NAG C Library

Library Contents

* This function will be withdrawn at Mark 8.

Chapter a00 – Library Identification

a00aac nag_implementation_details
   Library identification, details of implementation and mark

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
a02djc nag_complex_cos
   Complex cosine
a02dlc nag_complex_tan
   Complex tangent
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

c02ack nag_cubic_roots
   Zeros of a cubic polynomial with real coefficients

c02alc nag_quartic_roots
   Zeros of a real quartic 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_1 (c05ubc), 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 c06 functions
Chapter 01 – Quadrature

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

d01ajc nag_ld_quad_gen
1-D adaptive quadrature, allowing for badly-behaved integrands

d01akc nag_ld_quad_osc
1-D adaptive quadrature, suitable for oscillating functions

d01alc nag_ld_quad_brkpts
1-D adaptive quadrature, allowing for singularities at specified points

d01amc nag_ld_quad_inf
1-D adaptive quadrature over infinite or semi-infinite interval

d01anc nag_ld_quad_wt_trig
1-D adaptive quadrature, finite interval, sine or cosine weight functions

d01apc nag_ld_quad_wt_allog
1-D adaptive quadrature, weight function with end-point singularities of algebraic-logarithmic type

d01aqc nag_ld_quad_wt_cauchy
1-D adaptive quadrature, weight function $1/(x - c)$, Cauchy principal value

d01asc nag_ld_quad_inf_wt_trig
1-D adaptive quadrature, semi-infinite interval, sine or cosine weight function

d01bac nag_ld_quad_gauss
1-D Gaussian quadrature rule evaluation

d01fcc nag_multid_quad_adapt
Multi-dimensional adaptive quadrature

d01gac nag_ld_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_ld_quad_gen_1
1-D adaptive quadrature, allowing for badly-behaved integrands, thread-safe

d01skc nag_ld_quad_osc_1
1-D adaptive quadrature, suitable for oscillating functions, thread-safe

d01slc nag_ld_quad_brkpts_1
1-D adaptive quadrature, allowing for singularities at specified points, thread-safe

d01smc nag_ld_quad_inf_1
1-D adaptive quadrature over infinite or semi-infinite interval, thread-safe

d01snc nag_ld_quad_wt_trig_1
1-D adaptive quadrature, finite interval, sine or cosine weight functions, thread-safe

d01spc nag_ld_quad_wt_allog_1
1-D adaptive quadrature, weight function with end-point singularities of algebraic-logarithmic type, thread-safe

d01sqc nag_ld_quad_wt_cauchy_1
1-D adaptive quadrature, weight function $1/(x - c)$, Cauchy principal value, thread-safe

d01ssc nag_ld_quad_inf_wt_trig_1
1-D adaptive quadrature, semi-infinite interval, sine or cosine weight function, thread-safe

d01tac nag_ld_quad_gauss_1
1-D Gaussian quadrature rule evaluation, thread-safe

d01wcc nag_multid_quad_adapt_1
Multi-dimensional adaptive quadrature, 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 two-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_rkonestep
   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_rkonestep (d02pdc)

d02pwc nag_ode_ivp_rk_reset_tend
   A function to re-set the end point following a call to nag_ode_ivp_rkonestep (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_rkonestep (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_rkonestep (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 nonlinear two-point boundary value problems, using a finite difference technique with deferred correction

Chapter e01 – Interpolation

e01bac nag_ld_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
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Chapter e02 – Curve and Surface Fitting

e02adc nag_ld_cheb_fit
Computes the coefficients of a Chebyshev series polynomial for arbitrary data

e02aec nag_ld_cheb_eval
Evaluates the coefficients of a Chebyshev series polynomial

e02afc nag_ld_cheb_interp_fit
Computes the coefficients of a Chebyshev series polynomial for interpolated data

e02bac nag_lsq_spline_fit_knots
Least-squares curve cubic spline fit (including interpolation), one variable

e02bbc nag_lsq_spline_evaluate
Evaluation of fitted cubic spline, function only

e02bcc nag_lsq_spline_deriv
Evaluation of fitted cubic spline, function and derivatives

e02bdc nag_lsq_spline_intg
Evaluation of fitted cubic spline, definite integral

e02bec nag_lsq_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)
Chapter 6 – Linear Algebra

