to standard form of complex Hermitian-definite generalized eigenproblem $Ax = \lambda Bx$, $ABx = \lambda x$ or $BAx = \lambda x$, B factorized by F07FRF (CPOTRF/ZPOTRF)
F08TEF Reduction to standard form of real symmetric-definite generalized eigenproblem $Ax = \lambda Bx$, $ABx = \lambda x$ or $BAx = \lambda x$, packed storage, B factorized by F07GDF (SPPTRF/DPPTRF)
F08TSF Reduction to standard form of complex Hermitian-definite generalized eigenproblem $Ax = \lambda Bx$, $ABx = \lambda x$ or $BAx = \lambda x$, packed storage, B factorized by F07GRF (CPPTRF/ZPPTRF)
F08UEF Reduction of real symmetric-definite banded generalized eigenproblem $Ax = \lambda Bx$ to standard form $Cy = \lambda y$, such that C has the same bandwidth as A
F08UFF Computes a split Cholesky factorization of real symmetric positive-definite band matrix A
F08USF Reduction of complex Hermitian-definite banded generalized eigenproblem $Ax = \lambda Bx$ to standard form $Cy = \lambda y$, such that C has the same bandwidth as A
F08UTF Computes a split Cholesky factorization of complex Hermitian positive-definite band matrix A
F08WEF Orthogonal reduction of a pair of real general matrices to generalized upper Hessenberg form
F08WHF Balance a pair of real general matrices
F08WJF Transform eigenvectors of a pair of real balanced matrices to those of original matrix pair supplied to F08WHF (SGGBAL/DGGBAL)
F08WSF Unitary reduction of a pair of complex general matrices to generalized upper Hessenberg form
F08WVF Balance a pair of complex general matrices
F08WWF Transform eigenvectors of a pair of complex balanced matrices to those of original matrix pair supplied to F08WVF (CGGBAL/ZGGBAL)
F08XEF Eigenvalues and generalized Schur factorization of real generalized upper Hessenberg matrix reduced from a pair of real general matrices
F08XSF Eigenvalues and generalized Schur factorization of complex generalized upper Hessenberg matrix reduced from a pair of complex general matrices
F08YKF Left and right eigenvectors of a pair of real upper quasi-triangular matrices
F08YXF Left and right eigenvectors of a pair of complex upper triangular matrices

