Contents of the NAG C Library, Mark 5

Information to help with function selection is available in each Chapter Introduction. The Keywords in Context Index or online search facility may also be used.

Fully Documented Functions

Chapter a00 – Library Identification

`a00aac` nag_implementation_details
Library identification, details of implementation and mark

Chapter c02 – Zeros of Polynomials

`c02afc` nag_zeros_complex_poly
Zeros of a polynomial with complex coefficients
`c02agc` nag_zeros_real_poly
Zeros of a polynomial with real coefficients

Chapter c05 – Roots of One or More Transcendental Equations

`c05adc` nag_zero_cont_func_bd
Zero of a continuous function of one variable
`c05nbc` nag_zero_nonlin_eqns
Solution of a system of nonlinear equations (function values only)
`c05pbc` nag_zero_nonlin_eqns_deriv
Solution of a system of nonlinear equations (using first derivatives)
`c05sdc` nag_zero_cont_func_bd_1
Zero of a continuous function of one variable, thread-safe
`c05tbc` nag_zero_nonlin_eqns_1
Solution of a system of nonlinear equations (function values only), thread-safe
`c05ubc` nag_zero_nonlin_eqns_deriv_1
Solution of a system of nonlinear equations (using first derivatives), thread-safe
`c05zbc` nag_check_deriv
Derivative checker for nag_zero_nonlin_eqns_deriv (c05pbc)
`c05zcc` nag_check_deriv_1
Derivative checker for nag_zero_nonlin_eqns_deriv (c05pbc), thread-safe

Chapter c06 – Fourier Transforms

`c06eac` nag_fft_real
Single 1-D real discrete Fourier transform
`c06ebc` nag_fft_hermitian
Single 1-D Hermitian discrete Fourier transform
`c06ecc` nag_fft_complex
Single 1-D complex discrete Fourier transform
`c06ekc` nag_convolution_real
Circular convolution or correlation of two real vectors
`c06fpc` nag_fft_multiple_real
Multiple 1-D real discrete Fourier transforms
`c06fqc` nag_fft_multiple_hermitian
Multiple 1-D Hermitian discrete Fourier transforms
`c06frc` nag_fft_multiple_complex
Multiple 1-D complex discrete Fourier transforms
`c06fuc` nag_fft_2d_complex
2-D complex discrete Fourier transform
`c06gbc` nag_conjugate_hermitian
Complex conjugate of Hermitian sequence
`c06gcc` nag_conjugate_complex
Complex conjugate of complex sequence
`c06gqc` nag_multiple_conjugate_hermitian
Complex conjugate of multiple Hermitian sequences

`c06gsc` nag_multiple_hermitian_to_complex
Convert Hermitian sequences to general complex sequences
`c06gzc` nag_fft_init_trig
Initialisation function for other c6 functions
`c06hac` nag_fft_multiple_sine
Discrete sine transform
`c06hbc` nag_fft_multiple_cosine
Discrete cosine transform
`c06hcc` nag_fft_multiple_qtr_sine
Discrete quarter-wave sine transform
`c06hdc` nag_fft_multiple_qtr_cosine
Discrete quarter-wave cosine transform

Chapter d01 – Quadrature

`d01ajc` nag_1d_quad_gen
1-D adaptive quadrature, allowing for badly-behaved integrands
`d01akc` nag_1d_quad_osc
1-D adaptive quadrature, suitable for oscillating functions
`d01alc` nag_1d_quad_brkpts
1-D adaptive quadrature, allowing for singularities at specified points
`d01amc` nag_1d_quad_inf
1-D adaptive quadrature over infinite or semi-infinite interval
`d01anc` nag_1d_quad_wt_trig
1-D adaptive quadrature, finite interval, sine or cosine weight functions
`d01apc` nag_1d_quad_wt_alglog
1-D adaptive quadrature, weight function with end-point singularities of algebraic-logarithmic type
`d01aqc` nag_1d_quad_wt_cauchy
1-D adaptive quadrature, weight function $1/(x-c)$, Cauchy principal value
`d01asc` nag_1d_quad_inf_wt_trig
1-D adaptive quadrature, semi-infinite interval, sine or cosine weight function
`d01bac` nag_1d_quad_gauss
1-D Gaussian quadrature rule evaluation
`d01fcc` nag_multid_quad_adapt
Multi-dimensional adaptive quadrature
`d01gac` nag_1d_quad_vals
1-D integration of a function defined by data values only
`d01gbc` nag_multid_quad_monte_carlo
Multi-dimensional quadrature, using Monte Carlo method
`d01sjc` nag_1d_quad_gen_1
1-D adaptive quadrature, allowing for badly-behaved integrands, thread-safe
`d01skc` nag_1d_quad_osc_1
1-D adaptive quadrature, suitable for oscillating functions, thread-safe
`d01slc` nag_1d_quad_brkpts_1
1-D adaptive quadrature, allowing for singularities at specified points, thread-safe
`d01smc` nag_1d_quad_inf_1
1-D adaptive quadrature over infinite or semi-infinite interval, thread-safe
`d01snc` nag_1d_quad_wt_trig_1
1-D adaptive quadrature, finite interval, sine or cosine weight functions, thread-safe
`d01spc` nag_1d_quad_wt_alglog_1
1-D adaptive quadrature, weight function with end-point singularities of algebraic-logarithmic type, thread-safe
`d01sqc` nag_1d_quad_wt_cauchy_1
1-D adaptive quadrature, weight function $1/(x-c)$, Cauchy principal value, thread-safe
`d01ssc` nag_1d_quad_inf_wt_trig_1
1-D adaptive quadrature, semi-infinite interval, sine or cosine weight function, thread-safe
`d01tac` nag_1d_quad_gauss_1
1-D Gaussian quadrature rule evaluation, thread-safe

