STATA FUNCTIONS REFERENCE MANUAL

RELEASE 14

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Contents

Cross-referencing the documentation

When reading this manual, you will find references to other Stata manuals. For example,

> [U] **26 Overview of Stata estimation commands**
> [R] **regress**
> [XT] **xtreg**

The first example is a reference to chapter 26, *Overview of Stata estimation commands*, in the *User's Guide*; the second is a reference to the `regress` entry in the *Base Reference Manual*; and the third is a reference to the `xtreg` entry in the *Longitudinal-Data/Panel-Data Reference Manual*.

All the manuals in the Stata Documentation have a shorthand notation:

[GSM]	*Getting Started with Stata for Mac*
[GSU]	*Getting Started with Stata for Unix*
[GSW]	*Getting Started with Stata for Windows*
[U]	*Stata User's Guide*
[R]	*Stata Base Reference Manual*
[BAYES]	*Stata Bayesian Analysis Reference Manual*
[D]	*Stata Data Management Reference Manual*
[FN]	*Stata Functions Reference Manual*
[G]	*Stata Graphics Reference Manual*
[IRT]	*Stata Item Response Theory Reference Manual*
[XT]	*Stata Longitudinal-Data/Panel-Data Reference Manual*
[ME]	*Stata Multilevel Mixed-Effects Reference Manual*
[MI]	*Stata Multiple-Imputation Reference Manual*
[MV]	*Stata Multivariate Statistics Reference Manual*
[PSS]	*Stata Power and Sample-Size Reference Manual*
[P]	*Stata Programming Reference Manual*
[SEM]	*Stata Structural Equation Modeling Reference Manual*
[SVY]	*Stata Survey Data Reference Manual*
[ST]	*Stata Survival Analysis Reference Manual*
[TS]	*Stata Time-Series Reference Manual*
[TE]	*Stata Treatment-Effects Reference Manual: Potential Outcomes/Counterfactual Outcomes*
[I]	*Stata Glossary and Index*
[M]	*Mata Reference Manual*

Title

intro — Introduction to functions reference manual

Description

This manual describes the functions allowed by Stata. For information on Mata functions, see [M-4] **intro**.

A quick note about missing values: Stata denotes a numeric missing value by `.`, `.a`, `.b`, ..., or `.z`. A string missing value is denoted by `""` (the empty string). Here any one of these may be referred to by *missing*. If a numeric value x is missing, then $x \geq$ `.` is true. If a numeric value x is not missing, then $x <$ `.` is true.

See [U] **12.2.1 Missing values** for details.

Reference

Cox, N. J. 2011. Speaking Stata: Fun and fluency with functions. *Stata Journal* 11: 460–471.

Also see

[U] **1.3 What's new**

Title

Functions by category

Contents

Date and time functions

`bofd("`cal`",`e_d`)`	the e_b business date corresponding to e_d
`Cdhms(`e_d`,`h`,`m`,`s`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to e_d, h, m, s
`Chms(`h`,`m`,`s`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to h, m, s on 01jan1960
`Clock(`s_1`,`s_2[`,`Y]`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to s_1 based on s_2 and Y
`clock(`s_1`,`s_2[`,`Y]`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to s_1 based on s_2 and Y
`Cmdyhms(`M`,`D`,`Y`,`h`,`m`,`s`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to M, D, Y, h, m, s
`Cofc(`e_{tc}`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of e_{tc} (ms. without leap seconds since 01jan1960 00:00:00.000)
`cofC(`e_{tC}`)`	the e_{tc} datetime (ms. without leap seconds since 01jan1960 00:00:00.000) of e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
`Cofd(`e_d`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of date e_d at time 00:00:00.000
`cofd(`e_d`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) of date e_d at time 00:00:00.000
`daily(`s_1`,`s_2[`,`Y]`)`	a synonym for `date(`s_1`,`s_2[`,`Y]`)`
`date(`s_1`,`s_2[`,`Y]`)`	the e_d date (days since 01jan1960) corresponding to s_1 based on s_2 and Y
`day(`e_d`)`	the numeric day of the month corresponding to e_d
`dhms(`e_d`,`h`,`m`,`s`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to e_d, h, m, and s
`dofb(`e_b`,"`cal`")`	the e_d datetime corresponding to e_b
`dofC(`e_{tC}`)`	the e_d date (days since 01jan1960) of datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)

dofc(e_{tc})	the e_d date (days since 01jan1960) of datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
dofh(e_h)	the e_d date (days since 01jan1960) of the start of half-year e_h
dofm(e_m)	the e_d date (days since 01jan1960) of the start of month e_m
dofq(e_q)	the e_d date (days since 01jan1960) of the start of quarter e_q
dofw(e_w)	the e_d date (days since 01jan1960) of the start of week e_w
dofy(e_y)	the e_d date (days since 01jan1960) of 01jan in year e_y
dow(e_d)	the numeric day of the week corresponding to date e_d; $0 =$ Sunday, $1 =$ Monday, ..., $6 =$ Saturday
doy(e_d)	the numeric day of the year corresponding to date e_d
halfyear(e_d)	the numeric half of the year corresponding to date e_d
halfyearly(s_1,s_2[,Y])	the e_h half-yearly date (half-years since 1960h1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see date()
hh(e_{tc})	the hour corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
hhC(e_{tC})	the hour corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
hms(h,m,s)	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to h, m, s on 01jan1960
hofd(e_d)	the e_h half-yearly date (half years since 1960h1) containing date e_d
hours(ms)	$ms/3{,}600{,}000$
mdy(M,D,Y)	the e_d date (days since 01jan1960) corresponding to M, D, Y
mdyhms(M,D,Y,h,m,s)	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to M, D, Y, h, m, s
minutes(ms)	$ms/60{,}000$
mm(e_{tc})	the minute corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
mmC(e_{tC})	the minute corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
mofd(e_d)	the e_m monthly date (months since 1960m1) containing date e_d
month(e_d)	the numeric month corresponding to date e_d
monthly(s_1,s_2[,Y])	the e_m monthly date (months since 1960m1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see date()
msofhours(h)	$h \times 3{,}600{,}000$
msofminutes(m)	$m \times 60{,}000$
msofseconds(s)	$s \times 1{,}000$
qofd(e_d)	the e_q quarterly date (quarters since 1960q1) containing date e_d
quarter(e_d)	the numeric quarter of the year corresponding to date e_d
quarterly(s_1,s_2[,Y])	the e_q quarterly date (quarters since 1960q1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see date()
seconds(ms)	$ms/1{,}000$
ss(e_{tc})	the second corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
ssC(e_{tC})	the second corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)

tC(l)	convenience function to make typing dates and times in expressions easier
tc(l)	convenience function to make typing dates and times in expressions easier
td(l)	convenience function to make typing dates in expressions easier
th(l)	convenience function to make typing half-yearly dates in expressions easier
tm(l)	convenience function to make typing monthly dates in expressions easier
tq(l)	convenience function to make typing quarterly dates in expressions easier
tw(l)	convenience function to make typing weekly dates in expressions easier
week(e_d)	the numeric week of the year corresponding to date e_d, the %td encoded date (days since 01jan1960)
weekly(s_1,s_2[,Y])	the e_w weekly date (weeks since 1960w1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see date()
wofd(e_d)	the e_w weekly date (weeks since 1960w1) containing date e_d
year(e_d)	the numeric year corresponding to date e_d
yearly(s_1,s_2[,Y])	the e_y yearly date (year) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see date()
yh(Y,H)	the e_h half-yearly date (half-years since 1960h1) corresponding to year Y, half-year H
ym(Y,M)	the e_m monthly date (months since 1960m1) corresponding to year Y, month M
yofd(e_d)	the e_y yearly date (year) containing date e_d
yq(Y,Q)	the e_q quarterly date (quarters since 1960q1) corresponding to year Y, quarter Q
yw(Y,W)	the e_w weekly date (weeks since 1960w1) corresponding to year Y, week W

Mathematical functions

abs(x)	the absolute value of x
ceil(x)	the unique integer n such that $n-1 < x \le n$; x (not ".") if x is missing, meaning that ceil(.a) = .a
cloglog(x)	the complementary log-log of x
comb(n,k)	the combinatorial function $n!/\{k!(n-k)!\}$
digamma(x)	the digamma() function, $d\ln\Gamma(x)/dx$
exp(x)	the exponential function e^x
floor(x)	the unique integer n such that $n \le x < n+1$; x (not ".") if x is missing, meaning that floor(.a) = .a
int(x)	the integer obtained by truncating x toward 0 (thus, int(5.2) = 5 and int(-5.8) = -5); x (not ".") if x is missing, meaning that int(.a) = .a
invcloglog(x)	the inverse of the complementary log-log function of x

invlogit(x)	the inverse of the logit function of x
ln(x)	the natural logarithm, $\ln(x)$
lnfactorial(n)	the natural log of factorial = $\ln(n!)$
lngamma(x)	$\ln\{\Gamma(x)\}$
log(x)	the natural logarithm, $\ln(x)$; thus, a synonym for ln(x)
log10(x)	the base-10 logarithm of x
logit(x)	the log of the odds ratio of x, logit(x) $= \ln\{x/(1-x)\}$
max(x_1,x_2,...,x_n)	the maximum value of $x_1, x_2, \ldots, x_n$
min(x_1,x_2,...,x_n)	the minimum value of $x_1, x_2, \ldots, x_n$
mod(x,y)	the modulus of x with respect to y
reldif(x,y)	the "relative" difference $\lvert x-y\rvert/(\lvert y\rvert+1)$; 0 if both arguments are the same type of extended missing value; *missing* if only one argument is missing or if the two arguments are two different types of *missing*
round(x,y) or round(x)	x rounded in units of y or x rounded to the nearest integer if the argument y is omitted; x (not ".") if x is missing (meaning that round(.a) $=$ .a and that round(.a,y) $=$ .a if y is not missing) and if y is missing, then "." is returned
sign(x)	the sign of x: -1 if $x<0$, 0 if $x=0$, 1 if $x>0$, or *missing* if x is missing
sqrt(x)	the square root of x
sum(x)	the running sum of x, treating missing values as zero
trigamma(x)	the second derivative of lngamma(x) = $d^2 \ln\Gamma(x)/dx^2$
trunc(x)	a synonym for int(x)

Matrix functions

cholesky(M)	the Cholesky decomposition of the matrix: if $R=$ cholesky(S), then $RR^T=S$
colnumb(M,s)	the column number of M associated with column name s; *missing* if the column cannot be found
colsof(M)	the number of columns of M
corr(M)	the correlation matrix of the variance matrix
det(M)	the determinant of matrix M
diag(v)	the square, diagonal matrix created from the row or column vector
diag0cnt(M)	the number of zeros on the diagonal of M
el(s,i,j)	s[floor(i),floor(j)], the i,j element of the matrix named s; *missing* if i or j are out of range or if matrix s does not exist
get(*systemname*)	a copy of Stata internal system matrix *systemname*
hadamard(M,N)	a matrix whose i, j element is $M[i,j]\cdot N[i,j]$ (if M and N are not the same size, this function reports a conformability error)
I(n)	an $n\times n$ identity matrix if n is an integer; otherwise, a round(n) $\times$ round(n) identity matrix
inv(M)	the inverse of the matrix M

invsym(M)	the inverse of M if M is positive definite
issymmetric(M)	1 if the matrix is symmetric; otherwise, 0
J(r,c,z)	the $r \times c$ matrix containing elements z
matmissing(M)	1 if any elements of the matrix are missing; otherwise, 0
matuniform(r,c)	the $r \times c$ matrices containing uniformly distributed pseudorandom numbers on the interval $(0, 1)$
mreldif(X,Y)	the relative difference of X and Y, where the relative difference is defined as $\max_{i,j}\{\lvert x_{ij} - y_{ij}\rvert/(\lvert y_{ij}\rvert + 1)\}$
nullmat(*matname*)	use with the row-join (,) and column-join (\\) operators in programming situations
rownumb(M,s)	the row number of M associated with row name s; *missing* if the row cannot be found
rowsof(M)	the number of rows of M
sweep(M,i)	matrix M with ith row/column swept
trace(M)	the trace of matrix M
vec(M)	a column vector formed by listing the elements of M, starting with the first column and proceeding column by column
vecdiag(M)	the row vector containing the diagonal of matrix M

