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## Contents

[M-5] Manual entry	Function	Purpose
	Pseudorandom variates	
<b>runiform()</b>	runiform() rnormal() rseed() rngstate()	uniform random variates normal (Gaussian) random variates obtain or set the random-variate seed obtain or set the random-number generator state
	rbeta() rbinomial() rcauchy() rchi2() rdiscrete() rexponential() rgamma() rhypergeometric() rigaussian() rlaplace() rlogistic() rnbinoomial() rpoisson() rt() runiformint() rweibull() rweibullph()	beta random variates binomial random variates Cauchy random variates chi-squared random variates discrete random variates exponential random variates gamma random variates hypergeometric random variates inverse Gaussian random variates Laplace random variates logistic random variates negative binomial random variates Poisson random variates Student's <i>t</i> random variates uniform random integer variates Weibull random variates Weibull (proportional hazards) random variates

Means, variances, & correlations
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<b>mean()</b>	mean() variance() quadvariance() meanvariance() quadmeanvariance() correlation() quadcorrelation()	mean variance quad-precision variance mean and variance quad-precision mean and variance correlation quad-precision correlation
<b>cross()</b>	cross()	$X'X$ , $X'Z$ , $X'\text{diag}(w)Z$ , etc.
<b>corr()</b>	corr()	make correlation from variance matrix
<b>crossdev()</b>	crossdev()	$(X: -x)'(X: -x)$ , $(X: -x)'(Z: -z)$ , etc.
<b>quadcross()</b>	quadcross() quadcrossdev()	quad-precision cross() quad-precision crossdev()

Factorial & combinations
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<b>factorial()</b>	factorial() lnfactorial() gamma() lngamma() digamma() trigamma()	factorial natural logarithm of factorial gamma function natural logarithm of gamma function derivative of lngamma() second derivative of lngamma()
<b>comb()</b>	comb()	combinatorial function $n$ choose $k$
<b>cvpermute()</b>	cvpermutsetup() cvpermute()	permutation setup return permutations, one at a time

## Densities &amp; distributions

<b>normal()</b>	normalden()	normal density
	normal()	cumulative normal
	invnormal()	inverse cumulative normal
	lnnormalden()	logarithm of the normal density
	lnnormal()	logarithm of the cumulative normal
	binormal()	cumulative binormal
	lnmvnormalden()	logarithm of the multivariate normal density
	betaden()	beta density
	ibeta()	cumulative beta; a.k.a. incomplete beta function
	ibetatail()	reverse cumulative beta
	invibeta()	inverse cumulative beta
	invibetatail()	inverse reverse cumulative beta
	binomialp()	binomial probability
	binomial()	cumulative binomial
	binomialtail()	reverse cumulative binomial
	invbinomial()	inverse cumulative binomial
	invbinomialtail()	inverse reverse cumulative binomial
	cauchyden()	Cauchy density
	cauchy()	cumulative Cauchy
	cauchytail()	reverse cumulative Cauchy
	invcauchy()	inverse cumulative Cauchy
	invcauchytail()	inverse reverse cumulative Cauchy
	lncauchyden()	logarithm of the Cauchy density
	chi2()	cumulative chi-squared
	chi2den()	chi-squared density
	chi2tail()	reverse cumulative chi-squared
	invchi2()	inverse cumulative chi-squared
	invchi2tail()	inverse reverse cumulative chi-squared
	dunnettprob()	cumulative multiple range; used in Dunnett's multiple comparison
	invdunnettprob()	inverse cumulative multiple range; used in Dunnett's multiple comparison