`d01wcc` nag_multid_quad_adapt_1
Multi-dimensional adaptive quadrature, thread-safe
`d01xbc` nag_multid_quad_monte_carlo_1
Multi-dimensional quadrature, using Monte Carlo method, thread-safe

Chapter d02 – Ordinary Differential Equations

`d02cjc` nag_ode_ivp_adams_gen
Ordinary differential equation solver using a variable-order variable-step Adams method (black box)
`d02ejc` nag_ode_ivp_bdf_gen
Ordinary differential equations solver, stiff, initial value problems using the Backward Differentiation Formulae
`d02gac` nag_ode_bvp_fd_nonlin_fixedbc
Ordinary differential equations solver, for simple nonlinear 2-point boundary value problems, using a finite difference technique with deferred correction
`d02gbc` nag_ode_bvp_fd_lin_gen
Ordinary differential equations solver, for general linear two-point boundary value problems, using a finite difference technique with deferred correction
`d02pcc` nag_ode_ivp_rk_range
Ordinary differential equations solver, initial value problems over a range using Runge–Kutta methods
`d02pdc` nag_ode_ivp_rk_onestep
Ordinary differential equations solver, initial value problems, one time step using Runge–Kutta methods
`d02ppc` nag_ode_ivp_rk_free
Freeing function for use with the Runge–Kutta suite (d02p functions)
`d02pvc` nag_ode_ivp_rk_setup
Set-up function for use with nag_ode_ivp_rk_range (d02pcc) and/or nag_ode_ivp_rk_onestep (d02pdc)
`d02pwc` nag_ode_ivp_rk_reset_tend
A function to re-set the end point following a call to nag_ode_ivp_rk_onestep (d02pdc)
`d02pxc` nag_ode_ivp_rk_interp
Ordinary differential equations solver, computes the solution by interpolation anywhere on an integration step taken by nag_ode_ivp_rk_onestep (d02pdc)
`d02pzc` nag_ode_ivp_rk_errass
A function to provide global error assessment during an integration with either nag_ode_ivp_rk_range (d02pcc) or nag_ode_ivp_rk_onestep (d02pdc)
`d02qfc` nag_ode_ivp_adams_roots
Ordinary differential equation solver using Adams method (sophisticated use)
`d02qwc` nag_ode_ivp_adams_setup
Set-up function for nag_ode_ivp_adams_roots (d02qfc)
`d02qyc` nag_ode_ivp_adams_free
Freeing function for use with nag_ode_ivp_adams_roots (d02qfc)
`d02qzc` nag_ode_ivp_adams_interp
Interpolation function for use with nag_ode_ivp_adams_roots (d02qfc)
`d02rac` nag_ode_bvp_fd_nonlin_gen
Ordinary differential equations solver, for general non-linear two-point boundary value problems, using a finite difference technique with deferred correction

Chapter e01 – Interpolation

`e01bac` nag_1d_spline_interpolant
Interpolating function, cubic spline interpolant, one variable
`e01bec` nag_monotonic_interpolant
Interpolating function, monotonicity-preserving, piecewise cubic Hermite, one variable
`e01bfc` nag_monotonic_evaluate
Evaluation of interpolant computed by nag_monotonic_interpolant (e01bec), function only
`e01bgc` nag_monotonic_deriv
Evaluation of interpolant computed by nag_monotonic_interpolant (e01bec), function and first derivative

`e01bhc` nag_monotonic_intg
Evaluation of interpolant computed by nag_monotonic_interpolant (e01bec), definite integral
`e01dac` nag_2d_spline_interpolant
Interpolating function, bicubic spline interpolant, two variables
`e01sac` nag_2d_scat_interpolant
A function to generate a two-dimensional surface interpolating a set of data points, using either the method of Renka and Cline or using the modified Shepard's method
`e01sbc` nag_2d_scat_eval
A function to evaluate at a set of points, the two-dimensional interpolant function generated by nag_2d_scat_interpolant (e01sac)
`e01szc` nag_2d_scat_free
Freeing function for use with nag_2d_scat_eval (e01sbc)