F11 – Sparse Linear Algebra

F11BAF Real sparse nonsymmetric linear systems, setup for F11BBF
F11BBF Real sparse nonsymmetric linear systems, preconditioned RGMRES, CGS or Bi-CGSTAB
F11BCF Real sparse nonsymmetric linear systems, diagnostic for F11BBF
F11BDF Real sparse nonsymmetric linear systems, setup for F11BEF
F11BEF Real sparse nonsymmetric linear systems, preconditioned RGMRES, CGS, Bi-CGSTAB or TFQMR method
F11BFF Real sparse nonsymmetric linear systems, diagnostic for F11BEF
F11BRF Complex sparse non-Hermitian linear systems, setup for F11BSF
F11BSF Complex sparse non-Hermitian linear systems, preconditioned RGMRES, CGS,Bi-CGSTAB or TFQMR method
F11BTF Complex sparse non-Hermitian linear systems, diagnostic for F11BSF
F11DAF Real sparse nonsymmetric linear systems, incomplete LU factorization
F11DBF Solution of linear system involving incomplete LU preconditioning matrix generated by F11DAF
F11DCF Solution of real sparse nonsymmetric linear system, RGMRES, CGS, Bi-CGSTAB or TFQMR method, preconditioner computed by F11DAF
F11DDF Solution of linear system involving preconditioning matrix generated by applying SSOR to real sparse nonsymmetric matrix
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
F11DNF Complex sparse non-Hermitian linear systems, incomplete LU factorization
F11DPF Solution of complex linear system involving incomplete LU preconditioning matrix generated by F11DNF
F11DQF Solution of complex sparse non-Hermitian linear system, RGMRES, CGS, Bi-CGSTAB or TFQMR method, preconditioner computed by F11DNF (Black Box)
F11DRF Solution of linear system involving preconditioning matrix generated by applying SSOR to complex sparse non-Hermitian matrix
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
F11GAF Real sparse symmetric linear systems, setup for F11GBF
F11GBF Real sparse symmetric linear systems, preconditioned conjugate gradient or Lanczos
F11GCF Real sparse symmetric linear systems, diagnostic for F11GBF
F11GDF Real sparse symmetric linear systems, setup for F11GEF
F11GEF Real sparse symmetric linear systems, preconditioned conjugate gradient or Lanczos
F11GFF Real sparse symmetric linear systems, diagnostic for F11GEF
F11GRF Complex sparse symmetric linear systems, setup for F11GEF
F11GSF Complex sparse symmetric linear systems, preconditioned conjugate gradient or Lanczos
F11GTF Complex sparse symmetric linear systems, diagnostic for F11GEF
F11JAF Real sparse symmetric matrix, incomplete Cholesky factorization
F11JBF Solution of linear system involving incomplete Cholesky preconditioning matrix generated by F11JAF
F11JCF Solution of real sparse symmetric linear system, conjugate gradient/Lanczos method, preconditioner computed by F11JAF (Black Box)
F11JDF Solution of linear system involving preconditioning matrix generated by applying SSOR to real sparse symmetric matrix
F11JEF Solution of real sparse symmetric linear system, conjugate gradient/Lanczos method, Jacobi or SSOR preconditioner (Black Box)
F11JNF Complex sparse Hermitian matrix, incomplete Cholesky factorization
F11JPF Solution of complex linear system involving incomplete Cholesky preconditioning matrix generated by F11JNF
F11JQF Solution of complex sparse Hermitian linear system, conjugate gradient/Lanczos method, preconditioner computed by F11JNF (Black Box)
F11JRF Solution of linear system involving preconditioning matrix generated by applying SSOR to complex sparse Hermitian matrix

F11JSF Solution of complex sparse Hermitian linear system, conjugate gradient/Lanczos method, Jacobi or SSOR preconditioner (Black Box)
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
F11ZAF Real sparse nonsymmetric matrix reorder routine
F11ZBF Real sparse symmetric matrix reorder routine
F11ZNF Complex sparse non-Hermitian matrix reorder routine
F11ZPF Complex sparse Hermitian matrix reorder routine

G01 – Simple Calculations on Statistical Data

G01AAF Mean, variance, skewness, kurtosis, etc, one variable, from raw data
G01ABF Mean, variance, skewness, kurtosis, etc, two variables, from raw data
G01ADF Mean, variance, skewness, kurtosis, etc, one variable, from frequency table
G01AEF Frequency table from raw data
G01AFF Two-way contingency table analysis, with χ^2/Fisher's exact test
G01AGF Lineprinter scatterplot of two variables
G01AHF Lineprinter scatterplot of one variable against Normal scores
G01AJF Lineprinter histogram of one variable
G01ALF Computes a five-point summary (median, hinges and extremes)
G01ARF Constructs a stem and leaf plot
G01ASF Constructs a box and whisker plot
G01BJF Binomial distribution function
G01BKF Poisson distribution function
G01BLF Hypergeometric distribution function
G01DAF Normal scores, accurate values
G01DBF Normal scores, approximate values
G01DCF Normal scores, approximate variance-covariance matrix
G01DDF Shapiro and Wilk's W test for Normality
G01DHF Ranks, Normal scores, approximate Normal scores or exponential (Savage) scores
G01EAF Computes probabilities for the standard Normal distribution
G01EBF Computes probabilities for Student's t-distribution
G01ECF Computes probabilities for χ^2 distribution
G01EDF Computes probabilities for F-distribution
G01EEF Computes upper and lower tail probabilities and probability density function for the beta distribution
G01EFF Computes probabilities for the gamma distribution
G01EMF Computes probability for the Studentized range statistic
G01EPF Computes bounds for the significance of a Durbin–Watson statistic
G01ERF Computes probability for von Mises distribution
G01EYF Computes probabilities for the one-sample Kolmogorov–Smirnov distribution
G01EZF Computes probabilities for the two-sample Kolmogorov–Smirnov distribution
G01FAF Computes deviates for the standard Normal distribution
G01FBF Computes deviates for Student's t-distribution
G01FCF Computes deviates for the χ^2 distribution
G01FDF Computes deviates for the F-distribution
G01FEF Computes deviates for the beta distribution
G01FFF Computes deviates for the gamma distribution
G01FMF Computes deviates for the Studentized range statistic
G01GBF Computes probabilities for the non-central Student's t-distribution
G01GCF Computes probabilities for the non-central χ^2 distribution
G01GDF Computes probabilities for the non-central F-distribution
G01GEF Computes probabilities for the non-central beta distribution
G01HAF Computes probability for the bivariate Normal distribution
G01HBF Computes probabilities for the multivariate Normal distribution
G01JCF Computes probability for a positive linear combination of χ^2 variables