Programming functions

autocode(x,n,x_0,x_1)	partitions the interval from x_0 to x_1 into n equal-length intervals and returns the upper bound of the interval that contains x
byteorder()	1 if your computer stores numbers by using a hilo byte order and evaluates to 2 if your computer stores numbers by using a lohi byte order
c(*name*)	the value of the system or constant result c(*name*) (see [P] **creturn**)
_caller()	version of the program or session that invoked the currently running program; see [P] **version**
chop(x, ϵ)	round(x) if abs(x − round(x)) $< \epsilon$; otherwise, x; or x if x is missing
clip(x,a,b)	x if $a < x < b$, b if $x \geq b$, a if $x \leq a$, or *missing* if x is missing or if $a > b$; x if x is missing
cond(x,a,b[,c])	a if x is *true* and nonmissing, b if x is *false*, and c if x is *missing*; a if c is not specified and x evaluates to *missing*
e(*name*)	the value of stored result e(*name*); see [U] **18.8 Accessing results calculated by other programs**
e(sample)	1 if the observation is in the estimation sample and 0 otherwise
epsdouble()	the machine precision of a double-precision number
epsfloat()	the machine precision of a floating-point number
fileexists(f)	1 if the file specified by f exists; otherwise, 0
fileread(f)	the contents of the file specified by f
filereaderror(f)	0 or positive integer, said value having the interpretation of a return code

filewrite(f,s[,r])	writes the string specified by s to the file specified by f and returns the number of bytes in the resulting file
float(x)	the value of x rounded to float precision
fmtwidth(*fmtstr*)	the output length of the %*fmt* contained in *fmtstr*; *missing* if *fmtstr* does not contain a valid %*fmt*
has_eprop(*name*)	1 if *name* appears as a word in e(properties); otherwise, 0
inlist(z,a,b,...)	1 if z is a member of the remaining arguments; otherwise, 0
inrange(z,a,b)	1 if it is known that $a \le z \le b$; otherwise, 0
irecode(x,x_1,...,x_n)	*missing* if x is missing or $x_1, \ldots, x_n$ is not weakly increasing; 0 if $x \le x_1$; 1 if $x_1 < x \le x_2$; 2 if $x_2 < x \le x_3$; ...; n if $x > x_n$
matrix(*exp*)	restricts name interpretation to scalars and matrices; see scalar()
maxbyte()	the largest value that can be stored in storage type byte
maxdouble()	the largest value that can be stored in storage type double
maxfloat()	the largest value that can be stored in storage type float
maxint()	the largest value that can be stored in storage type int
maxlong()	the largest value that can be stored in storage type long
mi(x_1,x_2,...,x_n)	a synonym for missing(x_1,x_2,...,x_n)
minbyte()	the smallest value that can be stored in storage type byte
mindouble()	the smallest value that can be stored in storage type double
minfloat()	the smallest value that can be stored in storage type float
minint()	the smallest value that can be stored in storage type int
minlong()	the smallest value that can be stored in storage type long
missing(x_1,x_2,...,x_n)	1 if any x_i evaluates to *missing*; otherwise, 0
r(*name*)	the value of the stored result r(*name*); see **[U] 18.8 Accessing results calculated by other programs**
recode(x,x_1,...,x_n)	*missing* if $x_1, \ldots, x_n$ is not weakly increasing; x if x is missing; x_1 if $x \le x_1$; x_2 if $x \le x_2$, ...; otherwise, x_n if $x > x_1$, x_2, ..., x_{n-1} or $x_i \ge .$ is interpreted as $x_i = +\infty$
replay()	1 if the first nonblank character of local macro '0' is a comma, or if '0' is empty
return(*name*)	the value of the to-be-stored result r(*name*); see **[P] return**
s(*name*)	the value of stored result s(*name*); see **[U] 18.8 Accessing results calculated by other programs**
scalar(*exp*)	restricts name interpretation to scalars and matrices
smallestdouble()	the smallest double-precision number greater than zero

Random-number functions

rbeta(a,b)	beta(a,b) random variates, where a and b are the beta distribution shape parameters
rbinomial(n,p)	binomial(n,p) random variates, where n is the number of trials and p is the success probability
rchi2(*df*)	chi-squared, with *df* degrees of freedom, random variates

`rexponential(`b`)`	exponential random variates with scale b
`rgamma(`a`,`b`)`	gamma(a,b) random variates, where a is the gamma shape parameter and b is the scale parameter
`rhypergeometric(`N`,`K`,`n`)`	hypergeometric random variates
`rigaussian(`m`,`a`)`	inverse Gaussian random variates with mean m and shape parameter a
`rlogistic()`	logistic variates with mean 0 and standard deviation $\pi/\sqrt{3}$
`rlogistic(`s`)`	logistic variates with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
`rlogistic(`m`,`s`)`	logistic variates with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
`rnbinomial(`n`,`p`)`	negative binomial random variates
`rnormal()`	standard normal (Gaussian) random variates, that is, variates from a normal distribution with a mean of 0 and a standard deviation of 1
`rnormal(`m`)`	normal(m,1) (Gaussian) random variates, where m is the mean and the standard deviation is 1
`rnormal(`m`,`s`)`	normal(m,s) (Gaussian) random variates, where m is the mean and s is the standard deviation
`rpoisson(`m`)`	Poisson(m) random variates, where m is the distribution mean
`rt(`*df*`)`	Student's t random variates, where *df* is the degrees of freedom
`runiform()`	uniformly distributed random variates over the interval $(0,1)$
`runiform(`a`,`b`)`	uniformly distributed random variates over the interval (a,b)
`runiformint(`a`,`b`)`	uniformly distributed random integer variates on the interval $[a,b]$
`rweibull(`a`,`b`)`	Weibull variates with shape a and scale b
`rweibull(`a`,`b`,`g`)`	Weibull variates with shape a, scale b, and location g
`rweibullph(`a`,`b`)`	Weibull (proportional hazards) variates with shape a and scale b
`rweibullph(`a`,`b`,`g`)`	Weibull (proportional hazards) variates with shape a, scale b, and location g

Selecting time-span functions

`tin(`d_1`,`d_2`)`	*true* if $d_1 \le t \le d_2$, where t is the time variable previously `tsset`
`twithin(`d_1`,`d_2`)`	*true* if $d_1 < t < d_2$, where t is the time variable previously `tsset`

Statistical functions

`betaden(`a`,`b`,`x`)`	the probability density of the beta distribution, where a and b are the shape parameters; `0` if $x < 0$ or $x > 1$
`binomial(`n`,`k`,`θ`)`	the probability of observing `floor(`k`)` or fewer successes in `floor(`n`)` trials when the probability of a success on one trial is θ; `0` if $k < 0$; or `1` if $k > n$
`binomialp(`n`,`k`,`p`)`	the probability of observing `floor(`k`)` successes in `floor(`n`)` trials when the probability of a success on one trial is p

binomialtail(n,k,θ)	the probability of observing floor(k) or more successes in floor(n) trials when the probability of a success on one trial is θ; 1 if $k < 0$; or 0 if $k > n$
binormal(h,k,ρ)	the joint cumulative distribution $\Phi(h, k, \rho)$ of bivariate normal with correlation ρ
chi2(df,x)	the cumulative χ^2 distribution with df degrees of freedom; 0 if $x < 0$
chi2den(df,x)	the probability density of the chi-squared distribution with df degrees of freedom; 0 if $x < 0$
chi2tail(df,x)	the reverse cumulative (upper tail or survivor) χ^2 distribution with df degrees of freedom; 1 if $x < 0$
dgammapda(a,x)	$\frac{\partial P(a,x)}{\partial a}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dgammapdada(a,x)	$\frac{\partial^2 P(a,x)}{\partial a^2}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dgammapdadx(a,x)	$\frac{\partial^2 P(a,x)}{\partial a \partial x}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dgammapdx(a,x)	$\frac{\partial P(a,x)}{\partial x}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dgammapdxdx(a,x)	$\frac{\partial^2 P(a,x)}{\partial x^2}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dunnettprob(k,df,x)	the cumulative multiple range distribution that is used in Dunnett's multiple-comparison method with k ranges and df degrees of freedom; 0 if $x < 0$
exponential(b,x)	the cumulative exponential distribution with scale b
exponentialden(b,x)	the probability density function of the exponential distribution with scale b
exponentialtail(b,x)	the reverse cumulative exponential distribution with scale b
F(df_1,df_2,f)	the cumulative F distribution with df_1 numerator and df_2 denominator degrees of freedom: F(df_1,df_2,f) $= \int_0^f$ Fden(df_1,df_2,t) dt; 0 if $f < 0$
Fden(df_1,df_2,f)	the probability density function of the F distribution with df_1 numerator and df_2 denominator degrees of freedom; 0 if $f < 0$
Ftail(df_1,df_2,f)	the reverse cumulative (upper tail or survivor) F distribution with df_1 numerator and df_2 denominator degrees of freedom; 1 if $f < 0$
gammaden(a,b,g,x)	the probability density function of the gamma distribution; 0 if $x < g$
gammap(a,x)	the cumulative gamma distribution with shape parameter a; 0 if $x < 0$
gammaptail(a,x)	the reverse cumulative (upper tail or survivor) gamma distribution with shape parameter a; 1 if $x < 0$
hypergeometric(N,K,n,k)	the cumulative probability of the hypergeometric distribution
hypergeometricp(N,K,n,k)	the hypergeometric probability of k successes out of a sample of size n, from a population of size N containing K elements that have the attribute of interest
ibeta(a,b,x)	the cumulative beta distribution with shape parameters a and b; 0 if $x < 0$; or 1 if $x > 1$
ibetatail(a,b,x)	the reverse cumulative (upper tail or survivor) beta distribution with shape parameters a and b; 1 if $x < 0$; or 0 if $x > 1$

igaussian(m,a,x) — the cumulative inverse Gaussian distribution with mean m and shape parameter a; 0 if $x \leq 0$

igaussianden(m,a,x) — the probability density of the inverse Gaussian distribution with mean m and shape parameter a; 0 if $x \leq 0$

igaussiantail(m,a,x) — the reverse cumulative (upper tail or survivor) inverse Gaussian distribution with mean m and shape parameter a; 1 if $x \leq 0$

invbinomial(n,k,p) — the inverse of the cumulative binomial; that is, θ ($\theta =$ probability of success on one trial) such that the probability of observing floor(k) or fewer successes in floor(n) trials is p

invbinomialtail(n,k,p) — the inverse of the right cumulative binomial; that is, θ ($\theta =$ probability of success on one trial) such that the probability of observing floor(k) or more successes in floor(n) trials is p

invchi2(df,p) — the inverse of chi2(): if chi2(df,x) $= p$, then invchi2(df,p) $=$ x

invchi2tail(df,p) — the inverse of chi2tail(): if chi2tail(df,x) $= p$, then invchi2tail(df,p) $= x$

invdunnettprob(k,df,p) — the inverse cumulative multiple range distribution that is used in Dunnett's multiple-comparison method with k ranges and df degrees of freedom

invexponential(b,p) — the inverse cumulative exponential distribution with scale b: if exponential(b,x) $= p$, then invexponential(b,p) $= x$

invexponentialtail(b,p) — the inverse reverse cumulative exponential distribution with scale b: if exponentialtail(b,x) $= p$, then invexponentialtail(b,p) $= x$

invF(df_1,df_2,p) — the inverse cumulative F distribution: if F(df_1,df_2,f) $= p$, then invF(df_1,df_2,p) $= f$

invFtail(df_1,df_2,p) — the inverse reverse cumulative (upper tail or survivor) F distribution: if Ftail(df_1,df_2,f) $= p$, then invFtail(df_1,df_2,p) $= f$

invgammap(a,p) — the inverse cumulative gamma distribution: if gammap(a,x) $= p$, then invgammap(a,p) $= x$

invgammaptail(a,p) — the inverse reverse cumulative (upper tail or survivor) gamma distribution: if gammaptail(a,x) $= p$, then invgammaptail(a,p) $= x$

invibeta(a,b,p) — the inverse cumulative beta distribution: if ibeta(a,b,x) $= p$, then invibeta(a,b,p) $= x$

invibetatail(a,b,p) — the inverse reverse cumulative (upper tail or survivor) beta distribution: if ibetatail(a,b,x) $= p$, then invibetatail(a,b,p) $= x$

invigaussian(m,a,p) — the inverse of igaussian(): if igaussian(m,a,x) $= p$, then invigaussian(m,a,p) $= x$

invigaussiantail(m,a,p) — the inverse of igaussiantail(): if igaussiantail(m,a,x) $= p$, then invigaussiantail(m,a,p x

invlogistic(p) — the inverse cumulative logistic distribution: if logistic(x) $= p$, then invlogistic(p) $= x$

invlogistic(s,p) — the inverse cumulative logistic distribution: if logistic(s,x) $= p$, then invlogistic(s,p) $= x$

invlogistic(m,s,p) — the inverse cumulative logistic distribution: if logistic(m,s,x) $= p$, then invlogistic(m,s,p) $= x$