Chapter e02 – Curve and Surface Fitting

`e02adc` nag_1d_cheb_fit
Computes the coefficients of a Chebyshev series polynomial for arbitrary data
`e02aec` nag_1d_cheb_eval
Evaluates the coefficients of a Chebyshev series polynomial
`e02afc` nag_1d_cheb_interp_fit
Computes the coefficients of a Chebyshev series polynomial for interpolated data
`e02bac` nag_1d_spline_fit_knots
Least-squares curve cubic spline fit (including interpolation), one variable
`e02bbc` nag_1d_spline_evaluate
Evaluation of fitted cubic spline, function only
`e02bcc` nag_1d_spline_deriv
Evaluation of fitted cubic spline, function and derivatives
`e02bdc` nag_1d_spline_intg
Evaluation of fitted cubic spline, definite integral
`e02bec` nag_1d_spline_fit
Least-squares cubic spline curve fit, automatic knot placement, one variable
`e02dcc` nag_2d_spline_fit_grid
Least-squares bicubic spline fit with automatic knot placement, two variables (rectangular grid)
`e02ddc` nag_2d_spline_fit_scat
Least-squares bicubic spline fit with automatic knot placement, two variables (scattered data)
`e02dec` nag_2d_spline_eval
Evaluation of bicubic spline, at a set of points
`e02dfc` nag_2d_spline_eval_rect
Evaluation of bicubic spline, at a mesh of points

Chapter e04 – Minimizing or Maximizing a Function

`e04abc` nag_opt_one_var_no_deriv
Minimizes a function of one variable, using function values only
`e04bbc` nag_opt_one_var_deriv
Minimizes a function of one variable, requires first derivatives
`e04ccc` nag_opt_simplex
Unconstrained minimization using simplex algorithm
`e04dgc` nag_opt_conj_grad
Unconstrained minimization using conjugate gradients
`e04fcc` nag_opt_lsq_no_deriv
Unconstrained nonlinear least squares (no derivatives required)
`e04gbc` nag_opt_lsq_deriv
Unconstrained nonlinear least squares (first derivatives required)
`e04hcc` nag_opt_check_deriv
Derivative checker for use with nag_opt_bounds_deriv (e04kbc)
`e04hdc` nag_opt_check_2nd_deriv
Checks 2nd derivatives of a user-defined function.
`e04jbc` nag_opt_bounds_no_deriv
Bound constrained nonlinear minimization (no derivatives required)

`e04kbc` nag_opt_bounds_deriv
Bound constrained nonlinear minimization (first derivatives required)
`e04lbc` nag_opt_bounds_2nd_deriv
Solves bound constrained problems. 1st and 2nd derivatives are required.
`e04mfc` nag_opt_lp
Linear programming
`e04myc` nag_opt_sparse_mps_free
Free memory allocated by nag_opt_sparse_mps_read (e04mzc)
`e04mzc` nag_opt_sparse_mps_read
Read MPSX data for sparse LP or QP problem from a file
`e04ncc` nag_opt_lin_lsq
Solves linear least-squares and convex quadratic programming problems (non-sparse)
`e04nfc` nag_opt_qp
Quadratic programming
`e04nkc` nag_opt_sparse_convex_qp
Solves sparse linear programming or convex quadratic programming problems
`e04ucc` nag_opt_nlp
Minimization with nonlinear constraints using a sequential QP method
`e04unc` nag_opt_nlin_lsq
Solves nonlinear least-squares problems using the sequential QP method
`e04xac` nag_opt_estimate_deriv
Computes an approximation to the gradient vector and/or the Hessian matrix for use with nag_opt_nlp (e04ucc) and other nonlinear optimization functions
`e04xxc` nag_opt_init
Initialisation function for option setting
`e04xyc` nag_opt_read
Read options from a textfile
`e04xzc` nag_opt_free
NAG memory freeing function for use with option setting
`e04yac` nag_opt_lsq_check_deriv
Least-squares derivative checker for use with nag_opt_lsq_deriv (e04gbc)
`e04ycc` nag_opt_lsq_covariance
Covariance matrix for nonlinear least-squares

Chapter f – Linear Algebra

`f01bnc` nag_complex_cholesky
UU^H factorization of complex Hermitian positive-definite matrix
`f01mcc` nag_real_cholesky_skyline
LDL^T factorization of real symmetric positive-definite variable-bandwidth (skyline) matrix
`f01qcc` nag_real_qr
QR factorization of real m by n matrix ($m \geq n$)
`f01qdc` nag_real_apply_q
Compute QB or Q^TB after factorization by nag_real_qr (f01qcc)
`f01qec` nag_real_form_q
Form columns of Q after factorization by nag_real_qr (f01qcc)
`f01rcc` nag_complex_qr
QR factorization of complex m by n matrix ($m \geq n$)
`f01rdc` nag_complex_apply_q
Compute QB or Q^HB after factorization by nag_complex_qr (f01rcc)
`f01rec` nag_complex_form_q
Form columns of Q after factorization by nag_complex_qr (f01rcc)
`f02aac` nag_real_symm_eigenvalues
All eigenvalues of real symmetric matrix
`f02abc` nag_real_symm_eigensystem
All eigenvalues and eigenvectors of real symmetric matrix
`f02adc` nag_real_symm_general_eigenvalues
All eigenvalues of generalized real symmetric-definite eigenproblem

