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## Contents

[M-5] Manual entry	Function	Purpose
	<b>Pseudorandom variates</b>	
<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 $\chi^2$ 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

<b>mean()</b>	mean()	mean
	variance()	variance
	quadvariance()	quad-precision variance
	meanvariance()	mean and variance
	quadmeanvariance()	quad-precision mean and variance
	correlation()	correlation
<b>cross()</b>	quadcorrelation()	quad-precision correlation
	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()	quad-precision cross()
	quadcrossdev()	quad-precision crossdev()

Factorial & combinations

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

## Densities &amp; distributions

<b>normal()</b>	normalden() normal() invnormal() lnnormalden() lnnormal()	normal density cumulative normal inverse cumulative normal logarithm of the normal density logarithm of the cumulative normal
	----- binormal()	cumulative binormal
	----- lnmvnormalden()	logarithm of the multivariate normal density
	----- betaden() ibeta()	beta density cumulative beta; a.k.a. incomplete beta function
	ibetatail() invibeta() invibetatail()	reverse cumulative beta inverse cumulative beta inverse reverse cumulative beta
	----- binomialp() binomial() binomialtail() invbinomial() invbinomialtail()	binomial probability cumulative binomial reverse cumulative binomial inverse cumulative binomial inverse reverse cumulative binomial
	----- cauchyden() cauchy() cauchytail() invcauchy() invcauchytail() lncauchyden()	Cauchy density cumulative Cauchy reverse cumulative Cauchy inverse cumulative Cauchy inverse reverse cumulative Cauchy logarithm of the Cauchy density
	----- chi2() chi2den() chi2tail() invchi2() invchi2tail()	cumulative $\chi^2$ $\chi^2$ density reverse cumulative $\chi^2$ inverse cumulative $\chi^2$ inverse reverse cumulative $\chi^2$
	----- dunnettprob() invdunnettprob()	cumulative multiple range; used in Dunnett's multiple comparison 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
<hr/>		
	<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 $F$
<hr/>		
	<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
<hr/>		
	<code>hypergeometricp()</code>	hypergeometric probability
	<code>hypergeometric()</code>	cumulative hypergeometric
<hr/>		
	<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
<hr/>		
	<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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<b>normal()</b> , <i>continued</i>	logisticden()	logistic density
	logistic()	cumulative logistic
	logistictail()	reverse cumulative logistic
	invlogistic()	inverse cumulative logistic
	invlogistictail()	inverse reverse cumulative logistic
	-----	
	nbetaden()	noncentral beta density
	nibeta()	cumulative noncentral beta
	invnibeta()	inverse cumulative noncentral beta
	-----	
	nbinomialp()	negative binomial probability
	nbinomial()	cumulative negative binomial
	nbinomialtail()	reverse cumulative negative binomial
	invnbinomial()	inverse cumulative negative binomial
	invnbinomialtail()	inverse reverse cumulative negative binomial
	-----	
	nchi2()	cumulative noncentral $\chi^2$
	nchi2den()	noncentral $\chi^2$ density
	nchi2tail()	reverse cumulative noncentral $\chi^2$
	invnchi2()	inverse cumulative noncentral $\chi^2$
	invnchi2tail()	inverse reverse cumulative noncentral $\chi^2$
	npnchi2()	noncentrality parameter of nchi2()
	-----	
	nF()	cumulative noncentral $F$
	nFden()	noncentral $F$ density
	nFtail()	reverse cumulative noncentral $F$
	invnF()	inverse cumulative noncentral $F$
	invnFtail()	inverse reverse cumulative noncentral $F$
	npnF()	noncentrality parameter of nF()
	-----	
	nt()	cumulative noncentral Student's $t$
	ntden()	noncentral Student's $t$ density
	nttail()	reverse cumulative noncentral $t$
	invnt()	inverse cumulative noncentral $t$
	invnttail()	inverse reverse cumulative noncentral $t$
	npnt()	noncentrality parameter of nt()
	-----	
	poissonp()	Poisson probability
	poisson()	cumulative Poisson
	poissontail()	reverse cumulative Poisson
	invpoisson()	inverse cumulative Poisson
	invpoissontail()	inverse reverse cumulative Poisson
	-----	

<b>normal()</b> , <i>continued</i>	<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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	<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>mvnormalcvderivqp()</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_*( 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
<b>LinearProgram()</b>	LinearProgram()	linear programming

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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_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

[stata.com](https://www.stata.com)

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

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