`invlogistictail(`p`)`	the inverse reverse cumulative logistic distribution: if `logistictail(`x`)` $= p$, then `invlogistictail(`p`)` $= x$
`invlogistictail(`s`,`p`)`	the inverse reverse cumulative logistic distribution: if `logistictail(`s`,`x`)` $= p$, then `invlogistictail(`s`,`p`)` $= x$
`invlogistictail(`m`,`s`,`p`)`	the inverse reverse cumulative logistic distribution: if `logistictail(`m`,`s`,`x`)` $= p$, then `invlogistictail(`m`,`s`,`p`)` $= x$
`invnbinomial(`n`,`k`,`q`)`	the value of the negative binomial parameter, p, such that $q =$ `nbinomial(`n`,`k`,`p`)`
`invnbinomialtail(`n`,`k`,`q`)`	the value of the negative binomial parameter, p, such that $q =$ `nbinomialtail(`n`,`k`,`p`)`
`invnchi2(`df`,`np`,`p`)`	the inverse cumulative noncentral χ^2 distribution: if `nchi2(`df`,`np`,`x`)` $= p$, then `invnchi2(`df`,`np`,`p`)` $= x$
`invnchi2tail(`df`,`np`,`p`)`	the inverse reverse cumulative (upper tail or survivor) noncentral χ^2 distribution: if `nchi2tail(`df`,`np`,`x`)` $= p$, then `invnchi2tail(`df`,`np`,`p`)` $= x$
`invnF(`df_1`,`df_2`,`np`,`p`)`	the inverse cumulative noncentral F distribution: if `nF(`df_1`,`df_2`,`np`,`f`)` $= p$, then `invnF(`df_1`,`df_2`,`np`,`p`)` $= f$
`invnFtail(`df_1`,`df_2`,`np`,`p`)`	the inverse reverse cumulative (upper tail or survivor) noncentral F distribution: if `nFtail(`df_1`,`df_2`,`np`,`x`)` $= p$, then `invnFtail(`df_1`,`df_2`,`np`,`p`)` $= x$
`invnibeta(`a`,`b`,`np`,`p`)`	the inverse cumulative noncentral beta distribution: if `nibeta(`a`,`b`,`np`,`x`)` $= p$, then `invibeta(`a`,`b`,`np`,`p`)` $= x$
`invnormal(`p`)`	the inverse cumulative standard normal distribution: if `normal(`z`)` $= p$, then `invnormal(`p`)` $= z$
`invnt(`df`,`np`,`p`)`	the inverse cumulative noncentral Student's t distribution: if `nt(`df`,`np`,`t`)` $= p$, then `invnt(`df`,`np`,`p`)` $= t$
`invnttail(`df`,`np`,`p`)`	the inverse reverse cumulative (upper tail or survivor) noncentral Student's t distribution: if `nttail(`df`,`np`,`t`)` $= p$, then `invnttail(`df`,`np`,`p`)` $= t$
`invpoisson(`k`,`p`)`	the Poisson mean such that the cumulative Poisson distribution evaluated at k is p: if `poisson(`m`,`k`)` $= p$, then `invpoisson(`k`,`p`)` $= m$
`invpoissontail(`k`,`q`)`	the Poisson mean such that the reverse cumulative Poisson distribution evaluated at k is q: if `poissontail(`m`,`k`)` $= q$, then `invpoissontail(`k`,`q`)` $= m$
`invt(`df`,`p`)`	the inverse cumulative Student's t distribution: if `t(`df`,`t`)` $= p$, then `invt(`df`,`p`)` $= t$
`invttail(`df`,`p`)`	the inverse reverse cumulative (upper tail or survivor) Student's t distribution: if `ttail(`df`,`t`)` $= p$, then `invttail(`df`,`p`)` $= t$
`invtukeyprob(`k`,`df`,`p`)`	the inverse cumulative Tukey's Studentized range distribution with k ranges and df degrees of freedom
`invweibull(`a`,`b`,`p`)`	the inverse cumulative Weibull distribution with shape a and scale b: if `weibull(`a`,`b`,`x`)` $= p$, then `invweibull(`a`,`b`,`p`)` $= x$
`invweibull(`a`,`b`,`g`,`p`)`	the inverse cumulative Weibull distribution with shape a, scale b, and location g: if `weibull(`a`,`b`,`g`,`x`)` $= p$, then `invweibull(`a`,`b`,`g`,`p`)` $= x$

invweibullph(a,b,p)	the inverse cumulative Weibull (proportional hazards) distribution with shape a and scale b: if weibullph(a,b,x) $= p$, then invweibullph(a,b,p) $= x$
invweibullph(a,b,g,p)	the inverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g: if weibullph(a,b,g,x) $=$ p, then invweibullph(a,b,g,p) $= x$
invweibullphtail(a,b,p)	the inverse reverse cumulative Weibull (proportional hazards) distribution with shape a and scale b: if weibullphtail(a,b,x)$=p$, then invweibullphtail(a,b,p)$=x$
invweibullphtail(a,b,g,p)	the inverse reverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g: if weibullphtail(a,b,g,x) $= p$, then invweibullphtail(a,b,g,p) $= x$
invweibulltail(a,b,p)	the inverse reverse cumulative Weibull distribution with shape a and scale b: if weibulltail(a,b,x) $= p$, then invweibulltail(a,b,p) $= x$
invweibulltail(a,b,g,p)	the inverse reverse cumulative Weibull distribution with shape a, scale b, and location g: if weibulltail(a,b,g,x) $= p$, then invweibulltail(a,b,g,p) $= x$
lnigammaden(a,b,x)	the natural logarithm of the inverse gamma density, where a is the shape parameter and b is the scale parameter
lnigaussianden(m,a,x)	the natural logarithm of the inverse Gaussian density with mean m and shape parameter a
lniwishartden(df,V,X)	the natural logarithm of the density of the inverse Wishart distribution; missing if $df \le n-1$
lnmvnormalden(M,V,X)	the natural logarithm of the multivariate normal density
lnnormal(z)	the natural logarithm of the cumulative standard normal distribution
lnnormalden(z)	the natural logarithm of the standard normal density, $N(0,1)$
lnnormalden(x,σ)	the natural logarithm of the normal density with mean 0 and standard deviation σ
lnnormalden(x,μ,σ)	the natural logarithm of the normal density with mean μ and standard deviation σ, $N(\mu,\sigma^2)$
lnwishartden(df,V,X)	the natural logarithm of the density of the Wishart distribution; missing if $df \le n-1$
logistic(x)	the cumulative logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$
logistic(s,x)	the cumulative logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
logistic(m,s,x)	the cumulative logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
logisticden(x)	the density of the logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$
logisticden(s,x)	the density of the logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
logisticden(m,s,x)	the density of the logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
logistictail(x)	the reverse cumulative logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$

`logistictail(`s`,`x`)`	the reverse cumulative logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
`logistictail(`m`,`s`,`x`)`	the reverse cumulative logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
`nbetaden(`a`,`b`,`np`,`x`)`	the probability density function of the noncentral beta distribution; `0` if $x < 0$ or $x > 1$
`nbinomial(`n`,`k`,`p`)`	the cumulative probability of the negative binomial distribution
`nbinomialp(`n`,`k`,`p`)`	the negative binomial probability
`nbinomialtail(`n`,`k`,`p`)`	the reverse cumulative probability of the negative binomial distribution
`nchi2(`df`,`np`,`x`)`	the cumulative noncentral χ^2 distribution; `0` if $x < 0$
`nchi2den(`df`,`np`,`x`)`	the probability density of the noncentral χ^2 distribution; `0` if $x < 0$
`nchi2tail(`df`,`np`,`x`)`	the reverse cumulative (upper tail or survivor) noncentral χ^2 distribution; `1` if $x < 0$
`nF(`df_1`,`df_2`,`np`,`f`)`	the cumulative noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `0` if $f < 0$
`nFden(`df_1`,`df_2`,`np`,`f`)`	the probability density function of the noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `0` if $f < 0$
`nFtail(`df_1`,`df_2`,`np`,`f`)`	the reverse cumulative (upper tail or survivor) noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `1` if $f < 0$
`nibeta(`a`,`b`,`np`,`x`)`	the cumulative noncentral beta distribution; `0` if $x < 0$; or `1` if $x > 1$
`normal(`z`)`	the cumulative standard normal distribution
`normalden(`z`)`	the standard normal density, $N(0,1)$
`normalden(`x`,`σ`)`	the normal density with mean 0 and standard deviation σ
`normalden(`x`,`μ`,`σ`)`	the normal density with mean μ and standard deviation σ, $N(\mu,\sigma^2)$
`npnchi2(`df`,`x`,`p`)`	the noncentrality parameter, np, for noncentral χ^2: if `nchi2(`df`,`np`,`x`)` $= p$, then `npnchi2(`df`,`x`,`p`)` $= np$
`npnF(`df_1`,`df_2`,`f`,`p`)`	the noncentrality parameter, np, for the noncentral F: if `nF(`df_1`,`df_2`,`np`,`f`)` $= p$, then `npnF(`df_1`,`df_2`,`f`,`p`)` $= np$
`npnt(`df`,`t`,`p`)`	the noncentrality parameter, np, for the noncentral Student's t distribution: if `nt(`df`,`np`,`t`)` $= p$, then `npnt(`df`,`t`,`p`)` $= np$
`nt(`df`,`np`,`t`)`	the cumulative noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np
`ntden(`df`,`np`,`t`)`	the probability density function of the noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np
`nttail(`df`,`np`,`t`)`	the reverse cumulative (upper tail or survivor) noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np
`poisson(`m`,`k`)`	the probability of observing `floor(`k`)` or fewer outcomes that are distributed as Poisson with mean m
`poissonp(`m`,`k`)`	the probability of observing `floor(`k`)` outcomes that are distributed as Poisson with mean m

`poissontail(`m`,`k`)`	the probability of observing `floor(`k`)` or more outcomes that are distributed as Poisson with mean m
`t(`*df*`,`t`)`	the cumulative Student's t distribution with *df* degrees of freedom
`tden(`*df*`,`t`)`	the probability density function of Student's t distribution
`ttail(`*df*`,`t`)`	the reverse cumulative (upper tail or survivor) Student's t distribution; the probability $T > t$
`tukeyprob(`k`,`*df*`,`x`)`	the cumulative Tukey's Studentized range distribution with k ranges and *df* degrees of freedom; `0` if $x < 0$
`weibull(`a`,`b`,`x`)`	the cumulative Weibull distribution with shape a and scale b
`weibull(`a`,`b`,`g`,`x`)`	the cumulative Weibull distribution with shape a, scale b, and location g
`weibullden(`a`,`b`,`x`)`	the probability density function of the Weibull distribution with shape a and scale b
`weibullden(`a`,`b`,`g`,`x`)`	the probability density function of the Weibull distribution with shape a, scale b, and location g
`weibullph(`a`,`b`,`x`)`	the cumulative Weibull (proportional hazards) distribution with shape a and scale b
`weibullph(`a`,`b`,`g`,`x`)`	the cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g
`weibullphden(`a`,`b`,`x`)`	the probability density function of the Weibull (proportional hazards) distribution with shape a and scale b
`weibullphden(`a`,`b`,`g`,`x`)`	the probability density function of the Weibull (proportional hazards) distribution with shape a, scale b, and location g
`weibullphtail(`a`,`b`,`x`)`	the reverse cumulative Weibull (proportional hazards) distribution with shape a and scale b
`weibullphtail(`a`,`b`,`g`,`x`)`	the reverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g
`weibulltail(`a`,`b`,`x`)`	the reverse cumulative Weibull distribution with shape a and scale b
`weibulltail(`a`,`b`,`g`,`x`)`	the reverse cumulative Weibull distribution with shape a, scale b, and location g

String functions

`abbrev(`s`,`n`)`	name s, abbreviated to a length of n
`char(`n`)`	the character corresponding to ASCII or extended ASCII code n; `""` if n is not in the domain
`collatorlocale(`*loc*`,`*type*`)`	the most closely related locale supported by ICU from *loc* if *type* is `1`; the actual locale where the collation data comes from if *type* is `2`
`collatorversion(`*loc*`)`	the version string of a collator based on locale *loc*
`indexnot(`s_1`,`s_2`)`	the position in ASCII string s_1 of the first character of s_1 not found in ASCII string s_2, or `0` if all characters of s_1 are found in s_2
`plural(`n`,`s`)`	the plural of s if $n \neq \pm 1$
`plural(`n`,`s_1`,`s_2`)`	the plural of s_1, as modified by or replaced with s_2, if $n \neq \pm 1$
`real(`s`)`	s converted to numeric or *missing*

regexm(s,re)	performs a match of a regular expression and evaluates to 1 if regular expression re is satisfied by the ASCII string s; otherwise, 0
regexr(s_1,re,s_2)	replaces the first substring within ASCII string s_1 that matches re with ASCII string s_2 and returns the resulting string
regexs(n)	subexpression n from a previous regexm() match, where $0 \leq n < 10$
soundex(s)	the soundex code for a string, s
soundex_nara(s)	the U.S. Census soundex code for a string, s
strcat(s_1,s_2)	there is no strcat() function; instead the addition operator is used to concatenate strings
strdup(s_1,n)	there is no strdup() function; instead the multiplication operator is used to create multiple copies of strings
string(n)	a synonym for strofreal(n)
string(n,s)	a synonym for strofreal(n,s)
stritrim(s)	s with multiple, consecutive internal blanks (ASCII space character char(32)) collapsed to one blank
strlen(s)	the number of characters in ASCII s or length in bytes
strlower(s)	lowercase ASCII characters in string s
strltrim(s)	s without leading blanks (ASCII space character char(32))
strmatch(s_1,s_2)	1 if s_1 matches the pattern s_2; otherwise, 0
strofreal(n)	n converted to a string
strofreal(n,s)	n converted to a string using the specified display format
strpos(s_1,s_2)	the position in s_1 at which s_2 is first found; otherwise, 0
strproper(s)	a string with the first ASCII letter and any other letters immediately following characters that are not letters; all other ASCII letters converted to lowercase
strreverse(s)	reverses the ASCII string s
strrpos(s_1,s_2)	the position in s_1 at which s_2 is last found; otherwise, 0
strrtrim(s)	s without trailing blanks (ASCII space character char(32))
strtoname(s[,p])	s translated into a Stata 13 compatible name
strtrim(s)	s without leading and trailing blanks (ASCII space character char(32)); equivalent to strltrim(strrtrim(s))
strupper(s)	uppercase ASCII characters in string s
subinstr(s_1,s_2,s_3,n)	s_1, where the first n occurrences in s_1 of s_2 have been replaced with s_3
subinword(s_1,s_2,s_3,n)	s_1, where the first n occurrences in s_1 of s_2 as a word have been replaced with s_3
substr(s,n_1,n_2)	the substring of s, starting at n_1, for a length of n_2
tobytes(s[,n])	escaped decimal or hex digit strings of up to 200 bytes of s
uchar(n)	the Unicode character corresponding to Unicode code point n or an empty string if n is beyond the Unicode code-point range
udstrlen(s)	the number of display columns needed to display the Unicode string s in the Stata Results window
udsubstr(s,n_1,n_2)	the Unicode substring of s, starting at character n_1, for n_2 display columns