`f02aec` nag_real_symm_general_eigensystem
All eigenvalues and eigenvectors of generalized real symmetric-definite eigenproblem
`f02afc` nag_real_eigenvalues
All eigenvalues of real matrix
`f02agc` nag_real_eigensystem
All eigenvalues and eigenvectors of real matrix
`f02awc` nag_hermitian_eigenvalues
All eigenvalues of complex Hermitian matrix
`f02axc` nag_hermitian_eigensystem
All eigenvalues and eigenvectors of complex Hermitian matrix
`f02bjc` nag_real_general_eigensystem
All eigenvalues and optionally eigenvectors of real generalized eigenproblem, by QZ algorithm
`f02ecc` nag_real_eigensystem_sel
Computes selected eigenvalues and eigenvectors of a real general matrix
`f02gcc` nag_complex_eigensystem_sel
Computes selected eigenvalues and eigenvectors of a complex general matrix
`f02wec` nag_real_svd
SVD of real matrix
`f02xec` nag_complex_svd
SVD of complex matrix
`f03aec` nag_real_cholesky
LL^T factorization and determinant of real symmetric positive-definite matrix
`f03afc` nag_real_lu
LU factorization and determinant of real matrix
`f03ahc` nag_complex_lu
LU factorization and determinant of complex matrix
`f04adc` nag_complex_lin_eqn_mult_rhs
Approximate solution of complex simultaneous linear equations with multiple right-hand sides
`f04agc` nag_real_cholesky_solve_mult_rhs
Approximate solution of real symmetric positive-definite simultaneous linear equations (coefficient matrix already factorized by nag_real_cholesky (f03aec))
`f04ajc` nag_real_lu_solve_mult_rhs
Approximate solution of real simultaneous linear equations (coefficient matrix already factorized by nag_real_lu (f03afc))
`f04akc` nag_complex_lu_solve_mult_rhs
Approximate solution of complex simultaneous linear equations (coefficient matrix already factorized by nag_complex_lu (f03ahc))
`f04arc` nag_real_lin_eqn
Approximate solution of real simultaneous linear equations, one right-hand side
`f04awc` nag_hermitian_lin_eqn_mult_rhs
Approximate solution of complex Hermitian positive-definite simultaneous linear equations (coefficient matrix already factorized by nag_complex_cholesky (f01bnc))
`f04mcc` nag_real_cholesky_skyline_solve
Approximate solution of real symmetric positive-definite variable-bandwidth simultaneous linear equations (coefficient matrix already factorized by nag_real_cholesky_skyline (f01mcc))

Chapter f11 – Sparse Linear Algebra

`f11dac` nag_sparse_nsym_fac
Incomplete LU factorization (nonsymmetric)
`f11dcc` nag_sparse_nsym_fac_sol
Solver with incomplete LU preconditioning (nonsymmetric)
`f11dec` nag_sparse_nsym_sol
Solver with no/Jacobi/SSOR/preconditioning (nonsymmetric)
`f11jac` nag_sparse_sym_chol_fac
Incomplete Cholesky facroization (symmetric)
`f11jcc` nag_sparse_sym_chol_sol
Solver with incomplete Cholesky preconditioning (symmetric)

`f11jec` nag_sparse_sym_sol
Solver with Jacobi, SSOR, or no preconditioning (symmetric)
`f11zac` nag_sparse_nsym_sort
Sparse sort (nonsymmetric)
`f11zbc` nag_sparse_sym_sort
Sparse sort (symmetric)

Chapter g01 – Simple Calculations on Statistical Data

`g01aac` nag_summary_stats_1var
Mean, variance, skewness, kurtosis etc, one variable, from raw data
`g01alc` nag_5pt_summary_stats
five-point summary (median, hinges and extremes)
`g01bjc` nag_binomial_dist
Binomial distribution function
`g01bkc` nag_poisson_dist
Poisson distribution function
`g01blc` nag_hypergeom_dist
Hypergeometric distribution function
`g01cec` nag_deviates_normal_dist
Deviate of Normal distribution function
`g01ddc` nag_shapiro_wilk_test
Shapiro and Wilk's W test for Normality
`g01dhc` nag_ranks_and_scores
Ranks, Normal scores, approximate Normal scores or exponential (Savage) scores
`g01eac` nag_prob_normal
Probabilities for the standard Normal distribution
`g01ebc` nag_prob_students_t
Probabilities for Student's t-distribution
`g01ecc` nag_prob_chi_sq
Probabilities for χ^2 distribution
`g01edc` nag_prob_f_dist
Probabilities for F-distribution
`g01eec` nag_prob_beta_dist
Upper and lower tail probabilities and probability density function for the beta distribution
`g01efc` nag_gamma_dist
Probabilities for the gamma distribution
`g01fac` nag_deviates_normal
Deviates for the Normal distribution
`g01fbc` nag_deviates_students_t
Deviates for Student's t-distribution
`g01fcc` nag_deviates_chi_sq
Deviates for the χ^2 distribution
`g01fdc` nag_deviates_f_dist
Deviates for the F-distribution
`g01fec` nag_deviates_beta
Deviates for the beta distribution
`g01ffc` nag_deviates_gamma_dist
Deviates for the gamma distribution
`g01hac` nag_bivariate_normal_dist
Probability for the bivariate Normal distribution

Chapter g02 – Regression Analysis

`g02brc` nag_ken_spe_corr_coeff
Kendall and/or Spearman non-parametric rank correlation coefficients, allows variables and observations to be selectively disregarded
`g02bxc` nag_corr_cov
Product-moment correlation, unweighted/weighted correlation and covariance matrix, allows variables to be disregarded