G01JDF Computes lower tail probability for a linear combination of (central) χ^2 variables
G01MBF Computes reciprocal of Mills' Ratio
G01NAF Cumulants and moments of quadratic forms in Normal variables
G01NBF Moments of ratios of quadratic forms in Normal variables, and related statistics

G02 – Correlation and Regression Analysis

G02BAF Pearson product-moment correlation coefficients, all variables, no missing values
G02BBF Pearson product-moment correlation coefficients, all variables, casewise treatment of missing values
G02BCF Pearson product-moment correlation coefficients, all variables, pairwise treatment of missing values
G02BDF Correlation-like coefficients (about zero), all variables, no missing values
G02BEF Correlation-like coefficients (about zero), all variables, casewise treatment of missing values
G02BFF Correlation-like coefficients (about zero), all variables, pairwise treatment of missing values
G02BGF Pearson product-moment correlation coefficients, subset of variables, no missing values
G02BHF Pearson product-moment correlation coefficients, subset of variables, casewise treatment of missing values
G02BJF Pearson product-moment correlation coefficients, subset of variables, pairwise treatment of missing values
G02BKF Correlation-like coefficients (about zero), subset of variables, no missing values
G02BLF Correlation-like coefficients (about zero), subset of variables, casewise treatment of missing values
G02BMF Correlation-like coefficients (about zero), subset of variables, pairwise treatment of missing values
G02BNF Kendall/Spearman non-parametric rank correlation coefficients, no missing values, overwriting input data
G02BPF Kendall/Spearman non-parametric rank correlation coefficients, casewise treatment of missing values, overwriting input data
G02BQF Kendall/Spearman non-parametric rank correlation coefficients, no missing values, preserving input data
G02BRF Kendall/Spearman non-parametric rank correlation coefficients, casewise treatment of missing values, preserving input data
G02BSF Kendall/Spearman non-parametric rank correlation coefficients, pairwise treatment of missing values
G02BTF Update a weighted sum of squares matrix with a new observation
G02BUF Computes a weighted sum of squares matrix
G02BWF Computes a correlation matrix from a sum of squares matrix
G02BXF Computes (optionally weighted) correlation and covariance matrices
G02BYF Computes partial correlation/variance-covariance matrix from correlation/variance-covariance matrix computed by G02BXF
G02CAF Simple linear regression with constant term, no missing values
G02CBF Simple linear regression without constant term, no missing values
G02CCF Simple linear regression with constant term, missing values
G02CDF Simple linear regression without constant term, missing values
G02CEF Service routines for multiple linear regression, select elements from vectors and matrices
G02CFF Service routines for multiple linear regression, re-order elements of vectors and matrices
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
G02DCF Add/delete an observation to/from a general linear regression model
G02DDF Estimates of linear parameters and general linear regression model from updated model
G02DEF Add a new variable to a general linear regression model
G02DFF Delete a variable from a general linear regression model
G02DGF Fits a general linear regression model for new dependent variable
G02DKF Estimates and standard errors of parameters of a general linear regression model for given constraints
G02DNF Computes estimable function of a general linear regression model and its standard error