`uisdigit(`s`)` — 1 if the first Unicode character in s is a Unicode decimal digit; otherwise, 0

`uisletter(`s`)` — 1 if the first Unicode character in s is a Unicode letter; otherwise, 0

`ustrcompare(`s_1`,`s_2[`,`*loc*]`)` — compares two Unicode strings

`ustrcompareex(`s_1`,`s_2`,`*loc*`,`*st*`,`*case*`,`*cslv*`,`*norm*`,`*num*`,`*alt*`,`*fr*`)` — compares two Unicode strings

`ustrfix(`s[`,`*rep*]`)` — replaces each invalid UTF-8 sequence with a Unicode character

`ustrfrom(`s`,`*enc*`,`*mode*`)` — converts the string s in encoding *enc* to a UTF-8 encoded Unicode string

`ustrinvalidcnt(`s`)` — the number of invalid UTF-8 sequences in s

`ustrleft(`s`,`n`)` — the first n Unicode characters of the Unicode string s

`ustrlen(`s`)` — the number of characters in the Unicode string s

`ustrlower(`s[`,`*loc*]`)` — lowercase all characters of Unicode string s under the given locale *loc*

`ustrltrim(`s`)` — removes the leading Unicode whitespace characters and blanks from the Unicode string s

`ustrnormalize(`s`,`*norm*`)` — normalizes Unicode string s to one of the five normalization forms specified by *norm*

`ustrpos(`s_1`,`s_2[`,`n]`)` — the position in s_1 at which s_2 is first found; otherwise, 0

`ustrregexm(`s`,`*re*[`,`*noc*]`)` — performs a match of a regular expression and evaluates to 1 if regular expression *re* is satisfied by the Unicode string s; otherwise, 0

`ustrregexra(`s_1`,`*re*`,`s_2[`,`*noc*]`)` — replaces all substrings within the Unicode string s_1 that match *re* with s_2 and returns the resulting string

`ustrregexrf(`s_1`,`*re*`,`s_2[`,`*noc*]`)` — replaces the first substring within the Unicode string s_1 that matches *re* with s_2 and returns the resulting string

`ustrregexs(`n`)` — subexpression n from a previous `ustrregexm()` match

`ustrreverse(`s`)` — reverses the Unicode string s

`ustrright(`s`,`n`)` — the last n Unicode characters of the Unicode string s

`ustrrpos(`s_1`,`s_2`,`[`,`n]`)` — the position in s_1 at which s_2 is last found; otherwise, 0

`ustrrtrim(`s`)` — remove trailing Unicode whitespace characters and blanks from the Unicode string s

`ustrsortkey(`s[`,`*loc*]`)` — generates a null-terminated byte array that can be used by the `sort` command to produce the same order as `ustrcompare()`

`ustrsortkeyex(`s`,`*loc*`,`*st*`,`*case*`,`*cslv*`,`*norm*`,`*num*`,`*alt*`,`*fr*`)` — generates a null-terminated byte array that can be used by the `sort` command to produce the same order as `ustrcompare()`

`ustrtitle(`s[`,`*loc*]`)` — a string with the first characters of Unicode words titlecased and other characters lowercased

`ustrto(`s`,`*enc*`,`*mode*`)` — converts the Unicode string s in UTF-8 encoding to a string in encoding *enc*

`ustrtohex(`s[`,`n]`)` — escaped hex digit string of s up to 200 Unicode characters

`ustrtoname(`s[`,`p]`)` — string s translated into a Stata name

`ustrtrim(`s`)` — removes leading and trailing Unicode whitespace characters and blanks from the Unicode string s

ustrunescape(s)	the Unicode string corresponding to the escaped sequences of s
ustrupper(s[,loc])	uppercase all characters in string s under the given locale loc
ustrword(s,n[,noc])	the nth Unicode word in the Unicode string s
ustrwordcount(s[,loc])	the number of nonempty Unicode words in the Unicode string s
usubinstr(s_1,s_2,s_3,n)	replaces the first n occurrences of the Unicode string s_2 with the Unicode string s_3 in s_1
usubstr(s,n_1,n_2)	the Unicode substring of s, starting at n_1, for a length of n_2
word(s,n)	the nth word in s; *missing* ("") if n is missing
wordbreaklocale(loc,$type$)	the most closely related locale supported by ICU from loc if $type$ is 1, the actual locale where the word-boundary analysis data come from if $type$ is 2; or an empty string is returned for any other $type$
wordcount(s)	the number of words in s

Trigonometric functions

acos(x)	the radian value of the arccosine of x
acosh(x)	the inverse hyperbolic cosine of x
asin(x)	the radian value of the arcsine of x
asinh(x)	the inverse hyperbolic sine of x
atan(x)	the radian value of the arctangent of x
atan2(y, x)	the radian value of the arctangent of y/x, where the signs of the parameters y and x are used to determine the quadrant of the answer
atanh(x)	the inverse hyperbolic tangent of x
cos(x)	the cosine of x, where x is in radians
cosh(x)	the hyperbolic cosine of x
sin(x)	the sine of x, where x is in radians
sinh(x)	the hyperbolic sine of x
tan(x)	the tangent of x, where x is in radians
tanh(x)	the hyperbolic tangent of x

Also see

[D] **egen** — Extensions to generate

[M-5] **intro** — Alphabetical index to functions

[U] **13.3 Functions**

[U] **14.8 Matrix functions**

Title

Functions by name

`abbrev(`s`,`n`)`	name s, abbreviated to a length of n
`abs(`x`)`	the absolute value of x
`acos(`x`)`	the radian value of the arccosine of x
`acosh(`x`)`	the inverse hyperbolic cosine of x
`asin(`x`)`	the radian value of the arcsine of x
`asinh(`x`)`	the inverse hyperbolic sine of x
`atan(`x`)`	the radian value of the arctangent of x
`atan2(`y`, `x`)`	the radian value of the arctangent of y/x, where the signs of the parameters y and x are used to determine the quadrant of the answer
`atanh(`x`)`	the inverse hyperbolic tangent of x
`autocode(`x`,`n`,`x_0`,`x_1`)`	partitions the interval from x_0 to x_1 into n equal-length intervals and returns the upper bound of the interval that contains x
`betaden(`a`,`b`,`x`)`	the probability density of the beta distribution, where a and b are the shape parameters; `0` if $x < 0$ or $x > 1$
`binomial(`n`,`k`,`θ`)`	the probability of observing `floor(`k`)` or fewer successes in `floor(`n`)` trials when the probability of a success on one trial is θ; `0` if $k < 0$; or `1` if $k > n$
`binomialp(`n`,`k`,`p`)`	the probability of observing `floor(`k`)` successes in `floor(`n`)` trials when the probability of a success on one trial is p
`binomialtail(`n`,`k`,`θ`)`	the probability of observing `floor(`k`)` or more successes in `floor(`n`)` trials when the probability of a success on one trial is θ; `1` if $k < 0$; or `0` if $k > n$
`binormal(`h`,`k`,`ρ`)`	the joint cumulative distribution $\Phi(h, k, \rho)$ of bivariate normal with correlation ρ
`bofd("`*cal*`",`e_d`)`	the e_b business date corresponding to e_d
`byteorder()`	`1` if your computer stores numbers by using a hilo byte order and evaluates to `2` if your computer stores numbers by using a lohi byte order
`c(`*name*`)`	the value of the system or constant result `c(`*name*`)` (see [P] **creturn**)
`_caller()`	`version` of the program or session that invoked the currently running program; see [P] **version**
`Cdhms(`e_d`,`h`,`m`,`s`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to e_d, h, m, s
`ceil(`x`)`	the unique integer n such that $n - 1 < x \leq n$; x (not "`.`") if x is missing, meaning that `ceil(.a)` = `.a`
`char(`n`)`	the character corresponding to ASCII or extended ASCII code n; `""` if n is not in the domain
`chi2(`*df*`,`x`)`	the cumulative χ^2 distribution with *df* degrees of freedom; `0` if $x < 0$
`chi2den(`*df*`,`x`)`	the probability density of the chi-squared distribution with *df* degrees of freedom; `0` if $x < 0$

chi2tail(df,x)	the reverse cumulative (upper tail or survivor) χ^2 distribution with df degrees of freedom; 1 if $x < 0$
Chms(h,m,s)	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to h, m, s on 01jan1960
chop(x, ϵ)	round(x) if abs(x − round(x)) $< \epsilon$; otherwise, x; or x if x is missing
cholesky(M)	the Cholesky decomposition of the matrix: if R = cholesky(S), then $RR^T = S$
clip(x,a,b)	x if $a < x < b$, b if $x \geq b$, a if $x \leq a$, or *missing* if x is missing or if $a > b$; x if x is missing
Clock(s_1,s_2[,Y])	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to s_1 based on s_2 and Y
clock(s_1,s_2[,Y])	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to s_1 based on s_2 and Y
cloglog(x)	the complementary log-log of x
Cmdyhms(M,D,Y,h,m,s)	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to M, D, Y, h, m, s
Cofc(e_{tc})	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of e_{tc} (ms. without leap seconds since 01jan1960 00:00:00.000)
cofC(e_{tC})	the e_{tc} datetime (ms. without leap seconds since 01jan1960 00:00:00.000) of e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
Cofd(e_d)	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of date e_d at time 00:00:00.000
cofd(e_d)	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) of date e_d at time 00:00:00.000
collatorlocale(loc,$type$)	the most closely related locale supported by ICU from loc if $type$ is 1; the actual locale where the collation data comes from if $type$ is 2
collatorversion(loc)	the version string of a collator based on locale loc
colnumb(M,s)	the column number of M associated with column name s; *missing* if the column cannot be found
colsof(M)	the number of columns of M
comb(n,k)	the combinatorial function $n!/\{k!(n-k)!\}$
cond(x,a,b[,c])	a if x is *true* and nonmissing, b if x is *false*, and c if x is *missing*; a if c is not specified and x evaluates to *missing*
corr(M)	the correlation matrix of the variance matrix
cos(x)	the cosine of x, where x is in radians
cosh(x)	the hyperbolic cosine of x
daily(s_1,s_2[,Y])	a synonym for date(s_1,s_2[,Y])
date(s_1,s_2[,Y])	the e_d date (days since 01jan1960) corresponding to s_1 based on s_2 and Y
day(e_d)	the numeric day of the month corresponding to e_d
det(M)	the determinant of matrix M
dgammapda(a,x)	$\frac{\partial P(a,x)}{\partial a}$, where $P(a,x)$ = gammap(a,x); 0 if $x < 0$

dgammapdada(a,x)	$\frac{\partial^2 P(a,x)}{\partial a^2}$, where $P(a,x)=$ gammap(a,x); 0 if $x<0$
dgammapdadx(a,x)	$\frac{\partial^2 P(a,x)}{\partial a \partial x}$, where $P(a,x)=$ gammap(a,x); 0 if $x<0$
dgammapdx(a,x)	$\frac{\partial P(a,x)}{\partial x}$, where $P(a,x)=$ gammap(a,x); 0 if $x<0$
dgammapdxdx(a,x)	$\frac{\partial^2 P(a,x)}{\partial x^2}$, where $P(a,x)=$ gammap(a,x); 0 if $x<0$
dhms(e_d,h,m,s)	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to e_d, h, m, and s
diag(v)	the square, diagonal matrix created from the row or column vector
diag0cnt(M)	the number of zeros on the diagonal of M
digamma(x)	the digamma() function, $d\ln\Gamma(x)/dx$
dofb(e_b,"*cal*")	the e_d datetime corresponding to e_b
dofC(e_{tC})	the e_d date (days since 01jan1960) of datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
dofc(e_{tc})	the e_d date (days since 01jan1960) of datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
dofh(e_h)	the e_d date (days since 01jan1960) of the start of half-year e_h
dofm(e_m)	the e_d date (days since 01jan1960) of the start of month e_m
dofq(e_q)	the e_d date (days since 01jan1960) of the start of quarter e_q
dofw(e_w)	the e_d date (days since 01jan1960) of the start of week e_w
dofy(e_y)	the e_d date (days since 01jan1960) of 01jan in year e_y
dow(e_d)	the numeric day of the week corresponding to date e_d; $0=$ Sunday, $1=$ Monday, …, $6=$ Saturday
doy(e_d)	the numeric day of the year corresponding to date e_d
dunnettprob(k,df,x)	the cumulative multiple range distribution that is used in Dunnett's multiple-comparison method with k ranges and df degrees of freedom; 0 if $x<0$
e(*name*)	the value of stored result e(*name*); see **[U] 18.8 Accessing results calculated by other programs**
el(s,i,j)	s[floor(i),floor(j)], the i,j element of the matrix named s; *missing* if i or j are out of range or if matrix s does not exist
e(sample)	1 if the observation is in the estimation sample and 0 otherwise
epsdouble()	the machine precision of a double-precision number
epsfloat()	the machine precision of a floating-point number
exp(x)	the exponential function e^x
exponential(b,x)	the cumulative exponential distribution with scale b
exponentialden(b,x)	the probability density function of the exponential distribution with scale b
exponentialtail(b,x)	the reverse cumulative exponential distribution with scale b
F(df_1,df_2,f)	the cumulative F distribution with df_1 numerator and df_2 denominator degrees of freedom: F(df_1,df_2,f) $= \int_0^f$ Fden(df_1,df_2,t) dt; 0 if $f<0$
Fden(df_1,df_2,f)	the probability density function of the F distribution with df_1 numerator and df_2 denominator degrees of freedom; 0 if $f<0$
fileexists(f)	1 if the file specified by f exists; otherwise, 0