`g02cac` nag_simple_linear_regression
Simple linear regression with or without a constant term, data may be weighted
`g02cbc` nag_regress_confid_interval
Simple linear regression confidence intervals for the regression line and individual points
`g02dac` nag_regsn_mult_linear
Fits a general (multiple) linear regression model
`g02dcc` nag_regsn_mult_linear_addrem_obs
Add/delete an observation to/from a general linear regression model
`g02ddc` nag_regsn_mult_linear_upd_model
Estimates of regression parameters from an updated model
`g02dec` nag_regsn_mult_linear_add_var
Add a new independent variable to a general linear regression model
`g02dfc` nag_regsn_mult_linear_delete_var
Delete an independent variable from a general linear regression model
`g02dgc` nag_regsn_mult_linear_newyvar
Fits a general linear regression model to new dependent variable
`g02dkc` nag_regsn_mult_linear_tran_model
Estimates of parameters of a general linear regression model for given constraints
`g02dnc` nag_regsn_mult_linear_est_func
Estimate of an estimable function for a general linear regression model
`g02fac` nag_regsn_std_resid_influence
Calculate standardized residuals and influence statistics
`g02gac` nag_glm_normal
Fits a Generalised linear model with Normal errors
`g02gbc` nag_glm_binomial
Fits a generalised linear model with binomial errors
`g02gcc` nag_glm_poisson
Fits a generalised linear model with Poisson errors
`g02gdc` nag_glm_gamma
Fits a generalised linear model with gamma errors
`g02gkc` nag_glm_tran_model
Estimates and standard errors of the parameters of a general linear model for given constraints
`g02gnc` nag_glm_est_func
Estimatable function and the standard error of a generalized linear model
`g02hac` nag_robust_m_regsn_estim
Robust regression, standard M-estimates
`g02hkc` nag_robust_corr_estim
Robust estimation of a correlation matrix, Huber's weight function

Chapter g03 – Multivariate Methods

`g03aac` nag_mv_prin_comp
Principal component analysis
`g03acc` nag_mv_canon_var
Canonical variate analysis
`g03adc` nag_mv_canon_corr
Canonical correlation analysis
`g03bac` nag_mv_orthomax
Orthogonal rotations for loading matrix
`g03bcc` nag_mv_procustes
Procrustes rotations
`g03cac` nag_mv_factor
Maximum likelihood estimates of parameters
`g03ccc` nag_mv_fac_score
Factor score coefficients, following nag_mv_factor (g03cac)
`g03dac` nag_mv_discrim
Test for equality of wthin-group covariance matrices
`g03dbc` nag_mv_discrim_mahaldist
Mahalanobis squared distances, following nag_mv_discrim (g03dac)

`g03dcc` nag_mv_discrim_group
Allocation of observations to groups, following nag_mv_discrim (g03dac)
`g03eac` nag_mv_distance_mat
Compute distance (dissimilarity) matrix
`g03ecc` nag_mv_hierar_cluster_analysis
Performs hierarchical cluster analysis
`g03efc` nag_mv_kmeans_cluster_analysis
K-means
`g03ehc` nag_mv_dendrogram
Construct dendogram following nag_mv_hierar_cluster_analysis (g03ecc)
`g03ejc` nag_mv_cluster_indicator
Construct clusters following nag_mv_hierar_cluster_analysis (g03ecc)
`g03fac` nag_mv_prin_coord_analysis
Principal co-ordinate analysis
`g03fcc` nag_mv_ordinal_multidimscale
Multidimensional scaling
`g03xzc` nag_mv_dend_free
Frees memory allocated to the dendrogram array in nag_mv_dendrogram (g03ehc)
`g03zac` nag_mv_z_scores
Standardize values of a data matrix

Chapter g04 – Analysis of Variance

`g04bbc` nag_anova_random
General block design or completely randomized design
`g04cac` nag_anova_factorial
Complete factorial design
`g04czc` nag_anova_factorial_free
Complete factorial design

Chapter g05 – Random Number Generators

`g05cac` nag_random_continuous_uniform
Pseudo-random real number, uniform distribution over (0,1)
`g05cbc` nag_random_init_repeatable
Initialise random number generating functions to give repeatable sequence
`g05ccc` nag_random_init_nonrepeatable
Initialise random number generating functions to give non-repeatable sequence
`g05cfc` nag_save_random_state
Save state of random number generating functions
`g05cgc` nag_restore_random_state
Restore state of random number generating functions
`g05dac` nag_random_continuous_uniform_ab
Pseudo-random real number, uniform distribution over (a, b)
`g05dbc` nag_random_exp
Pseudo-random real number, (negative) exponential distribution
`g05ddc` nag_random_normal
Pseudo-random real number, Normal distribution
`g05dyc` nag_random_discrete_uniform
Pseudo-random integer from uniform distribution
`g05eac` nag_ref_vec_multi_normal
Set up reference vector for multivariate Normal distribution
`g05ecc` nag_ref_vec_poisson
Set up reference vector for generating pseudo-random integers, Poisson distribution
`g05edc` nag_ref_vec_binomial
Set up reference vector for generating pseudo-random integers, binomial distribution
`g05ehc` nag_ran_permut_vec
Pseudo-random permutation of a vector of integers
`g05ejc` nag_ran_sample_vec
Pseudo-random sample without replacement from an integer vector