G02EAF Computes residual sums of squares for all possible linear regressions for a set of independent variables
G02ECF Calculates R^2 and C_P values from residual sums of squares
G02EEF Fits a linear regression model by forward selection
G02FAF Calculates standardized residuals and influence statistics
G02FCF Computes Durbin–Watson test statistic
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
G02GNF Computes estimable function of a generalized linear model and its standard error
G02HAF Robust regression, standard M-estimates
G02HBF Robust regression, compute weights for use with G02HDF
G02HDF Robust regression, compute regression with user-supplied functions and weights
G02HFF Robust regression, variance-covariance matrix following G02HDF
G02HKF Calculates a robust estimation of a correlation matrix, Huber's weight function
G02HLF Calculates a robust estimation of a correlation matrix, user-supplied weight function plus derivatives
G02HMF Calculates a robust estimation of a correlation matrix, user-supplied weight function

G03 – Multivariate Methods

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
G03CCF Computes factor score coefficients (for use after G03CAF)
G03DAF Computes test statistic for equality of within-group covariance matrices and matrices for discriminant analysis
G03DBF Computes Mahalanobis squared distances for group or pooled variance-covariance matrices (for use after G03DAF)
G03DCF Allocates observations to groups according to selected rules (for use after G03DAF)
G03EAF Computes distance matrix
G03ECF Hierarchical cluster analysis
G03EFF K-means cluster analysis
G03EHF Constructs dendrogram (for use after G03ECF)
G03EJF Computes cluster indicator variable (for use after G03ECF)
G03FAF Performs principal co-ordinate analysis, classical metric scaling
G03FCF Performs non-metric (ordinal) multidimensional scaling
G03ZAF Produces standardized values (z-scores) for a data matrix

G04 – Analysis of Variance

G04AGF Two-way analysis of variance, hierarchical classification, subgroups of unequal size
G04BBF Analysis of variance, randomized block or completely randomized design, treatment means and standard errors
G04BCF Analysis of variance, general row and column design, treatment means and standard errors
G04CAF Analysis of variance, complete factorial design, treatment means and standard errors
G04DAF Computes sum of squares for contrast between means
G04DBF Computes confidence intervals for differences between means computed by G04BBF or G04BCF,
G04EAF Computes orthogonal polynomials or dummy variables for factor/classification variable

G05 – Random Number Generators

G05LBF Generates a vector of random numbers from a Student's t-distribution, seeds and generator number passed explicitly
G05LCF Generates a vector of random numbers from a χ^2 distribution, seeds and generator number passed explicitly
G05LDF Generates a vector of random numbers from an F-distribution, seeds and generator number passed explicitly
G05LEF Generates a vector of random numbers from a β distribution, seeds and generator number passed explicitly
G05LFF Generates a vector of random numbers from a γ distribution, seeds and generator number passed explicitly
G05LGF Generates a vector of random numbers from a uniform distribution, seeds and generator number passed explicitly
G05LHF Generates a vector of random numbers from a triangular distribution, seeds and generator number passed explicitly
G05LJF Generates a vector of random numbers from an exponential distribution, seeds and generator number passed explicitly
G05LKF Generates a vector of random numbers from a lognormal distribution, seeds and generator number passed explicitly
G05LLF Generates a vector of random numbers from a Cauchy distribution, seeds and generator number passed explicitly
G05LMF Generates a vector of random numbers from a Weibull distribution, seeds and generator number passed explicitly
G05LNF Generates a vector of random numbers from a logistic distribution, seeds and generator number passed explicitly
G05LPF Generates a vector of random numbers from a Von Mises distribution, seeds and generator number passed explicitly
G05LQF Generates a vector of random numbers from an exponential mixture distribution, seeds and generator number passed explicitly
G05LZF Generates a vector of random numbers from a multivariate Normal distribution, seeds and generator number passed explicitly
G05MAF Generates a vector of random integers from a uniform distribution, seeds and generator number passed explicitly
G05MBF Generates a vector of random integers from a geometric distribution, seeds and generator number passed explicitly
G05MCF Generates a vector of random integers from a negative binomial distribution, seeds and generator number passed explicitly
G05MDF Generates a vector of random integers from a logarithmic distribution, seeds and generator number passed explicitly
G05MEF Generates a vector of random integers from a Poisson distribution with varying mean, seeds and generator number passed explicitly
G05MJF Generates a vector of random integers from a binomial distribution, seeds and generator number passed explicitly
G05MKF Generates a vector of random integers from a Poisson distribution, seeds and generator number passed explicitly
G05MLF Generates a vector of random integers from a hypergeometric distribution, seeds and generator number passed explicitly
G05MRF Generates a vector of random integers from a multinomial distribution, seeds and generator number passed explicitly
G05MZF Generates a vector of random integers from a general discrete distribution, seeds and generator number passed explicitly
G05NAF Pseudo-random permutation of an integer vector
G05NBF Pseudo-random sample from an integer vector
G05PAF Generates a realisation of a time series from an ARMA model
G05PCF Generates a realisation of a multivariate time series from a VARMA model
G05QAF Computes a random orthogonal matrix
G05QBF Computes a random correlation matrix
G05QDF Generates a random table matrix
G05YAF Multi-dimensional quasi-random number generator with a uniform probability distribution