f01bnc nag_complex_cholesky
UU^H factorization of complex Hermitian positive-definite matrix
f01ecc nag_real_cholesky
LL^T factorization of real symmetric positive-definite variable-bandwidth (skyline) matrix
f01qcc nag_real_qr
QR factorization of real m by n matrix (m ≥ 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 ≥ n)
f01rdc nag_complex_apply_q
Compute QB or Q^H B after factorization by nag_complex_qr (f01rcc)
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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 f06 – Linear Algebra Support Functions

f06pac dgemv
Matrix-vector product, real rectangular matrix
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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 dtmv
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

f06pjc dtsrv
System of equations, real triangular band matrix

f06pmc dtpsv
System of equations, real triangular packed matrix

f06pcc dger
Rank-1 update, real rectangular matrix

f06pcc dsyr
Rank-1 update, real symmetric matrix

f06pqc dspr
Rank-1 update, real symmetric packed matrix

f06prc dsyr2
Rank-2 update, real symmetric matrix

f06pqc 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

f06scz 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

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Introduction

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 Jacobi, SSOR or no preconditioning (nonsymmetric)
f11jac nag_sparse_sym_chol_fac
Incomplete Cholesky factorization (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_lvar
  Mean, variance, skewness, kurtosis etc, one variable, from raw data

g01aec nag_frequency_table
  Frequency table 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 $\chi^2$ distribution

g01edc nag_prob_f_dist
  Probabilities for F-distribution

g01ecc 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 $\chi^2$ distribution

g01fcdc 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

g01gbc nag_prob_non_central_students_t
  Computes probabilities for the non-central Student’s t-distribution

g01gcc nag_prob_non_central_chi_sq
  Computes probabilities for the non-central $\chi^2$ distribution

g01gdc nag_prob_non_central_f_dist
  Computes probabilities for the non-central F-distribution

g01gec nag_prob_non_central_beta_dist
  Computes probabilities for the non-central beta distribution

g01hac nag_bivariate_normal_dist
  Probability for the bivariate Normal distribution

g01hbc nag_multi_normal
  Computes probabilities for the multivariate Normal distribution
Chapter g02 – Correlation and Regression Analysis

g02brc nag_kenspe_coorr_coef
    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

g02byc nag_partial_corr
    Computes partial correlation/variance-covariance matrix from correlation/variance-covariance
    matrix computed by nag_corr_cov (g02bxc)

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_regrsn_mult_linear
    Fits a general (multiple) linear regression model

g02dcc nag_regrsn_mult_linear_addrem_obs
    Add/delete an observation to/from a general linear regression model

g02ddc nag_regrsn_mult_linear_upd_model
    Estimates of regression parameters from an updated model

g02dec nag_regrsn_mult_linear_add_var
    Add a new independent variable to a general linear regression model

g02dfe nag_regrsn_mult_linear_delete_var
    Delete an independent variable from a general linear regression model

g02dgf nag_regrsn_mult_linear_newyvar
    Fits a general linear regression model to new dependent variable

g02dkc nag_regrsn_mult_linear_tran_model
    Estimates of parameters of a general linear regression model for given constraints

g02dnc nag_regrsn_mult_linear_est_func
    Estimate of an estimable function for a general linear regression model

g02fac nag_regrsn_std_resid_influence
    Calculate standardized residuals and influence statistics

g02gac nag_glm_normal
    Fits a generalized linear model with Normal errors

g02gbc nag_glm_binomial
    Fits a generalized linear model with binomial errors

g02gcc nag_glm_poisson
    Fits a generalized linear model with Poisson errors

g02gdc nag_glm_gamma
    Fits a generalized 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
    Estimable function and the standard error of a generalized linear model

g02hac nag_robust_m_regrsn_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_procrustes
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 within-group covariance matrices

g03dbc nag_mv_discrim_mahaldist
Mahalanobis squared distances, following nag_mv_discrim (g03dac)

g03dcc nag_mv_discrim_group
Allocates 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 dendrogram 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

g03zcnc 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

g04bcc nag_anova_row_col
Analysis of variance, general row and column design, treatment means and standard errors

g04cac nag_anova_factorial
Complete factorial design

g04czc nag_anova_factorial_free
Memory freeing function for nag_anova_factorial (g04cac)

g04dbc nag_anova_confid_interval
Computes confidence intervals for differences between means computed by nag_anova_random (g04bbc) or nag_anova_row_col (g04bcc)

g04eac nag_dummy_vars
Computes orthogonal polynomials or dummy variables for factor/classification variable