`g05exc` nag_ref_vec_discrete_pdf_cdf
Set up reference vector from supplied cumulative distribution function or probability distribution function
`g05eyc` nag_return_discrete
Pseudo-random integer from reference vector
`g05ezc` nag_return_multi_normal
Pseudo-random multivariate Normal vector from reference vector
`g05fec` nag_random_beta
Pseudo-random real numbers from the beta distribution
`g05ffc` nag_random_gamma
Pseudo-random real numbers from the gamma distribution
`g05hac` nag_arma_time_series
ARMA time series of n terms

Chapter g07 – Univariate Estimation

`g07cac` nag_2_sample_t_test
t-test statistic, for a difference in means between two Normal populations, confidence interval
`g07dac` nag_median_1var
Robust estimation, median, median absolute deviation, robust standard deviation
`g07dbc` nag_robust_m_estim_1var
Robust estimation, M-estimate of location and scale parameters, standard weight function
`g07ddc` nag_robust_trimmed_1var
Trimmed and winsorized mean of a sample with estimates of the variances of the two means

Chapter g10 – Smoothing in Statistics

`g10cac` nag_running_median_smoother
Smoothed data sequence using running median smoother

Chapter g11 – Contingency Table Analysis

`g11aac` nag_chi_sq_2_way_table
χ^2 statistic for two-way contingency table

Chapter g12 – Survival Analysis

`g12aac` nag_prod_limit_surviv_fn
Kaplan-Meier (product-limit) estimates of survival probabilities

Chapter g13 – Time Series Analysis

`g13abc` nag_tsa_auto_corr
Sample autocorrelation function
`g13acc` nag_tsa_auto_corr_part
Partial autocorrelation function
`g13bec` nag_tsa_multi_inp_model_estim
Estimation for time series models
`g13bjc` nag_tsa_multi_inp_model_forecast
Forecasting function
`g13bxc` nag_tsa_options_init
Initialisation function for option setting
`g13byc` nag_tsa_transf_orders
Function to allocate memory to transfer function model orders
`g13bzc` nag_tsa_trans_free
Freeing function for the structure holding the transfer function model orders
`g13cbc` nag_tsa_spectrum_univar
Univariate time series, smoothed sample spectrum using spectral smoothing by the trapezium frequency (Daniell) window
`g13cdc` nag_tsa_spectrum_bivar
Multivariate time series, smoothed sample cross spectrum using spectral smoothing by the trapezium frequency (Daniell) window

`g13cec` nag_tsa_cross_spectrum_bivar
Multivariate time series, cross amplitude spectrum, squared coherency, bounds, univariate and bivariate (cross) spectra
`g13cfc` nag_tsa_gain_phase_bivar
Multivariate time series, gain, phase, bounds, univariate and bivariate (cross) spectra
`g13cgc` nag_tsa_noise_spectrum_bivar
Multivariate time series, noise spectrum, bounds, impulse response function and its standard error
`g13eac` nag_kalman_sqrt_filt_cov_var
One iteration step of the time-varying Kalman filter recursion using the square root covariance implementation
`g13ebc` nag_kalman_sqrt_filt_cov_invar
One iteration step of the time-invariant Kalman filter recursion using the square root covariance implementation with (A, C) in lower observer Hessenberg form
`g13ecc` nag_kalman_sqrt_filt_info_var
One iteration step of the time-varying Kalman filter recursion using the square root information implementation
`g13edc` nag_kalman_sqrt_filt_info_invar
One iteration step of the time-invariant Kalman filter recursion using the square root information implementation with $(A^{-1}, A^{-1}B)$ in upper controller Hessenberg form
`g13ewc` nag_trans_hessenberg_observer
Unitary state-space transformation to reduce (A, C) to lower or upper observer Hessenberg form
`g13exc` nag_trans_hessenberg_controller
Unitary state-space transformation to reduce (B, A) to lower or upper controller Hessenberg form
`g13xzc` nag_tsa_free
Freeing function for use with g13 option setting

Chapter h – Operations Research

`h02bbc` nag_ip_bb
Solves integer programming problems using a branch and bound method
`h02buc` nag_ip_mps_read
Read MPSX data for IP, LP or QP problem from a file
`h02bvc` nag_ip_mps_free
Free memory allocated by nag_ip_mps_read (h02buc)
`h02xxc` nag_ip_init
Initialize option structure to null values
`h02xyc` nag_ip_read
Read optional parameter values from a file
`h02xzc` nag_ip_free
Free NAG allocated memory from option structures
`h03abc` nag_transport
Classical transportation algorithm

Chapter m01 – Sorting

`m01cac` nag_double_sort
Quicksort of set of values of data type double
`m01csc` nag_quicksort
Quicksort of set of values of arbitrary data type
`m01ctc` nag_stable_sort
Stable sort of set of values of arbitrary data type
`m01cuc` nag_chain_sort
Chain sort of linked list
`m01dsc` nag_rank_sort
Rank sort of set of values of arbitrary data type
`m01esc` nag_reorder_vector
Reorders set of values of arbitrary data type into the order specified by a set of indices
`m01fsc` nag_search_vector
Searches a vector for either the first or last match to a given value

`m01zac` nag_make_indices
Inverts a permutation converting a rank vector to an index vector or vice versa