`fileread(`f`)`	the contents of the file specified by f
`filereaderror(`f`)`	`0` or positive integer, said value having the interpretation of a return code
`filewrite(`f`,`s`[,`r`])`	writes the string specified by s to the file specified by f and returns the number of bytes in the resulting file
`float(`x`)`	the value of x rounded to `float` precision
`floor(`x`)`	the unique integer n such that $n \leq x < n+1$; x (not "`.`") if x is missing, meaning that `floor(.a)` = `.a`
`fmtwidth(`*fmtstr*`)`	the output length of the *%fmt* contained in *fmtstr*; *missing* if *fmtstr* does not contain a valid *%fmt*
`Ftail(`df_1`,`df_2`,`f`)`	the reverse cumulative (upper tail or survivor) F distribution with df_1 numerator and df_2 denominator degrees of freedom; `1` if $f < 0$
`gammaden(`a`,`b`,`g`,`x`)`	the probability density function of the gamma distribution; `0` if $x < g$
`gammap(`a`,`x`)`	the cumulative gamma distribution with shape parameter a; `0` if $x < 0$
`gammaptail(`a`,`x`)`	the reverse cumulative (upper tail or survivor) gamma distribution with shape parameter a; `1` if $x < 0$
`get(`*systemname*`)`	a copy of Stata internal system matrix *systemname*
`hadamard(`M`,`N`)`	a matrix whose i, j element is $M[i,j] \cdot N[i,j]$ (if M and N are not the same size, this function reports a conformability error)
`halfyear(`e_d`)`	the numeric half of the year corresponding to date e_d
`halfyearly(`s_1`,`s_2`[,`Y`])`	the e_h half-yearly date (half-years since 1960h1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
`has_eprop(`*name*`)`	`1` if *name* appears as a word in `e(properties)`; otherwise, `0`
`hh(`e_{tc}`)`	the hour corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
`hhC(`e_{tC}`)`	the hour corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
`hms(`h`,`m`,`s`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to h, m, s on 01jan1960
`hofd(`e_d`)`	the e_h half-yearly date (half years since 1960h1) containing date e_d
`hours(`ms`)`	$ms/3{,}600{,}000$
`hypergeometric(`N`,`K`,`n`,`k`)`	the cumulative probability of the hypergeometric distribution
`hypergeometricp(`N`,`K`,`n`,`k`)`	the hypergeometric probability of k successes out of a sample of size n, from a population of size N containing K elements that have the attribute of interest
`I(`n`)`	an $n \times n$ identity matrix if n is an integer; otherwise, a `round(`n`)` $\times$ `round(`n`)` identity matrix
`ibeta(`a`,`b`,`x`)`	the cumulative beta distribution with shape parameters a and b; `0` if $x < 0$; or `1` if $x > 1$
`ibetatail(`a`,`b`,`x`)`	the reverse cumulative (upper tail or survivor) beta distribution with shape parameters a and b; `1` if $x < 0$; or `0` if $x > 1$
`igaussian(`m`,`a`,`x`)`	the cumulative inverse Gaussian distribution with mean m and shape parameter a; `0` if $x \leq 0$
`igaussianden(`m`,`a`,`x`)`	the probability density of the inverse Gaussian distribution with mean m and shape parameter a; `0` if $x \leq 0$

igaussiantail(m,a,x)	the reverse cumulative (upper tail or survivor) inverse Gaussian distribution with mean m and shape parameter a; 1 if $x \leq 0$
indexnot(s_1,s_2)	the position in ASCII string s_1 of the first character of s_1 not found in ASCII string s_2, or 0 if all characters of s_1 are found in s_2
inlist(z,a,b,...)	1 if z is a member of the remaining arguments; otherwise, 0
inrange(z,a,b)	1 if it is known that $a \leq z \leq b$; otherwise, 0
int(x)	the integer obtained by truncating x toward 0 (thus, int(5.2) $= 5$ and int(-5.8) $= -5$); x (not ".") if x is missing, meaning that int(.a) $=$ .a
inv(M)	the inverse of the matrix M
invbinomial(n,k,p)	the inverse of the cumulative binomial; that is, θ ($\theta =$ probability of success on one trial) such that the probability of observing floor(k) or fewer successes in floor(n) trials is p
invbinomialtail(n,k,p)	the inverse of the right cumulative binomial; that is, θ ($\theta =$ probability of success on one trial) such that the probability of observing floor(k) or more successes in floor(n) trials is p
invchi2(df,p)	the inverse of chi2(): if chi2(df,x) $= p$, then invchi2(df,p) $=$ x
invchi2tail(df,p)	the inverse of chi2tail(): if chi2tail(df,x) $= p$, then invchi2tail(df,p) $= x$
invcloglog(x)	the inverse of the complementary log-log function of x
invdunnettprob(k,df,p)	the inverse cumulative multiple range distribution that is used in Dunnett's multiple-comparison method with k ranges and df degrees of freedom
invexponential(b,p)	the inverse cumulative exponential distribution with scale b: if exponential(b,x) $= p$, then invexponential(b,p) $= x$
invexponentialtail(b,p)	the inverse reverse cumulative exponential distribution with scale b: if exponentialtail(b,x) $= p$, then invexponentialtail(b,p) $= x$
invF(df_1,df_2,p)	the inverse cumulative F distribution: if F(df_1,df_2,f) $= p$, then invF(df_1,df_2,p) $= f$
invFtail(df_1,df_2,p)	the inverse reverse cumulative (upper tail or survivor) F distribution: if Ftail(df_1,df_2,f) $= p$, then invFtail(df_1,df_2,p) $= f$
invgammap(a,p)	the inverse cumulative gamma distribution: if gammap(a,x) $= p$, then invgammap(a,p) $= x$
invgammaptail(a,p)	the inverse reverse cumulative (upper tail or survivor) gamma distribution: if gammaptail(a,x) $= p$, then invgammaptail(a,p) $= x$
invibeta(a,b,p)	the inverse cumulative beta distribution: if ibeta(a,b,x) $= p$, then invibeta(a,b,p) $= x$
invibetatail(a,b,p)	the inverse reverse cumulative (upper tail or survivor) beta distribution: if ibetatail(a,b,x) $= p$, then invibetatail(a,b,p) $= x$
invigaussian(m,a,p)	the inverse of igaussian(): if igaussian(m,a,x) $= p$, then invigaussian(m,a,p) $= x$
invigaussiantail(m,a,p)	the inverse of igaussiantail(): if igaussiantail(m,a,x) $= p$, then invigaussiantail(m,a,p x

invlogistic(p)
: the inverse cumulative logistic distribution: if logistic(x) $= p$, then invlogistic(p) $= x$

invlogistic(s,p)
: the inverse cumulative logistic distribution: if logistic(s,x) $= p$, then invlogistic(s,p) $= x$

invlogistic(m,s,p)
: the inverse cumulative logistic distribution: if logistic(m,s,x) $= p$, then invlogistic(m,s,p) $= x$

invlogistictail(p)
: the inverse reverse cumulative logistic distribution: if logistictail(x) $= p$, then invlogistictail(p) $= x$

invlogistictail(s,p)
: the inverse cumulative logistic distribution: if logistic(s,x) $= p$, then invlogistic(s,p) $= x$

invlogistictail(m,s,p)
: the inverse cumulative logistic distribution: if logistic(m,s,x) $= p$, then invlogistic(m,s,p) $= x$

invlogit(x)
: the inverse of the logit function of x

invnbinomial(n,k,q)
: the value of the negative binomial parameter, p, such that $q =$ nbinomial(n,k,p)

invnbinomialtail(n,k,q)
: the value of the negative binomial parameter, p, such that $q =$ nbinomialtail(n,k,p)

invnchi2(df,np,p)
: the inverse cumulative noncentral χ^2 distribution: if nchi2(df,np,x) $= p$, then invnchi2(df,np,p) $= x$

invnchi2tail(df,np,p)
: the inverse reverse cumulative (upper tail or survivor) noncentral χ^2 distribution: if nchi2tail(df,np,x) $= p$, then invnchi2tail(df,np,p) $= x$

invnF(df_1,df_2,np,p)
: the inverse cumulative noncentral F distribution: if nF(df_1,df_2,np,f) $= p$, then invnF(df_1,df_2,np,p) $= f$

invnFtail(df_1,df_2,np,p)
: the inverse reverse cumulative (upper tail or survivor) noncentral F distribution: if nFtail(df_1,df_2,np,x) $= p$, then invnFtail(df_1,df_2,np,p) $= x$

invnibeta(a,b,np,p)
: the inverse cumulative noncentral beta distribution: if nibeta(a,b,np,x) $= p$, then invibeta(a,b,np,p) $= x$

invnormal(p)
: the inverse cumulative standard normal distribution: if normal(z) $= p$, then invnormal(p) $= z$

invnt(df,np,p)
: the inverse cumulative noncentral Student's t distribution: if nt(df,np,t) $= p$, then invnt(df,np,p) $= t$

invnttail(df,np,p)
: the inverse reverse cumulative (upper tail or survivor) noncentral Student's t distribution: if nttail(df,np,t) $= p$, then invnttail(df,np,p) $= t$

invpoisson(k,p)
: the Poisson mean such that the cumulative Poisson distribution evaluated at k is p: if poisson(m,k) $= p$, then invpoisson(k,p) $= m$

invpoissontail(k,q)
: the Poisson mean such that the reverse cumulative Poisson distribution evaluated at k is q: if poissontail(m,k) $= q$, then invpoissontail(k,q) $= m$

invsym(M)
: the inverse of M if M is positive definite

invt(df,p)
: the inverse cumulative Student's t distribution: if t(df,t) $= p$, then invt(df,p) $= t$

invttail(df,p)
: the inverse reverse cumulative (upper tail or survivor) Student's t distribution: if ttail(df,t) $= p$, then invttail(df,p) $= t$