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
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_lvar
Robust estimation, median, median absolute deviation, robust standard deviation

g07dbc nag_robust_m_estim_lvar
Robust estimation, \(M\)-estimate of location and scale parameters, standard weight function

g07ddc nag_robust_trimmed_lvar
Trimmed and winsorized mean of a sample with estimates of the variances of the two means
Chapter g08 – Nonparametric Statistics

g08aac nag_sign_test
Sign test on two paired samples

g08acc nag_median_test
Median test on two samples of unequal size

g08aeq nag_friedman_test
Friedman two-way analysis of variance on \( k \) matched samples

g08afc nag_kruskal_wallis_test
Kruskal–Wallis one-way analysis of variance on \( k \) samples of unequal size

g08afc nag_wilcoxon_test
Performs the Wilcoxon one-sample (matched pairs) signed rank test

g08amc nag_mann_whitney
Performs the Mann–Whitney \( U \) test on two independent samples

g08cbc nag_1_sample_ks_test
Performs the one-sample Kolmogorov–Smirnov test for standard distributions

g08cdd nag_2_sample_ks_test
Performs the two-sample Kolmogorov–Smirnov test

g08cgc nag_chi_sq_goodness_of_fit_test
Performs the \( \chi^2 \) goodness of fit test, for standard continuous distributions

g08eac nag_runs_test
Performs the runs up or runs down test for randomness

g08eac nag_pairs_test
Performs the pairs (serial) test for randomness

g08ecc nag_triplets_test
Performs the triplets test for randomness

g08edc nag_gaps_test
Performs the gaps test for randomness

Chapter g10 – Smoothing in Statistics

g10abc nag_smooth_spline_fit
Fit cubic smoothing spline, smoothing parameter given

g10acc nag_smooth_spline_estim
Fit cubic smoothing spline, smoothing parameter estimated

g10bac nag_kernel_density_estim
Kernel density estimate using Gaussian kernel

g10cac nag_running_median_smother
Smoothed data sequence using running median smoother

g10zac nag_order_data
Reorder data to give ordered distinct observations

Chapter g11 – Contingency Table Analysis

g11aac nag_chi_sq_2_way_table
\( \chi^2 \) statistic for two-way contingency table

g11bac nag_tabulate_stats
Computes multiway table from set of classification factors using selected statistic

g11bbc nag_tabulate_percentile
Computes multiway table from set of classification factors using given percentile/quantile

Chapter g12 – Survival Analysis

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

g12bac nag_surviv_cox_model
Fits Cox’s proportional hazard model
Chapter g13 – Time Series Analysis

g13abc nag_tsa_auto_corr
   Sample autocorrelation function

g13acc nag_tsa_auto_corr_part
   Partial autocorrelation function

g13asc nag_tsa_resid_corr
   Univariate time series, diagnostic checking of residuals, following
   nag_tsa_multi_inp_model_estim (g13bec)

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
   Allocates 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

g13gcg 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

g13fac nag_estimate_archI
   Univariate time series, parameter estimation for either a symmetric GARCH process or a
   GARCH process with asymmetry of the form \((\epsilon_t + \gamma)^2\)

g13fbc nag_forecast_archI
   Univariate time series, forecast function for either a symmetric GARCH process or a GARCH
   process with asymmetry of the form \((\epsilon_t + \gamma)^2\)

g13fcc nag_estimate_archII
   Univariate time series, parameter estimation for a GARCH process with asymmetry of the form
   \(|\epsilon_t + \gamma\epsilon_t|^2\)
gl3fcd nag_forecast_agarchII
Univariate time series, forecast function for a GARCH process with asymmetry of the form
\((\epsilon_{t-1} + \gamma \epsilon_{t-1})^2\)

gl3fec nag_estimate_garchGJR
Univariate time series, parameter estimation for an asymmetric Glosten, Jagannathan and Runkle (GJR) GARCH process

gl3ffc nag_forecast_garchGJR
Univariate time series, forecast function for an asymmetric Glosten, Jagannathan and Runkle (GJR) GARCH process

gl3xzc nag_tsa_free
Freeing function for use with gl3 option setting

Chapter h – Operations Research

h02bcc 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)

h02xzc nag_ip_init
Initialise 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
Quick sort of set of values of data type double

m01csc nag_quicksort
Quick sort of set of values of arbitrary data type

m01ctc nag_stable_sort
Stable sort of set of values of arbitrary data type

m01cac 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

s10aad nag_tanh
Hyperbolic tangent, tanh \(x\)

s10abc nag_sinh
Hyperbolic sine, sinh \(x\)

s10acc nag_cosh
Hyperbolic cosine, cosh \(x\)