G05YBF Multi-dimensional quasi-random number generator with a Gaussian or log-normal probability distribution
G05ZAF Selects either the basic generator or the Wichmann–Hill generator for those routines using internal communication

G07 – Univariate Estimation

G07AAF Computes confidence interval for the parameter of a binomial distribution
G07ABF Computes confidence interval for the parameter of a Poisson distribution
G07BBF Computes maximum likelihood estimates for parameters of the Normal distribution from grouped and/or censored data
G07BEF Computes maximum likelihood estimates for parameters of the Weibull distribution
G07CAF Computes t-test statistic for a difference in means between two Normal populations, confidence interval
G07DAF Robust estimation, median, median absolute deviation, robust standard deviation
G07DBF Robust estimation, M-estimates for location and scale parameters, standard weight functions
G07DCF Robust estimation, M-estimates for location and scale parameters, user-defined weight functions
G07DDF Computes a trimmed and winsorized mean of a single sample with estimates of their variance
G07EAF Robust confidence intervals, one-sample
G07EBF Robust confidence intervals, two-sample

G08 – Nonparametric Statistics

G08AAF Sign test on two paired samples
G08ACF Median test on two samples of unequal size
G08AEF Friedman two-way analysis of variance on k matched samples
G08AFF Kruskal–Wallis one-way analysis of variance on k samples of unequal size
G08AGF Performs the Wilcoxon one-sample (matched pairs) signed rank test
G08AHF Performs the Mann–Whitney U test on two independent samples
G08AJF Computes the exact probabilities for the Mann–Whitney U statistic, no ties in pooled sample
G08AKF Computes the exact probabilities for the Mann–Whitney U statistic, ties in pooled sample
G08ALF Performs the Cochran Q test on cross-classified binary data
G08BAF Mood's and David's tests on two samples of unequal size
G08CBF Performs the one-sample Kolmogorov–Smirnov test for standard distributions
G08CCF Performs the one-sample Kolmogorov–Smirnov test for a user-supplied distribution
G08CDF Performs the two-sample Kolmogorov–Smirnov test
G08CGF Performs the χ^2 goodness of fit test, for standard continuous distributions
G08DAF Kendall's coefficient of concordance
G08EAF Performs the runs up or runs down test for randomness
G08EBF Performs the pairs (serial) test for randomness
G08ECF Performs the triplets test for randomness
G08EDF Performs the gaps test for randomness
G08RAF Regression using ranks, uncensored data
G08RBF Regression using ranks, right-censored data

G10 – Smoothing in Statistics

G10ABF Fit cubic smoothing spline, smoothing parameter given
G10ACF Fit cubic smoothing spline, smoothing parameter estimated
G10BAF Kernel density estimate using Gaussian kernel
G10CAF Compute smoothed data sequence using running median smoothers
G10ZAF Reorder data to give ordered distinct observations

G11 – Contingency Table Analysis

G11AAF χ^2 statistics for two-way contingency table
G11BAF Computes multiway table from set of classification factors using selected statistic
G11BBF Computes multiway table from set of classification factors using given percentile/quantile
G11BCF Computes marginal tables for multiway table computed by G11BAF or G11BBF