`invtukeyprob(`k`,`df`,`p`)`	the inverse cumulative Tukey's Studentized range distribution with k ranges and df degrees of freedom
`invweibull(`a`,`b`,`p`)`	the inverse cumulative Weibull distribution with shape a and scale b: if `weibull(`a`,`b`,`x`)` $= p$, then `invweibull(`a`,`b`,`p`)` $= x$
`invweibull(`a`,`b`,`g`,`p`)`	the inverse cumulative Weibull distribution with shape a, scale b, and location g: if `weibull(`a`,`b`,`g`,`x`)` $= p$, then `invweibull(`a`,`b`,`g`,`p`)` $= x$
`invweibullph(`a`,`b`,`p`)`	the inverse cumulative Weibull (proportional hazards) distribution with shape a and scale b: if `weibullph(`a`,`b`,`x`)` $= p$, then `invweibullph(`a`,`b`,`p`)` $= x$
`invweibullph(`a`,`b`,`g`,`p`)`	the inverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g: if `weibullph(`a`,`b`,`g`,`x`)` $=$ p, then `invweibullph(`a`,`b`,`g`,`p`)` $= x$
`invweibullphtail(`a`,`b`,`p`)`	the inverse reverse cumulative Weibull (proportional hazards) distribution with shape a and scale b: if `weibullphtail(`a`,`b`,`x`)`$=p$, then `invweibullphtail(`a`,`b`,`p`)`$=x$
`invweibullphtail(`a`,`b`,`g`,`p`)`	the inverse reverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g: if `weibullphtail(`a`,`b`,`g`,`x`)` $= p$, then `invweibullphtail(`a`,`b`,`g`,`p`)` $= x$
`invweibulltail(`a`,`b`,`p`)`	the inverse reverse cumulative Weibull distribution with shape a and scale b: if `weibulltail(`a`,`b`,`x`)` $= p$, then `invweibulltail(`a`,`b`,`p`)` $= x$
`invweibulltail(`a`,`b`,`g`,`p`)`	the inverse reverse cumulative Weibull distribution with shape a, scale b, and location g: if `weibulltail(`a`,`b`,`g`,`x`)` $= p$, then `invweibulltail(`a`,`b`,`g`,`p`)` $= x$
`irecode(`x`,`x_1`,`$\dots$`,`x_n`)`	*missing* if x is missing or $x_1, \dots, x_n$ is not weakly increasing; `0` if $x \le x_1$; `1` if $x_1 < x \le x_2$; `2` if $x_2 < x \le x_3$; $\dots$; n if $x > x_n$
`issymmetric(`M`)`	`1` if the matrix is symmetric; otherwise, `0`
`J(`r`,`c`,`z`)`	the $r \times c$ matrix containing elements z
`ln(`x`)`	the natural logarithm, $\ln(x)$
`lnfactorial(`n`)`	the natural log of factorial = $\ln(n!)$
`lngamma(`x`)`	$\ln\{\Gamma(x)\}$
`lnigammaden(`a`,`b`,`x`)`	the natural logarithm of the inverse gamma density, where a is the shape parameter and b is the scale parameter
`lnigaussianden(`m`,`a`,`x`)`	the natural logarithm of the inverse Gaussian density with mean m and shape parameter a
`lniwishartden(`df`,`V`,`X`)`	the natural logarithm of the density of the inverse Wishart distribution; missing if $df \le n - 1$
`lnmvnormalden(`M`,`V`,`X`)`	the natural logarithm of the multivariate normal density
`lnnormal(`z`)`	the natural logarithm of the cumulative standard normal distribution
`lnnormalden(`z`)`	the natural logarithm of the standard normal density, $N(0,1)$
`lnnormalden(`x`,`σ`)`	the natural logarithm of the normal density with mean 0 and standard deviation σ
`lnnormalden(`x`,`μ`,`σ`)`	the natural logarithm of the normal density with mean μ and standard deviation σ, $N(\mu, \sigma^2)$

`lnwishartden(`df`,`V`,`X`)`	the natural logarithm of the density of the Wishart distribution; missing if $df \le n-1$
`log(`x`)`	the natural logarithm, $\ln(x)$; thus, a synonym for `ln(`x`)`
`log10(`x`)`	the base-10 logarithm of x
`logistic(`x`)`	the cumulative logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$
`logistic(`s`,`x`)`	the cumulative logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
`logistic(`m`,`s`,`x`)`	the cumulative logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
`logisticden(`x`)`	the density of the logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$
`logisticden(`s`,`x`)`	the density of the logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
`logisticden(`m`,`s`,`x`)`	the density of the logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
`logistictail(`x`)`	the reverse cumulative logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$
`logistictail(`s`,`x`)`	the reverse cumulative logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
`logistictail(`m`,`s`,`x`)`	the reverse cumulative logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
`logit(`x`)`	the log of the odds ratio of x, `logit(`x`)` $= \ln\{x/(1-x)\}$
`matmissing(`M`)`	`1` if any elements of the matrix are missing; otherwise, `0`
`matrix(`*exp*`)`	restricts name interpretation to scalars and matrices; see `scalar()`
`matuniform(`r`,`c`)`	the $r \times c$ matrices containing uniformly distributed pseudorandom numbers on the interval $(0,1)$
`max(`x_1`,`x_2`,...,`x_n`)`	the maximum value of $x_1, x_2, \ldots, x_n$
`maxbyte()`	the largest value that can be stored in storage type `byte`
`maxdouble()`	the largest value that can be stored in storage type `double`
`maxfloat()`	the largest value that can be stored in storage type `float`
`maxint()`	the largest value that can be stored in storage type `int`
`maxlong()`	the largest value that can be stored in storage type `long`
`mdy(`M`,`D`,`Y`)`	the e_d date (days since 01jan1960) corresponding to M, D, Y
`mdyhms(`M`,`D`,`Y`,`h`,`m`,`s`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to M, D, Y, h, m, s
`mi(`x_1`,`x_2`,...,`x_n`)`	a synonym for `missing(`x_1`,`x_2`,...,`x_n`)`
`min(`x_1`,`x_2`,...,`x_n`)`	the minimum value of $x_1, x_2, \ldots, x_n$
`minbyte()`	the smallest value that can be stored in storage type `byte`
`mindouble()`	the smallest value that can be stored in storage type `double`
`minfloat()`	the smallest value that can be stored in storage type `float`
`minint()`	the smallest value that can be stored in storage type `int`
`minlong()`	the smallest value that can be stored in storage type `long`

`minutes(`ms`)`	$ms/60{,}000$
`missing(`x_1`,`x_2`,`...`,`x_n`)`	`1` if any x_i evaluates to *missing*; otherwise, `0`
`mm(`e_{tc}`)`	the minute corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
`mmC(`e_{tC}`)`	the minute corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
`mod(`x`,`y`)`	the modulus of x with respect to y
`mofd(`e_d`)`	the e_m monthly date (months since 1960m1) containing date e_d
`month(`e_d`)`	the numeric month corresponding to date e_d
`monthly(`s_1`,`s_2`[,`Y`])`	the e_m monthly date (months since 1960m1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
`mreldif(`X`,`Y`)`	the relative difference of X and Y, where the relative difference is defined as $\max_{i,j}\{\lvert x_{ij}-y_{ij}\rvert/(\lvert y_{ij}\rvert+1)\}$
`msofhours(`h`)`	$h \times 3{,}600{,}000$
`msofminutes(`m`)`	$m \times 60{,}000$
`msofseconds(`s`)`	$s \times 1{,}000$
`nbetaden(`a`,`b`,`np`,`x`)`	the probability density function of the noncentral beta distribution; `0` if $x<0$ or $x>1$
`nbinomial(`n`,`k`,`p`)`	the cumulative probability of the negative binomial distribution
`nbinomialp(`n`,`k`,`p`)`	the negative binomial probability
`nbinomialtail(`n`,`k`,`p`)`	the reverse cumulative probability of the negative binomial distribution
`nchi2(`df`,`np`,`x`)`	the cumulative noncentral χ^2 distribution; `0` if $x<0$
`nchi2den(`df`,`np`,`x`)`	the probability density of the noncentral χ^2 distribution; `0` if $x<0$
`nchi2tail(`df`,`np`,`x`)`	the reverse cumulative (upper tail or survivor) noncentral χ^2 distribution; `1` if $x<0$
`nF(`df_1`,`df_2`,`np`,`f`)`	the cumulative noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `0` if $f<0$
`nFden(`df_1`,`df_2`,`np`,`f`)`	the probability density function of the noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `0` if $f<0$
`nFtail(`df_1`,`df_2`,`np`,`f`)`	the reverse cumulative (upper tail or survivor) noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `1` if $f<0$
`nibeta(`a`,`b`,`np`,`x`)`	the cumulative noncentral beta distribution; `0` if $x<0$; or `1` if $x>1$
`normal(`z`)`	the cumulative standard normal distribution
`normalden(`z`)`	the standard normal density, $N(0,1)$
`normalden(`x`,`σ`)`	the normal density with mean 0 and standard deviation σ
`normalden(`x`,`μ`,`σ`)`	the normal density with mean μ and standard deviation σ, $N(\mu,\sigma^2)$
`npnchi2(`df`,`x`,`p`)`	the noncentrality parameter, np, for noncentral χ^2: if `nchi2(`df`,`np`,`x`)` $=p$, then `npnchi2(`df`,`x`,`p`)` $=np$
`npnF(`df_1`,`df_2`,`f`,`p`)`	the noncentrality parameter, np, for the noncentral F: if `nF(`df_1`,`df_2`,`np`,`f`)` $=p$, then `npnF(`df_1`,`df_2`,`f`,`p`)` $=np$

`npnt(`df`,`t`,`p`)` the noncentrality parameter, np, for the noncentral Student's t distribution: if `nt(`df`,`np`,`t`)` $= p$, then `npnt(`df`,`t`,`p`)` $= np$

`nt(`df`,`np`,`t`)` the cumulative noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np

`ntden(`df`,`np`,`t`)` the probability density function of the noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np

`nttail(`df`,`np`,`t`)` the reverse cumulative (upper tail or survivor) noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np

`nullmat(`*matname*`)` use with the row-join (`,`) and column-join (`\`) operators in programming situations

`plural(`n`,`s`)` the plural of s if $n \neq \pm 1$

`plural(`n`,`s_1`,`s_2`)` the plural of s_1, as modified by or replaced with s_2, if $n \neq \pm 1$

`poisson(`m`,`k`)` the probability of observing `floor(`k`)` or fewer outcomes that are distributed as Poisson with mean m

`poissonp(`m`,`k`)` the probability of observing `floor(`k`)` outcomes that are distributed as Poisson with mean m

`poissontail(`m`,`k`)` the probability of observing `floor(`k`)` or more outcomes that are distributed as Poisson with mean m

`qofd(`e_d`)` the e_q quarterly date (quarters since 1960q1) containing date e_d

`quarter(`e_d`)` the numeric quarter of the year corresponding to date e_d

`quarterly(`s_1`,`s_2[`,`Y]`)` the e_q quarterly date (quarters since 1960q1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`

`r(`*name*`)` the value of the stored result `r(`*name*`)`; see [U] **18.8 Accessing results calculated by other programs**

`rbeta(`a`,`b`)` beta(a,b) random variates, where a and b are the beta distribution shape parameters

`rbinomial(`n`,`p`)` binomial(n,p) random variates, where n is the number of trials and p is the success probability

`rchi2(`df`)` chi-squared, with df degrees of freedom, random variates

`recode(`x`,`x_1`,`$\ldots$`,`x_n`)` *missing* if $x_1, \ldots, x_n$ is not weakly increasing; x if x is missing; x_1 if $x \leq x_1$; x_2 if $x \leq x_2$, ...; otherwise, x_n if $x > x_1$, x_2, ..., x_{n-1} or $x_i \geq .$ is interpreted as $x_i = +\infty$

`real(`s`)` s converted to numeric or *missing*

`regexm(`s`,`re`)` performs a match of a regular expression and evaluates to `1` if regular expression re is satisfied by the ASCII string s; otherwise, `0`

`regexr(`s_1`,`re`,`s_2`)` replaces the first substring within ASCII string s_1 that matches re with ASCII string s_2 and returns the resulting string

`regexs(`n`)` subexpression n from a previous `regexm()` match, where $0 \leq n < 10$

`reldif(`x`,`y`)` the "relative" difference $|x - y|/(|y| + 1)$; `0` if both arguments are the same type of extended missing value; *missing* if only one argument is missing or if the two arguments are two different types of *missing*

`replay()` `1` if the first nonblank character of local macro `` `0' `` is a comma, or if `` `0' `` is empty

`return(`*name*`)` the value of the to-be-stored result `r(`*name*`)`; see [P] **return**