Chapter s – Approximations of Special Functions

`s10aac` nag_tanh
Hyperbolic tangent, tanh x
`s10abc` nag_sinh
Hyperbolic sine, sinh x
`s10acc` nag_cosh
Hyperbolic cosine, cosh x
`s11aac` nag_arctanh
Inverse hyperbolic tangent, arctanh x
`s11abc` nag_arcsinh
Inverse hyperbolic sine, arcsinh x
`s11acc` nag_arccosh
Inverse hyperbolic cosine, arccosh x
`s13aac` nag_exp_integral
Exponential integral $E_1(x)$
`s13acc` nag_cos_integral
Cosine integral $\mathrm{Ci}(x)$
`s13adc` nag_sin_integral
Sine integral $\mathrm{Si}(x)$
`s14aac` nag_gamma
Gamma function $\Gamma(x)$
`s14abc` nag_log_gamma
Log Gamma function $\ln(\Gamma(x))$
`s14bac` nag_incomplete_gamma
Incomplete gamma functions $P(a,x)$ and $Q(a,x)$
`s15abc` nag_cumul_normal
Cumulative normal distribution function, $P(x)$
`s15acc` nag_cumul_normal_complem
Complement of cumulative normal distribution function, $Q(x)$
`s15adc` nag_erfc
Complement of error function, erfc x
`s15aec` nag_erf
Error function, erf x
`s17acc` nag_bessel_y0
Bessel function $Y_0(x)$
`s17adc` nag_bessel_y1
Bessel function $Y_1(x)$
`s17aec` nag_bessel_j0
Bessel function $J_0(x)$
`s17afc` nag_bessel_j1
Bessel function $J_1(x)$
`s17agc` nag_airy_ai
Airy function $\mathrm{Ai}(x)$
`s17ahc` nag_airy_bi
Airy function $\mathrm{Bi}(x)$
`s17ajc` nag_airy_ai_deriv
Airy function $\mathrm{Ai}'(x)$
`s17akc` nag_airy_bi_deriv
Airy function $\mathrm{Bi}'(x)$
`s18acc` nag_bessel_k0
Modified Bessel function $K_0(x)$
`s18adc` nag_bessel_k1
Modified Bessel function $K_1(x)$
`s18aec` nag_bessel_i0
Modified Bessel function $I_0(x)$

`s18afc` nag_bessel_i1
Modified Bessel function $I_1(x)$
`s18ccc` nag_bessel_k0_scaled
Scaled modified Bessel function $e^x K_0(x)$
`s18cdc` nag_bessel_k1_scaled
Scaled modified Bessel function $e^x K_1(x)$
`s18cec` nag_bessel_i0_scaled
Scaled modified Bessel function $e^{-|x|} I_0(x)$
`s18cfc` nag_bessel_i1_scaled
Scaled modified Bessel function $e^{-|x|} I_1(x)$
`s19aac` nag_kelvin_ber
Kelvin function ber x
`s19abc` nag_kelvin_bei
Kelvin function bei x
`s19acc` nag_kelvin_ker
Kelvin function ker x
`s19adc` nag_kelvin_kei
Kelvin function kei x
`s20acc` nag_fresnel_s
Fresnel integral $S(x)$
`s20adc` nag_fresnel_c
Fresnel integral $C(x)$
`s21bac` nag_elliptic_integral_rc
Degenerate symmetrised elliptic integral of 1st kind $R_C(x, y)$
`s21bbc` nag_elliptic_integral_rf
Symmetrised elliptic integral of 1st kind $R_F(x, y, z)$
`s21bcc` nag_elliptic_integral_rd
Symmetrised elliptic integral of 2nd kind $R_D(x, y, z)$
`s21bdc` nag_elliptic_integral_rj
Symmetrised elliptic integral of 3rd kind $R_J(x, y, z, r)$

Fundamental Support Functions

Chapter a02 – Complex Arithmetic

`a02bac` nag_complex
Complex number from real and imaginary parts
`a02bbc` nag_complex_real
Real part of a complex number
`a02bcc` nag_complex_imag
Imaginary part of a complex number
`a02cac` nag_complex_add
Addition of two complex numbers
`a02cbc` nag_complex_subtract
Subtraction of two complex numbers
`a02ccc` nag_complex_multiply
Multiplication of two complex numbers
`a02cdc` nag_complex_divide
Quotient of two complex numbers
`a02cec` nag_complex_negate
Negation of a complex number
`a02cfc` nag_complex_conjg
Conjugate of a complex number
`a02cgc` nag_complex_equal
Equality of two complex numbers
`a02chc` nag_complex_not_equal
Inequality of two complex numbers
`a02dac` nag_complex_arg
Argument of a complex number

`a02dbc` nag_complex_abs
Modulus of a complex number
`a02dcc` nag_complex_sqrt
Square root of a complex number
`a02ddc` nag_complex_i_power
Complex number raised to integer power
`a02dec` nag_complex_r_power
Complex number raised to real power
`a02dfc` nag_complex_c_power
Complex number raised to complex power
`a02dgc` nag_complex_log
Complex logarithm
`a02dhc` nag_complex_exp
Complex exponential
`a02djc` nag_complex_sin
Complex sine
`a02dkc` nag_complex_cos
Complex cosine
`a02dlc` nag_complex_tan
Complex tangent