G11CAF Returns parameter estimates for theconditional analysis of stratified data
G11SAF Contingency table, latent variable model for binary data
G11SBF Frequency count for G11SAF

G12 – Survival Analysis

G12AAF Computes Kaplan–Meier (product-limit) estimates of survival probabilities
G12BAF Fits Cox's proportional hazard model
G12ZAF Creates the risk sets associated with the Cox proportional hazards model for fixed covariates

G13 – Time Series Analysis

G13AAF Univariate time series, seasonal and non-seasonal differencing
G13ABF Univariate time series, sample autocorrelation function
G13ACF Univariate time series, partial autocorrelations from autocorrelations
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)
G13AGF Univariate time series, update state set for forecasting
G13AHF Univariate time series, forecasting from state set
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
G13AUF Computes quantities needed for range-mean or standard deviation-mean plot
G13BAF Multivariate time series, filtering (pre-whitening) by an ARIMA model
G13BBF Multivariate time series, filtering by a transfer function model
G13BCF Multivariate time series, cross-correlations
G13BDF Multivariate time series, preliminary estimation of transfer function model
G13BEF Multivariate time series, estimation of multi-input model
G13BGF Multivariate time series, update state set for forecasting from multi-input model
G13BHF Multivariate time series, forecasting from state set of multi-input model
G13BJF Multivariate time series, state set and forecasts from fully specified multi-input model
G13CAF Univariate time series, smoothed sample spectrum using rectangular, Bartlett, Tukey or Parzen lag window
G13CBF Univariate time series, smoothed sample spectrum using spectral smoothing by the trapezium frequency (Daniell) window
G13CCF Multivariate time series, smoothed sample cross spectrum using rectangular, Bartlett, Tukey or Parzen lag window
G13CDF Multivariate time series, smoothed sample cross spectrum using spectral smoothing by the trapezium frequency (Daniell) window
G13CEF Multivariate time series, cross amplitude spectrum, squared coherency, bounds, univariate and bivariate (cross) spectra
G13CFF Multivariate time series, gain, phase, bounds, univariate and bivariate (cross) spectra
G13CGF Multivariate time series, noise spectrum, bounds, impulse response function and its standard error
G13DBF Multivariate time series, multiple squared partial autocorrelations
G13DCF Multivariate time series, estimation of VARMA model
G13DJF Multivariate time series, forecasts and their standard errors
G13DKF Multivariate time series, updates forecasts and their standard errors
G13DLF Multivariate time series, differences and/or transforms (for use before G13DCF)
G13DMF Multivariate time series, sample cross-correlation or cross-covariance matrices
G13DNF Multivariate time series, sample partial lag correlation matrices, χ^2 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
G13EAF Combined measurement and time update, one iteration of Kalman filter, time-varying, square root covariance filter
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 $(\epsilon_{t-1}+\gamma)^2$
G13FBF Univariate time series, forecast function for either a symmetric GARCH process or a GARCH process with asymmetry of the form $(\epsilon_{t-1}+\gamma)^2$
G13FCF Univariate time series, parameter estimation for a GARCH process with asymmetry of the form $(|\epsilon_{t-1}|+\gamma\epsilon_{t-1})^2$
G13FDF Univariate time series, forecast function for a GARCH process with asymmetry of the form $(|\epsilon_{t-1}|+\gamma\epsilon_{t-1})^2$
G13FEF Univariate time series, parameter estimation for an asymmetric Glosten, Jagannathan and Runkle (GJR) GARCH process
G13FFF Univariate time series, forecast function for an asymmetric Glosten, Jagannathan and Runkle (GJR) GARCH process
G13FGF Univariate time series, forecast function for an exponential GARCH (EGARCH) process
G13FHF Univariate time series, forecast function for an exponential GARCH (EGARCH) process