<b>normal()</b> , <i>continued</i>	<code>exponentialden()</code>	exponential density
	<code>exponential()</code>	cumulative exponential
	<code>exponentialtail()</code>	reverse cumulative exponential
	<code>invexponential()</code>	inverse cumulative exponential
	<code>invexponentialtail()</code>	inverse reverse cumulative exponential
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	<code>Fden()</code>	$F$ density
	<code>F()</code>	cumulative $F$
	<code>Ftail()</code>	reverse cumulative $F$
	<code>invF()</code>	inverse cumulative $F$
	<code>invFtail()</code>	inverse reverse cumulative $F$
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	<code>gammaden()</code>	gamma density
	<code>gammap()</code>	cumulative gamma; a.k.a. incomplete gamma function
	<code>gammaptail()</code>	reverse cumulative gamma;
	<code>invgammap()</code>	inverse cumulative gamma
	<code>invgammaptail()</code>	inverse reverse cumulative gamma
	<code>dgammapda()</code>	$\partial P(a, x)/\partial a$ , where $P(a, x) = \text{gammap}(a, x)$
	<code>dgammapdx()</code>	$\partial P(a, x)/\partial x$ , where $P(a, x) = \text{gammap}(a, x)$
	<code>dgammapdada()</code>	$\partial^2 P(a, x)/\partial a^2$ , where $P(a, x) = \text{gammap}(a, x)$
	<code>dgammapdadx()</code>	$\partial^2 P(a, x)/\partial a \partial x$ , where $P(a, x) = \text{gammap}(a, x)$
	<code>dgammapdxdx()</code>	$\partial^2 P(a, x)/\partial x^2$ , where $P(a, x) = \text{gammap}(a, x)$
	<code>lnigammaden()</code>	logarithm of the inverse gamma density
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	<code>hypergeometricp()</code>	hypergeometric probability
	<code>hypergeometric()</code>	cumulative hypergeometric
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	<code>igaussianden()</code>	inverse Gaussian density
	<code>igaussian()</code>	cumulative inverse Gaussian
	<code>igaussiantail()</code>	reverse cumulative inverse Gaussian
	<code>invigaussian()</code>	inverse cumulative of inverse Gaussian
	<code>invigaussiantail()</code>	inverse reverse cumulative of inverse Gaussian
	<code>lnigaussianden()</code>	logarithm of the inverse Gaussian density
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	<code>laplaceden()</code>	Laplace density
	<code>laplace()</code>	cumulative Laplace
	<code>laplacetail()</code>	reverse cumulative Laplace
	<code>invlaplace()</code>	inverse cumulative Laplace
	<code>invlaplacetail()</code>	inverse reverse cumulative Laplace
	<code>lnlaplaceden()</code>	logarithm of the Laplace density
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	<code>logisticden()</code>	logistic density
	<code>logistic()</code>	cumulative logistic
	<code>logistictail()</code>	reverse cumulative logistic
	<code>invlogistic()</code>	inverse cumulative logistic
	<code>invlogistictail()</code>	inverse reverse cumulative logistic
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<b>normal()</b> , <i>continued</i>	<code>nbetaden()</code>	noncentral beta density
	<code>nibeta()</code>	cumulative noncentral beta
	<code>invnibeta()</code>	inverse cumulative noncentral beta
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	<code>nbinomialp()</code>	negative binomial probability
	<code>nbinomial()</code>	cumulative negative binomial
	<code>nbinomialtail()</code>	reverse cumulative negative binomial
	<code>invnbinomial()</code>	inverse cumulative negative binomial
	<code>invnbinomialtail()</code>	inverse reverse cumulative negative binomial
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	<code>nchi2()</code>	cumulative noncentral chi-squared
	<code>nchi2den()</code>	noncentral chi-squared density
	<code>nchi2tail()</code>	reverse cumulative noncentral chi-squared
	<code>invnchi2()</code>	inverse cumulative noncentral chi-squared
	<code>invnchi2tail()</code>	inverse reverse cumulative noncentral chi-squared
	<code>npnchi2()</code>	noncentrality parameter of <code>nchi2()</code>
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	<code>nF()</code>	cumulative noncentral $F$
	<code>nFden()</code>	noncentral $F$ density
	<code>nFtail()</code>	reverse cumulative noncentral $F$
	<code>invnF()</code>	inverse cumulative noncentral $F$
	<code>invnFtail()</code>	inverse reverse cumulative noncentral $F$
	<code>npnF()</code>	noncentrality parameter of <code>nF()</code>
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	<code>nt()</code>	cumulative noncentral Student's $t$
	<code>ntden()</code>	noncentral Student's $t$ density
	<code>nttail()</code>	reverse cumulative noncentral $t$
	<code>invnt()</code>	inverse cumulative noncentral $t$
	<code>invnttail()</code>	inverse reverse cumulative noncentral $t$
	<code>npnt()</code>	noncentrality parameter of <code>nt()</code>
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	<code>poissonp()</code>	Poisson probability
	<code>poisson()</code>	cumulative Poisson
	<code>poissontail()</code>	reverse cumulative Poisson
	<code>invpoisson()</code>	inverse cumulative Poisson
	<code>invpoissontail()</code>	inverse reverse cumulative Poisson
	<hr/>	
	<code>t()</code>	cumulative Student's $t$
	<code>tden()</code>	Student's $t$ density
	<code>ttail()</code>	reverse cumulative Student's $t$
	<code>invt()</code>	inverse cumulative Student's $t$
	<code>invttail()</code>	inverse reverse cumulative Student's $t$
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<b>normal()</b> , <i>continued</i>	<code>tukeyprob()</code>	cumulative multiple range; used in Tukey's multiple comparison
	<code>invtukeyprob()</code>	inverse cumulative multiple range; used in Tukey's multiple comparison
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	<code>weibullden()</code>	Weibull density
	<code>weibull()</code>	cumulative Weibull
	<code>weibulltail()</code>	reverse cumulative Weibull
	<code>invweibull()</code>	inverse cumulative Weibull
	<code>invweibulltail()</code>	inverse reverse cumulative Weibull
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	<code>weibullphden()</code>	Weibull (proportional hazards) density
	<code>weibullph()</code>	cumulative Weibull (proportional hazards)
	<code>weibullphtail()</code>	reverse cumulative Weibull (proportional hazards)
	<code>invweibullph()</code>	inverse cumulative Weibull (proportional hazards)
	<code>invweibullphtail()</code>	inverse reverse cumulative Weibull (proportional hazards)
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	<code>lnwishartden()</code>	logarithm of the Wishart density
	<code>lniwishartden()</code>	logarithm of the inverse Wishart density
<b>mvnormal()</b>	<code>mvnormal()</code>	multivariate normal probabilities (correlation specified)
	<code>mvnormalcv()</code>	multivariate normal probabilities (covariance specified)
	<code>mvnormalqp()</code>	<code>mvnormal()</code> with specified quadrature points
	<code>mvnormalcvqp()</code>	<code>mvnormalcv()</code> with specified quadrature points
	<code>mvnormalderiv()</code>	derivatives of <code>mvnormal()</code>
	<code>mvnormalcvderiv()</code>	derivatives of <code>mvnormalcv()</code>
	<code>mvnormaldervqp()</code>	<code>mvnormalderiv()</code> with specified quadrature points
	<code>mvnormalcvdervqp()</code>	<code>mvnormalcvderiv()</code> with specified quadrature points