Chapter f06 – Linear Algebra Support Functions

`f06pac` dgemv
Matrix-vector product, real rectangular matrix
`f06pbc` dgbmv
Matrix-vector product, real rectangular band matrix
`f06pcc` dsymv
Matrix-vector product, real symmetric matrix
`f06pdc` dsbmv
Matrix-vector product, real symmetric band matrix
`f06pec` dspmv
Matrix-vector product, real symmetric packed matrix
`f06pfc` dtrmv
Matrix-vector product, real triangular matrix
`f06pgc` dtbmv
Matrix-vector product, real triangular band matrix
`f06phc` dtpmv
Matrix-vector product, real triangular packed matrix
`f06pjc` dtrsv
System of equations, real triangular matrix
`f06pkc` dtbsv
System of equations, real triangular band matrix
`f06plc` dtpsv
System of equations, real triangular packed matrix
`f06pmc` dger
Rank-1 update, real rectangular matrix
`f06ppc` dsyr
Rank-1 update, real symmetric matrix
`f06pqc` dspr
Rank-1 update, real symmetric packed matrix
`f06prc` dsyr2
Rank-2 update, real symmetric matrix
`f06psc` dspr2
Rank-2 update, real symmetric packed matrix
`f06sac` zgemv
Matrix-vector product, complex rectangular matrix
`f06sbc` zgbmv
Matrix-vector product, complex rectangular band matrix

`f06scc` zhemv
Matrix-vector product, complex Hermitian matrix
`f06sdc` zhbmv
Matrix-vector product, complex Hermitian band matrix
`f06sec` zhpmv
Matrix-vector product, complex Hermitian packed matrix
`f06sfc` ztrmv
Matrix-vector product, complex triangular matrix
`f06sgc` ztbmv
Matrix-vector product, complex triangular band matrix
`f06shc` ztpmv
Matrix-vector product, complex triangular packed matrix
`f06sjc` ztrsv
System of equations, complex triangular matrix
`f06skc` ztbsv
System of equations, complex triangular band matrix
`f06slc` ztpsv
System of equations, complex triangular packed matrix
`f06smc` zgeru
Rank-1 update, complex rectangular matrix, unconjugated vector
`f06snc` zgerc
Rank-1 update, complex rectangular matrix, conjugated vector
`f06spc` zher
Rank-1 update, complex Hermitian matrix
`f06sqc` zhpr
Rank-1 update, complex Hermitian packed matrix
`f06src` zher2
Rank-2 update, complex Hermitian matrix
`f06ssc` zhpr2
Rank-2 update, complex Hermitian packed matrix
`f06yac` dgemm
Matrix-matrix product, two real rectangular matrices
`f06ycc` dsymm
Matrix-matrix product, one real symmetric matrix, one real rectangular matrix
`f06yfc` dtrmm
Matrix-matrix product, one real triangular matrix, one real rectangular matrix
`f06yjc` dtrsm
Solves a system of equations with multiple right-hand sides, real triangular coefficient matrix
`f06ypc` dsyrk
Rank-k update of a real symmetric matrix
`f06yrc` dsyr2k
Rank-2k update of a real symmetric matrix
`f06zac` zgemm
Matrix-matrix product, two complex rectangular matrices
`f06zcc` zhemm
Matrix-matrix product, one complex Hermitian matrix, one complex rectangular matrix
`f06zfc` ztrmm
Matrix-matrix product, one complex triangular matrix, one complex rectangular matrix
`f06zjc` ztrsm
Solves system of equations with multiple right-hand sides, complex triangular coefficient matrix
`f06zpc` zherk
Rank-k update of a complex Hermitian matrix
`f06zrc` zher2k
Rank-2k update of a complex Hermitian matrix
`f06ztc` zsymm
Matrix-matrix product, one complex symmetric matrix, one complex rectangular matrix
`f06zuc` zsyrk
Rank-k update of a complex symmetric matrix

`f06zwc` zsyr2k
Rank-2k update of a complex symmetric matrix

Chapter x01 – Mathematical Constants

`X01AAC` nag_pi
π
`X01ABC` nag_euler_constant
Euler's constant, γ

Chapter x02 – Machine Constants

`X02AHC` nag_max_sine_argument
Largest permissible argument for `sin` and `cos` functions
`X02AJC` nag_machine_precision
Machine precision
`X02AKC` nag_real_smallest_number
Smallest positive model number
`X02ALC` nag_real_largest_number
Largest positive model number
`X02AMC` nag_real_safe_small_number
Safe range of floating-point arithmetic
`X02BBC` nag_max_integer
Largest representable integer
`X02BEC` nag_decimal_digits
Maximum number of decimal digits that can be represented
`X02BHC` nag_real_base
Parameter b of model of floating-point arithmetic
`X02BJC` nag_real_base_digits
Parameter p of model of floating-point arithmetic
`X02BKC` nag_real_min_exponent
Parameter $e_{\min}$ of model of floating-point arithmetic
`X02BLC` nag_real_max_exponent
Parameter $e_{\max}$ of model of floating-point arithmetic
`X02DAC` nag_underflow_flag
Switch for taking precautions to avoid underflow
`X02DJC` nag_real_arithmetic_rounds
Parameter ROUNDS of model of floating-point arithmetic