`rexponential(`b`)`	exponential random variates with scale b
`rgamma(`a`,`b`)`	gamma(a,b) random variates, where a is the gamma shape parameter and b is the scale parameter
`rhypergeometric(`N`,`K`,`n`)`	hypergeometric random variates
`rigaussian(`m`,`a`)`	inverse Gaussian random variates with mean m and shape parameter a
`rlogistic()`	logistic variates with mean 0 and standard deviation $\pi/\sqrt{3}$
`rlogistic(`s`)`	logistic variates with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
`rlogistic(`m`,`s`)`	logistic variates with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
`rnbinomial(`n`,`p`)`	negative binomial random variates
`rnormal()`	standard normal (Gaussian) random variates, that is, variates from a normal distribution with a mean of 0 and a standard deviation of 1
`rnormal(`m`)`	normal(m,1) (Gaussian) random variates, where m is the mean and the standard deviation is 1
`rnormal(`m`,`s`)`	normal(m,s) (Gaussian) random variates, where m is the mean and s is the standard deviation
`round(`x`,`y`)` or `round(`x`)`	x rounded in units of y or x rounded to the nearest integer if the argument y is omitted; x (not "`.`") if x is missing (meaning that `round(.a)` = `.a` and that `round(.a,`y`)` = `.a` if y is not missing) and if y is missing, then "`.`" is returned
`rownumb(`M`,`s`)`	the row number of M associated with row name s; *missing* if the row cannot be found
`rowsof(`M`)`	the number of rows of M
`rpoisson(`m`)`	Poisson(m) random variates, where m is the distribution mean
`rt(`*df*`)`	Student's t random variates, where *df* is the degrees of freedom
`runiform()`	uniformly distributed random variates over the interval $(0, 1)$
`runiform(`a`,`b`)`	uniformly distributed random variates over the interval (a, b)
`runiformint(`a`,`b`)`	uniformly distributed random integer variates on the interval $[a, b]$
`rweibull(`a`,`b`)`	Weibull variates with shape a and scale b
`rweibull(`a`,`b`,`g`)`	Weibull variates with shape a, scale b, and location g
`rweibullph(`a`,`b`)`	Weibull (proportional hazards) variates with shape a and scale b
`rweibullph(`a`,`b`,`g`)`	Weibull (proportional hazards) variates with shape a, scale b, and location g
`s(`*name*`)`	the value of stored result `s(`*name*`)`; see **[U] 18.8 Accessing results calculated by other programs**
`scalar(`*exp*`)`	restricts name interpretation to scalars and matrices
`seconds(`ms`)`	$ms/1{,}000$
`sign(`x`)`	the sign of x: -1 if $x < 0$, 0 if $x = 0$, 1 if $x > 0$, or *missing* if x is missing
`sin(`x`)`	the sine of x, where x is in radians
`sinh(`x`)`	the hyperbolic sine of x
`smallestdouble()`	the smallest double-precision number greater than zero
`soundex(`s`)`	the soundex code for a string, s

soundex_nara(s)	the U.S. Census soundex code for a string, s
sqrt(x)	the square root of x
ss(e_{tc})	the second corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
ssC(e_{tC})	the second corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
strcat(s_1,s_2)	there is no strcat() function; instead the addition operator is used to concatenate strings
strdup(s_1,n)	there is no strdup() function; instead the multiplication operator is used to create multiple copies of strings
string(n)	a synonym for strofreal(n)
string(n,s)	a synonym for strofreal(n,s)
stritrim(s)	s with multiple, consecutive internal blanks (ASCII space character char(32)) collapsed to one blank
strlen(s)	the number of characters in ASCII s or length in bytes
strlower(s)	lowercase ASCII characters in string s
strltrim(s)	s without leading blanks (ASCII space character char(32))
strmatch(s_1,s_2)	1 if s_1 matches the pattern s_2; otherwise, 0
strofreal(n)	n converted to a string
strofreal(n,s)	n converted to a string using the specified display format
strpos(s_1,s_2)	the position in s_1 at which s_2 is first found; otherwise, 0
strproper(s)	a string with the first ASCII letter and any other letters immediately following characters that are not letters; all other ASCII letters converted to lowercase
strreverse(s)	reverses the ASCII string s
strrpos(s_1,s_2)	the position in s_1 at which s_2 is last found; otherwise, 0
strrtrim(s)	s without trailing blanks (ASCII space character char(32))
strtoname(s[,p])	s translated into a Stata 13 compatible name
strtrim(s)	s without leading and trailing blanks (ASCII space character char(32)); equivalent to strltrim(strrtrim(s))
strupper(s)	uppercase ASCII characters in string s
subinstr(s_1,s_2,s_3,n)	s_1, where the first n occurrences in s_1 of s_2 have been replaced with s_3
subinword(s_1,s_2,s_3,n)	s_1, where the first n occurrences in s_1 of s_2 as a word have been replaced with s_3
substr(s,n_1,n_2)	the substring of s, starting at n_1, for a length of n_2
sum(x)	the running sum of x, treating missing values as zero
sweep(M,i)	matrix M with ith row/column swept
t(df,t)	the cumulative Student's t distribution with df degrees of freedom
tan(x)	the tangent of x, where x is in radians
tanh(x)	the hyperbolic tangent of x
tC(l)	convenience function to make typing dates and times in expressions easier
tc(l)	convenience function to make typing dates and times in expressions easier

`td(`l`)`	convenience function to make typing dates in expressions easier
`tden(`df`,`t`)`	the probability density function of Student's t distribution
`th(`l`)`	convenience function to make typing half-yearly dates in expressions easier
`tin(`d_1`,`d_2`)`	*true* if $d_1 \le t \le d_2$, where t is the time variable previously `tsset`
`tm(`l`)`	convenience function to make typing monthly dates in expressions easier
`tobytes(`s[`,`n]`)`	escaped decimal or hex digit strings of up to 200 bytes of s
`tq(`l`)`	convenience function to make typing quarterly dates in expressions easier
`trace(`M`)`	the trace of matrix M
`trigamma(`x`)`	the second derivative of `lngamma(`x`)` = $d^2 \ln\Gamma(x)/dx^2$
`trunc(`x`)`	a synonym for `int(`x`)`
`ttail(`df`,`t`)`	the reverse cumulative (upper tail or survivor) Student's t distribution; the probability $T > t$
`tukeyprob(`k`,`df`,`x`)`	the cumulative Tukey's Studentized range distribution with k ranges and df degrees of freedom; `0` if $x < 0$
`tw(`l`)`	convenience function to make typing weekly dates in expressions easier
`twithin(`d_1`,`d_2`)`	*true* if $d_1 < t < d_2$, where t is the time variable previously `tsset`
`uchar(`n`)`	the Unicode character corresponding to Unicode code point n or an empty string if n is beyond the Unicode code-point range
`udstrlen(`s`)`	the number of display columns needed to display the Unicode string s in the Stata Results window
`udsubstr(`s`,`n_1`,`n_2`)`	the Unicode substring of s, starting at character n_1, for n_2 display columns
`uisdigit(`s`)`	`1` if the first Unicode character in s is a Unicode decimal digit; otherwise, `0`
`uisletter(`s`)`	`1` if the first Unicode character in s is a Unicode letter; otherwise, `0`
`ustrcompare(`s_1`,`s_2[`,`loc]`)`	compares two Unicode strings
`ustrcompareex(`s_1`,`s_2`,`loc`,`st`,`$case$`,`$cslv$`,`$norm$`,`num`,`alt`,`fr`)`	compares two Unicode strings
`ustrpos(`s_1`,`s_2[`,`n]`)`	the position in s_1 at which s_2 is first found; otherwise, `0`
`ustrrpos(`s_1`,`s_2`,`[`,`n]`)`	the position in s_1 at which s_2 is last found; otherwise, `0`
`ustrfix(`s[`,`rep]`)`	replaces each invalid UTF-8 sequence with a Unicode character
`ustrfrom(`s`,`enc`,`$mode$`)`	converts the string s in encoding enc to a UTF-8 encoded Unicode string
`ustrinvalidcnt(`s`)`	the number of invalid UTF-8 sequences in s
`ustrleft(`s`,`n`)`	the first n Unicode characters of the Unicode string s
`ustrlen(`s`)`	the number of characters in the Unicode string s
`ustrlower(`s[`,`loc]`)`	lowercase all characters of Unicode string s under the given locale loc
`ustrltrim(`s`)`	removes the leading Unicode whitespace characters and blanks from the Unicode string s

`ustrnormalize(`s`,`$norm$`)` normalizes Unicode string s to one of the five normalization forms specified by $norm$

`ustrregexm(`s`,`re[`,`noc]`)` performs a match of a regular expression and evaluates to `1` if regular expression re is satisfied by the Unicode string s; otherwise, `0`

`ustrregexra(`s_1`,`re`,`s_2[`,`noc]`)` replaces all substrings within the Unicode string s_1 that match re with s_2 and returns the resulting string

`ustrregexrf(`s_1`,`re`,`s_2[`,`noc]`)` replaces the first substring within the Unicode string s_1 that matches re with s_2 and returns the resulting string

`ustrregexs(`n`)` subexpression n from a previous `ustrregexm()` match

`ustrreverse(`s`)` reverses the Unicode string s

`ustrright(`s`,`n`)` the last n Unicode characters of the Unicode string s

`ustrrtrim(`s`)` remove trailing Unicode whitespace characters and blanks from the Unicode string s

`ustrsortkey(`s[`,`loc]`)` generates a null-terminated byte array that can be used by the `sort` command to produce the same order as `ustrcompare()`

`ustrsortkeyex(`s`,`loc`,`st`,`$case$`,`$cslv$`,`$norm$`,`num`,`alt`,`fr`)`
generates a null-terminated byte array that can be used by the `sort` command to produce the same order as `ustrcompare()`

`ustrtitle(`s[`,`loc]`)` a string with the first characters of Unicode words titlecased and other characters lowercased

`ustrto(`s`,`enc`,`$mode$`)` converts the Unicode string s in UTF-8 encoding to a string in encoding enc

`ustrtohex(`s[`,`n]`)` escaped hex digit string of s up to 200 Unicode characters

`ustrtoname(`s[`,`p]`)` string s translated into a Stata name

`ustrtrim(`s`)` removes leading and trailing Unicode whitespace characters and blanks from the Unicode string s

`ustrunescape(`s`)` the Unicode string corresponding to the escaped sequences of s

`ustrupper(`s[`,`loc]`)` uppercase all characters in string s under the given locale loc

`ustrword(`s`,`n[`,`noc]`)` the nth Unicode word in the Unicode string s

`ustrwordcount(`s[`,`loc]`)` the number of nonempty Unicode words in the Unicode string s

`usubinstr(`s_1`,`s_2`,`s_3`,`n`)` replaces the first n occurrences of the Unicode string s_2 with the Unicode string s_3 in s_1

`usubstr(`s`,`n_1`,`n_2`)` the Unicode substring of s, starting at n_1, for a length of n_2

`vec(`M`)` a column vector formed by listing the elements of M, starting with the first column and proceeding column by column

`vecdiag(`M`)` the row vector containing the diagonal of matrix M

`week(`e_d`)` the numeric week of the year corresponding to date e_d, the `%td` encoded date (days since 01jan1960)

`weekly(`s_1`,`s_2[`,`Y]`)` the e_w weekly date (weeks since 1960w1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`

`weibull(`a`,`b`,`x`)` the cumulative Weibull distribution with shape a and scale b

`weibull(`a`,`b`,`g`,`x`)` the cumulative Weibull distribution with shape a, scale b, and location g

`weibullden(`a`,`b`,`x`)` the probability density function of the Weibull distribution with shape a and scale b

weibullden(a,b,g,x)	the probability density function of the Weibull distribution with shape a, scale b, and location g
weibullph(a,b,x)	the cumulative Weibull (proportional hazards) distribution with shape a and scale b
weibullph(a,b,g,x)	the cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g
weibullphden(a,b,x)	the probability density function of the Weibull (proportional hazards) distribution with shape a and scale b
weibullphden(a,b,g,x)	the probability density function of the Weibull (proportional hazards) distribution with shape a, scale b, and location g
weibullphtail(a,b,x)	the reverse cumulative Weibull (proportional hazards) distribution with shape a and scale b
weibullphtail(a,b,g,x)	the reverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g
weibulltail(a,b,x)	the reverse cumulative Weibull distribution with shape a and scale b
weibulltail(a,b,g,x)	the reverse cumulative Weibull distribution with shape a, scale b, and location g
wofd(e_d)	the e_w weekly date (weeks since 1960w1) containing date e_d
word(s,n)	the nth word in s; *missing* ("") if n is missing
wordbreaklocale(loc,$type$)	the most closely related locale supported by ICU from loc if $type$ is 1, the actual locale where the word-boundary analysis data come from if $type$ is 2; or an empty string is returned for any other $type$
wordcount(s)	the number of words in s
year(e_d)	the numeric year corresponding to date e_d
yearly(s_1,s_2[,Y])	the e_y yearly date (year) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see date()
yh(Y,H)	the e_h half-yearly date (half-years since 1960h1) corresponding to year Y, half-year H
ym(Y,M)	the e_m monthly date (months since 1960m1) corresponding to year Y, month M
yofd(e_d)	the e_y yearly date (year) containing date e_d
yq(Y,Q)	the e_q quarterly date (quarters since 1960q1) corresponding to year Y, quarter Q
yw(Y,W)	the e_w weekly date (weeks since 1960w1) corresponding to year Y, week W

Also see

[D] **egen** — Extensions to generate

[M-5] **intro** — Alphabetical index to functions

[U] 13.3 Functions

[U] 14.8 Matrix functions

Title

Date and time functions

Contents   Functions   Also see

Contents

`bofd("`*cal*`",`e_d`)`	the e_b business date corresponding to e_d
`Cdhms(`e_d`,`h`,`m`,`s`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to e_d, h, m, s
`Chms(`h`,`m`,`s`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to h, m, s on 01jan1960
`Clock(`s_1`,`s_2 [`,`Y]`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to s_1 based on s_2 and Y
`clock(`s_1`,`s_2 [`,`Y]`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to s_1 based on s_2 and Y
`Cmdyhms(`M`,`D`,`Y`,`h`,`m`,`s`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to M, D, Y, h, m, s
`Cofc(`e_{tc}`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of e_{tc} (ms. without leap seconds since 01jan1960 00:00:00.000)
`cofC(`e_{tC}`)`	the e_{tc} datetime (ms. without leap seconds since 01jan1960 00:00:00.000) of e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
`Cofd(`e_d`)`	the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of date e_d at time 00:00:00.000
`cofd(`e_d`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) of date e_d at time 00:00:00.000
`daily(`s_1`,`s_2 [`,`Y]`)`	a synonym for `date(`s_1`,`s_2 [`,`Y]`)`
`date(`s_1`,`s_2 [`,`Y]`)`	the e_d date (days since 01jan1960) corresponding to s_1 based on s_2 and Y
`day(`e_d`)`	the numeric day of the month corresponding to e_d
`dhms(`e_d`,`h`,`m`,`s`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to e_d, h, m, and s
`dofb(`e_b`,"`*cal*`")`	the e_d datetime corresponding to e_b
`dofC(`e_{tC}`)`	the e_d date (days since 01jan1960) of datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
`dofc(`e_{tc}`)`	the e_d date (days since 01jan1960) of datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
`dofh(`e_h`)`	the e_d date (days since 01jan1960) of the start of half-year e_h
`dofm(`e_m`)`	the e_d date (days since 01jan1960) of the start of month e_m
`dofq(`e_q`)`	the e_d date (days since 01jan1960) of the start of quarter e_q
`dofw(`e_w`)`	the e_d date (days since 01jan1960) of the start of week e_w
`dofy(`e_y`)`	the e_d date (days since 01jan1960) of 01jan in year e_y