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Maximization & minimization

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<b>optimize()</b>	optimize() optimize_evaluate() optimize_init() optimize_init_*(*) optimize_result_*(*) optimize_query()	function maximization and minimization evaluate function at initial values begin optimization set details access results report settings
<b>moptimize()</b>	moptimize() moptimize_evaluate() moptimize_init() moptimize_init_*(*) moptimize_result_*(*) moptimize_ado_cleanup() moptimize_query() moptimize_util_*(*)	function optimization evaluate function at initial values begin setup of optimization problem set details access moptimize() results perform cleanup after ado report settings utility functions for writing evaluators and processing results

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Logits, odds, & related

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<b>logit()</b>	logit() invlogit() cloglog() invcloglog()	log of the odds ratio inverse log of the odds ratio complementary log-log inverse complementary log-log
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Multivariate normal

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<b>ghk()</b>	ghk() ghk_init() ghk_init_*(*) ghk() ghk_query_npts()	GHK multivariate normal (MVN) simulator GHK MVN initialization set details perform simulation return number of simulation points
<b>ghkfast()</b>	ghkfast() ghkfast_init() ghkfast_init_*(*) ghkfast() ghkfast_i() ghk_query_*(*)	GHK MVN simulator GHK MVN initialization set details perform simulation results for the <i>i</i> th observation display settings

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## Description

The above functions are statistical, probabilistic, or designed to work with data matrices.

## Remarks and examples

Concerning data matrices, see

[M-4] [stata](#)            Stata interface functions

and especially

[M-5] [st\\_data\(\)](#)        Load copy of current Stata dataset

[M-5] [st\\_view\(\)](#)        Make matrix that is a view onto current Stata dataset

For other mathematical functions, see

[M-4] [matrix](#)            Matrix mathematical functions

[M-4] [scalar](#)            Scalar mathematical functions

[M-4] [mathematical](#)    Important mathematical functions

## Also see

[M-4] [intro](#) — Categorical guide to Mata functions