H – Operations Research

H02BBF Integer LP problem (dense)
H02BFF Interpret MPSX data file defining IP or LP problem, optimize and print solution
H02BUF Convert MPSX data file defining IP or LP problem to format required by H02BBF or E04MFF/E04MFA
H02BVF Print IP or LP solutions with user specified names for rows and columns
H02BZF Integer programming solution, supplies further information on solution obtained by H02BBF
H02CBF Integer QP problem (dense)
H02CCF Read optional parameter values for H02CBF from external file
H02CDF Supply optional parameter values to H02CBF
H02CEF Integer LP or QP problem (sparse)
H02CFF Read optional parameter values for H02CEF from external file
H02CGF Supply optional parameter values to H02CEF
H03ABF Transportation problem, modified 'stepping stone' method
H03ADF Shortest path problem, Dijkstra's algorithm

M01 – Sorting

M01CAF Sort a vector, real numbers
M01CBF Sort a vector, integer numbers
M01CCF Sort a vector, character data
M01DAF Rank a vector, real numbers
M01DBF Rank a vector, integer numbers
M01DCF Rank a vector, character data
M01DEF Rank rows of a matrix, real numbers
M01DFF Rank rows of a matrix, integer numbers
M01DJF Rank columns of a matrix, real numbers
M01DKF Rank columns of a matrix, integer numbers
M01DZF Rank arbitrary data
M01EAF Rearrange a vector according to given ranks, real numbers
M01EBF Rearrange a vector according to given ranks, integer numbers
M01ECF Rearrange a vector according to given ranks, character data
M01EDF Rearrange a vector according to given ranks, complex numbers
M01ZAF Invert a permutation
M01ZBF Check validity of a permutation
M01ZCF Decompose a permutation into cycles

P01 – Error Trapping

P01ABF Return value of error indicator/terminate with error message

S – Approximations of Special Functions

S01BAF $\ln(1+x)$
S01EAF Complex exponential, e^z
S07AAF $\tan x$
S09AAF $\arcsin x$
S09ABF $\arccos x$
S10AAF $\tanh x$
S10ABF $\sinh x$
S10ACF $\cosh x$
S11AAF $\text{arctanh} x$
S11ABF $\text{arcsinh} x$
S11ACF $\text{arccosh} x$
S13AAF Exponential integral $E_1(x)$
S13ACF Cosine integral $\text{Ci}(x)$
S13ADF Sine integral $\text{Si}(x)$
S14AAF Gamma function
S14ABF Log Gamma function
S14ACF $\psi(x) - \ln x$
S14ADF Scaled derivatives of $\psi(x)$
S14AEF Polygamma function $\psi^{(n)}(x)$ for real x
S14AFF Polygamma function $\psi^{(n)}(z)$ for complex z
S14BAF Incomplete Gamma functions $P(a,x)$ and $Q(a,x)$
S15ABF Cumulative Normal distribution function $P(x)$
S15ACF Complement of cumulative Normal distribution function $Q(x)$
S15ADF Complement of error function $\text{erfc}(x)$
S15AEF Error function $\text{erf}(x)$
S15AFF Dawson's integral
S15DDF Scaled complex complement of error function, $\exp(-z^2)\text{erfc}(-iz)$
S17ACF Bessel function $Y_0(x)$
S17ADF Bessel function $Y_1(x)$
S17AEF Bessel function $J_0(x)$
S17AFF Bessel function $J_1(x)$
S17AGF Airy function $\text{Ai}(x)$
S17AHF Airy function $\text{Bi}(x)$
S17AJF Airy function $\text{Ai}'(x)$
S17AKF Airy function $\text{Bi}'(x)$
S17ALF Zeros of Bessel functions $J_\alpha(x)$, $J'_\alpha(x)$, $Y_\alpha(x)$ or $Y'_\alpha(x)$
S17DCF Bessel functions $Y_{\nu+a}(z)$, real $a \geq 0$, complex z, $\nu = 0, 1, 2, \ldots$
S17DEF Bessel functions $J_{\nu+a}(z)$, real $a \geq 0$, complex z, $\nu = 0, 1, 2, \ldots$
S17DGF Airy functions $\text{Ai}(z)$ and $\text{Ai}'(z)$, complex z
S17DHF Airy functions $\text{Bi}(z)$ and $\text{Bi}'(z)$, complex z
S17DLF Hankel functions $H^{(j)}_{\nu+a}(z)$, $j = 1, 2$, real $a \geq 0$, complex z, $\nu = 0, 1, 2, \ldots$
S18ACF Modified Bessel function $K_0(x)$
S18ADF Modified Bessel function $K_1(x)$
S18AEF Modified Bessel function $I_0(x)$
S18AFF Modified Bessel function $I_1(x)$
S18CCF Modified Bessel function $e^x K_0(x)$
S18CDF Modified Bessel function $e^x K_1(x)$
S18CEF Modified Bessel function $e^{-|x|} I_0(x)$
S18CFF Modified Bessel function $e^{-|x|} I_1(x)$
S18DCF Modified Bessel functions $K_{\nu+a}(z)$, real $a \geq 0$, complex z, $\nu = 0, 1, 2, \ldots$
S18DEF Modified Bessel functions $I_{\nu+a}(z)$, real $a \geq 0$, complex z, $\nu = 0, 1, 2, \ldots$
S19AAF Kelvin function ber x
S19ABF Kelvin function bei x
S19ACF Kelvin function ker x
S19ADF Kelvin function kei x
S20ACF Fresnel integral $S(x)$