s11aad nag_arctanh
Inverse hyperbolic tangent, arctanh \(x\)
Introduction

s11abc nag_arcsinh
  Inverse hyperbolic sine, \( \text{arcsinh} \ x \)

s11acc nag_arccosh
  Inverse hyperbolic cosine, \( \text{arccosh} \ x \)

s13aac nag_exp_integral
  Exponential integral \( E_1(x) \)

s13acc nag_cos_integral
  Cosine integral \( \text{Ci}(x) \)

s13adc nag_sin_integral
  Sine integral \( \text{Si}(x) \)

s14aac nag.gamma
  Gamma function \( \Gamma(x) \)

s14abc nag_log_gmma
  Log Gamma function \( \ln(\Gamma(x)) \)

s14aec nag_real_polygamma
  Derivative of the psi function \( \psi(x) \)

s14afc nag_complex_polygamma
  Derivative of the psi function \( \psi(z) \)

s14bac nag_incomplete_gmma
  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, \( \text{erfc} \ x \)

s15aec nag.erf
  Error function, \( \text{erf} \ x \)

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 \( A_i(x) \)

s17ahc nag_airy_bi
  Airy function \( B_i(x) \)

s17ajc nag_airy_ai_deriv
  Airy function \( A_i'(x) \)

s17akc nag_airy_bi_deriv
  Airy function \( B_i'(x) \)

s17alc nag_bessel_zeros
  Zeros of Bessel functions \( J_\alpha(x), J'_\alpha(x), Y_\alpha(x) \) or \( Y'_\alpha(x) \)

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 \( e^xK_0(x) \)

s18cdc nag_bessel_k1_scaled
  Scaled modified Bessel function \( e^xK_1(x) \)
s18cec nag_bessel_i0_scaled
Scaled modified Bessel function $e^{-|x|}I_0(x)$
s18cfc nag_bessel_i1_scaled
Scaled modified Bessel function $e^{-|x|}I_1(x)$
s18ecc nag_bessel_i_nu_scaled
Scaled modified Bessel function $e^{-x}I_{\nu}(x)$
s18edc nag_bessel_k_nu_scaled
Scaled modified Bessel function $e^{x}K_{\nu}(x)$
s18eeic nag_bessel_i_nu
Modified Bessel function $I_{\nu}(x)$
s18efc nag_bessel_k_nu
Modified Bessel function $K_{\nu}(x)$
s18egc nag_bessel_k_alpha
Modified Bessel functions $K_{\alpha+n}(x)$ for real $x > 0$, selected values of $\alpha \geq 0$ and $n = 0, 1, \ldots, N$
s18ehc nag_bessel_k_alpha_scaled
Scaled modified Bessel functions $e^{x}K_{\alpha+n}(x)$ for real $x > 0$, selected values of $\alpha \geq 0$ and $n = 0, 1, \ldots, N$
s18eic nag_bessel_i_alpha
Modified Bessel functions $I_{\alpha+n}(x)$ or $I_{\alpha-n}(x)$ for real $x \neq 0$, non-negative $\alpha < 1$ and $n = 1, 2, \ldots, [N]+1$
s18eic nag_bessel_j_alpha
Bessel functions $J_{\alpha+n}(x)$ or $J_{\alpha-n}(x)$ for real $x \neq 0$, non-negative $\alpha < 1$ and $n = 1, 2, \ldots, [N]+1$
s19acc nag_kelvin_ber
Kelvin function ber $x$
s19abc nag_kelvin_bei
Kelvin function bei $x$
s19acc nag_kelvin_ger
Kelvin function ker $x$
s19adc nag_kelvin_je
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 $R_F(x, y, z)$
s21bccc nag_elliptic_integral_rd
Symmetrised elliptic integral of 2nd kind $R_D(x, y, z)$
s21bcdc nag_elliptic_integral_jr
Symmetrised elliptic integral of 3rd kind $R_J(x, y, z, r)$
s21bcb nag_jacobian_elliptic
Jacobian elliptic functions sn, cn and dn with complex arguments
s21ccc nag_jacobian_theta
Jacobian theta functions with real arguments
s21 dac nag_elliptic_integral_f
Elliptic integrals of the second kind with complex arguments
s22aac nag_legendre_p
Legendre and associated Legendre functions of the first kind with real arguments
Chapter x01 – Mathematical Constants

X01AAC nag_pi
\[ \pi \]
X01ABC nag_euler_constant
Euler's constant, \( \gamma \)

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
X02ANC nag_complex_safe_small_number
Safe range of NAG complex 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