S20ADF Fresnel integral $C(x)$
S21BAF Degenerate symmetrised elliptic integral of 1st kind $R_C(x, y)$
S21BBF Symmetrised elliptic integral of 1st kind $R_F(x, y, z)$
S21BCF Symmetrised elliptic integral of 2nd kind $R_D(x, y, z)$
S21BDF Symmetrised elliptic integral of 3rd kind $R_J(x, y, z, r)$
S21CAF Jacobian elliptic functions sn, cn and dn of real argument
S21CBF Jacobian elliptic functions sn, cn and dn of complex argument
S21CCF Jacobian theta functions $\theta_k(x, q)$ of real argument
S21DAF General elliptic integral of 2nd kind $F(z, k', a, b)$ of complex argument
S22AAF Legendre functions of 1st kind $P_n^m(x)$ or $\overline{P_n^m}(x)$

X01 – Mathematical Constants

X01AAF Provides the mathematical constant π
X01ABF Provides the mathematical constant γ (Euler's Constant)

X02 – Machine Constants

X02AHF The largest permissible argument for sin and cos
X02AJF The machine precision
X02AKF The smallest positive model number
X02ALF The largest positive model number
X02AMF Safe range of real floating-point arithmetic
X02ANF The safe range parameter for complex floating-point arithmetic
X02BBF The largest representable integer
X02BEF The maximum number of decimal digits that can be represented
X02BHF The floating-point model parameter, b
X02BJF The floating-point model parameter, p
X02BKF The floating-point model parameter e_{min}
X02BLF The floating-point model parameter e_{max}
X02DAF Switch for taking precautions to avoid underflow
X02DJF The floating-point model parameter ROUNDS

X03 – Inner Products

X03AAF Real inner product added to initial value, basic/additional precision
X03ABF Complex inner product added to initial value, basic/additional precision

X04 – Input/Output Utilities

X04AAF Returns or sets unit number for error message
X04ABF Returns or sets unit number for advisory message
X04ACF Open unit number for reading, writing or appending, and associate unit with named file
X04ADF Close file associated with given unit number
X04BAF Write formatted record to external file
X04BBF Read formatted record from external file
X04CAF Print real general matrix (easy-to-use)
X04CBF Print real general matrix (comprehensive)
X04CCF Print real packed triangular matrix (easy-to-use)
X04CDF Print real packed triangular matrix (comprehensive)
X04CEF Print real packed banded matrix (easy-to-use)
X04CFF Print real packed banded matrix (comprehensive)
X04DAF Print complex general matrix (easy-to-use)
X04DBF Print complex general matrix (comprehensive)
X04DCF Print complex packed triangular matrix (easy-to-use)
X04DDF Print complex packed triangular matrix (comprehensive)
X04DEF Print complex packed banded matrix (easy-to-use)
X04DFF Print complex packed banded matrix (comprehensive)
X04EAF Print integer matrix (easy-to-use)