`dow(`e_d`)`	the numeric day of the week corresponding to date e_d; 0 = Sunday, 1 = Monday, ..., 6 = Saturday
`doy(`e_d`)`	the numeric day of the year corresponding to date e_d
`halfyear(`e_d`)`	the numeric half of the year corresponding to date e_d
`halfyearly(`s_1`,`s_2[`,`Y]`)`	the e_h half-yearly date (half-years since 1960h1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
`hh(`e_{tc}`)`	the hour corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
`hhC(`e_{tC}`)`	the hour corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
`hms(`h`,`m`,`s`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to h, m, s on 01jan1960
`hofd(`e_d`)`	the e_h half-yearly date (half years since 1960h1) containing date e_d
`hours(`ms`)`	$ms/$3,600,000
`mdy(`M`,`D`,`Y`)`	the e_d date (days since 01jan1960) corresponding to M, D, Y
`mdyhms(`M,D,Y,h,m,s`)`	the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to M, D, Y, h, m, s
`minutes(`ms`)`	$ms/$60,000
`mm(`e_{tc}`)`	the minute corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
`mmC(`e_{tC}`)`	the minute corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
`mofd(`e_d`)`	the e_m monthly date (months since 1960m1) containing date e_d
`month(`e_d`)`	the numeric month corresponding to date e_d
`monthly(`s_1`,`s_2[`,`Y]`)`	the e_m monthly date (months since 1960m1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
`msofhours(`h`)`	$h \times$ 3,600,000
`msofminutes(`m`)`	$m \times$ 60,000
`msofseconds(`s`)`	$s \times$ 1,000
`qofd(`e_d`)`	the e_q quarterly date (quarters since 1960q1) containing date e_d
`quarter(`e_d`)`	the numeric quarter of the year corresponding to date e_d
`quarterly(`s_1`,`s_2[`,`Y]`)`	the e_q quarterly date (quarters since 1960q1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
`seconds(`ms`)`	$ms/$1,000
`ss(`e_{tc}`)`	the second corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
`ssC(`e_{tC}`)`	the second corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
`tC(`l`)`	convenience function to make typing dates and times in expressions easier
`tc(`l`)`	convenience function to make typing dates and times in expressions easier
`td(`l`)`	convenience function to make typing dates in expressions easier
`th(`l`)`	convenience function to make typing half-yearly dates in expressions easier

`tm(`l`)`	convenience function to make typing monthly dates in expressions easier
`tq(`l`)`	convenience function to make typing quarterly dates in expressions easier
`tw(`l`)`	convenience function to make typing weekly dates in expressions easier
`week(`e_d`)`	the numeric week of the year corresponding to date e_d, the `%td` encoded date (days since 01jan1960)
`weekly(`s_1`,`s_2[`,`Y]`)`	the e_w weekly date (weeks since 1960w1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
`wofd(`e_d`)`	the e_w weekly date (weeks since 1960w1) containing date e_d
`year(`e_d`)`	the numeric year corresponding to date e_d
`yearly(`s_1`,`s_2[`,`Y]`)`	the e_y yearly date (year) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
`yh(`Y`,`H`)`	the e_h half-yearly date (half-years since 1960h1) corresponding to year Y, half-year H
`ym(`Y`,`M`)`	the e_m monthly date (months since 1960m1) corresponding to year Y, month M
`yofd(`e_d`)`	the e_y yearly date (year) containing date e_d
`yq(`Y`,`Q`)`	the e_q quarterly date (quarters since 1960q1) corresponding to year Y, quarter Q
`yw(`Y`,`W`)`	the e_w weekly date (weeks since 1960w1) corresponding to year Y, week W

Functions

Stata's date and time functions are described with examples in **[U] 24 Working with dates and times** and **[D] datetime**. What follows is a technical description. We use the following notation:

e_b	`%tb` business calendar date (days)
e_{tc}	`%tc` encoded datetime (ms. since 01jan1960 00:00:00.000)
e_{tC}	`%tC` encoded datetime (ms. with leap seconds since 01jan1960 00:00:00.000)
e_d	`%td` encoded date (days since 01jan1960)
e_w	`%tw` encoded weekly date (weeks since 1960w1)
e_m	`%tm` encoded monthly date (months since 1960m1)
e_q	`%tq` encoded quarterly date (quarters since 1960q1)
e_h	`%th` encoded half-yearly date (half-years since 1960h1)
e_y	`%ty` encoded yearly date (years)
M	month, 1–12
D	day of month, 1–31
Y	year, 0100–9999
h	hour, 0–23
m	minute, 0–59
s	second, 0–59 or 60 if leap seconds
W	week number, 1–52
Q	quarter number, 1–4
H	half-year number, 1 or 2

The date and time functions, where integer arguments are required, allow noninteger values and use the `floor()` of the value.

A Stata date-and-time (`%t`) variable is recorded as the milliseconds, days, weeks, etc., depending upon the units from 01jan1960; negative values indicate dates and times before 01jan1960. Allowable dates and times are those between 01jan0100 and 31dec9999, inclusive, but all functions are based on the Gregorian calendar, and values do not correspond to historical dates before Friday, 15oct1582.

`bofd("`*cal*`",`e_d`)`
- Description: the e_b business date corresponding to e_d
- Domain *cal*: business calendar names and formats
- Domain e_d: `%td` as defined by business calendar named *cal*
- Range: as defined by business calendar named *cal*

`Cdhms(`e_d`,`h`,`m`,`s`)`
- Description: the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to e_d, h, m, s
- Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
- Domain h: integers 0 to 23
- Domain m: integers 0 to 59
- Domain s: reals 0.000 to 60.999
- Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to >253,717,919,999,999) or *missing*

`Chms(`h`,`m`,`s`)`
- Description: the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to h, m, s on 01jan1960
- Domain h: integers 0 to 23
- Domain m: integers 0 to 59
- Domain s: reals 0.000 to 60.999
- Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to >253,717,919,999,999) or *missing*

`Clock(`s_1`,`s_2 [`,`Y]`)`
- Description: the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to s_1 based on s_2 and Y

  Function `Clock()` works the same as function `clock()` except that `Clock()` returns a leap second–adjusted `%tC` value rather than an unadjusted `%tc` value. Use `Clock()` only if original time values have been adjusted for leap seconds.
- Domain s_1: strings
- Domain s_2: strings
- Domain Y: integers 1000 to 9998 (but probably 2001 to 2099)
- Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to >253,717,919,999,999) or *missing*

clock(s_1,s_2[,Y])

Description: the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to s_1 based on s_2 and Y

s_1 contains the date, time, or both, recorded as a string, in virtually any format. Months can be spelled out, abbreviated (to three characters), or indicated as numbers; years can include or exclude the century; blanks and punctuation are allowed.

s_2 is any permutation of M, D, [##]Y, h, m, and s, with their order defining the order that month, day, year, hour, minute, and second occur (and whether they occur) in s_1. ##, if specified, indicates the default century for two-digit years in s_1. For instance, s_2 = "MD19Y hm" would translate s_1 = "11/15/91 21:14" as 15nov1991 21:14. The space in "MD19Y hm" was not significant and the string would have translated just as well with "MD19Yhm".

Y provides an alternate way of handling two-digit years. Y specifies the largest year that is to be returned when a two-digit year is encountered; see function date() below. If neither ## nor Y is specified, clock() returns *missing* when it encounters a two-digit year.

Domain s_1: strings

Domain s_2: strings

Domain Y: integers 1000 to 9998 (but probably 2001 to 2099)

Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999) or *missing*

Cmdyhms(M,D,Y,h,m,s)

Description: the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) corresponding to M, D, Y, h, m, s

Domain M: integers 1 to 12

Domain D: integers 1 to 31

Domain Y: integers 0100 to 9999 (but probably 1800 to 2100)

Domain h: integers 0 to 23

Domain m: integers 0 to 59

Domain s: reals 0.000 to 60.999

Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to >253,717,919,999,999) or *missing*

Cofc(e_{tc})

Description: the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of e_{tc} (ms. without leap seconds since 01jan1960 00:00:00.000)

Domain e_{tc}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999)

Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to >253,717,919,999,999)

cofC(e_{tC})

Description: the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of e_{tc} (ms. without leap seconds since 01jan1960 00:00:00.000)

Domain e_{tC}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to >253,717,919,999,999)

Range datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999)

`Cofd(`e_d`)`

Description: the e_{tC} datetime (ms. with leap seconds since 01jan1960 00:00:00.000) of date e_d at time 00:00:00.000
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to >253,717,919,999,999)

`cofd(`e_d`)`

Description: the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) of date e_d at time 00:00:00.000
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999)

`daily(`s_1`,`s_2[`,`Y]`)`

Description: a synonym for `date(`s_1`,`s_2[`,`Y]`)`

`date(`s_1`,`s_2[`,`Y]`)`

Description: the e_d date (days since 01jan1960) corresponding to s_1 based on s_2 and Y

s_1 contains the date, recorded as a string, in virtually any format. Months can be spelled out, abbreviated (to three characters), or indicated as numbers; years can include or exclude the century; blanks and punctuation are allowed.

s_2 is any permutation of `M`, `D`, and [*##*]Y, with their order defining the order that month, day, and year occur in s_1. *##*, if specified, indicates the default century for two-digit years in s_1. For instance, s_2 = `"MD19Y"` would translate s_1 = `"11/15/91"` as 15nov1991.

Y provides an alternate way of handling two-digit years. When a two-digit year is encountered, the largest year, *topyear*, that does not exceed Y is returned.

`date("1/15/08","MDY",1999)` = 15jan1908
`date("1/15/08","MDY",2019)` = 15jan2008

`date("1/15/51","MDY",2000)` = 15jan1951
`date("1/15/50","MDY",2000)` = 15jan1950
`date("1/15/49","MDY",2000)` = 15jan1949

`date("1/15/01","MDY",2050)` = 15jan2001
`date("1/15/00","MDY",2050)` = 15jan2000

If neither *##* nor Y is specified, `date()` returns *missing* when it encounters a two-digit year. See *Working with two-digit years* in [D] **datetime translation** for more information.

Domain s_1: strings
Domain s_2: strings
Domain Y: integers 1000 to 9998 (but probably 2001 to 2099)
Range: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549) or *missing*

`day(`e_d`)`

Description: the numeric day of the month corresponding to e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: integers 1 to 31 or *missing*

`dhms(`e_d`,`h`,`m`,`s`)`

Description: the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to e_d, h, m, and s

Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)

Domain h: integers 0 to 23

Domain m: integers 0 to 59

Domain s: reals 0.000 to 59.999

Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999) or *missing*

`dofb(`e_b`,"`cal`")`

Description: the e_d datetime corresponding to e_b

Domain e_b: `%tb` as defined by business calendar named cal

Domain cal: business calendar names and formats

Range: as defined by business calendar named cal

`dofC(`e_{tC}`)`

Description: the e_d date (days since 01jan1960) of datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)

Domain e_{tC}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to $>$253,717,919,999,999)

Range: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)

`dofc(`e_{tc}`)`

Description: the e_d date (days since 01jan1960) of datetime e_{tc} (ms. since 01jan1960 00:00:00.000)

Domain e_{tc}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999)

Range: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)

`dofh(`e_h`)`

Description: the e_d date (days since 01jan1960) of the start of half-year e_h

Domain e_h: `%th` dates 0100h1 to 9999h2 (integers −3,720 to 16,079)

Range: `%td` dates 01jan0100 to 01jul9999 (integers −679,350 to 2,936,366)

`dofm(`e_m`)`

Description: the e_d date (days since 01jan1960) of the start of month e_m

Domain e_m: `%tm` dates 0100m1 to 9999m12 (integers −22,320 to 96,479)

Range: `%td` dates 01jan0100 to 01dec9999 (integers −679,350 to 2,936,519)

`dofq(`e_q`)`

Description: the e_d date (days since 01jan1960) of the start of quarter e_q

Domain e_q: `%tq` dates 0100q1 to 9999q4 (integers −7,440 to 32,159)

Range: `%td` dates 01jan0100 to 01oct9999 (integers −679,350 to 2,936,458)

`dofw(`e_w`)`

Description: the e_d date (days since 01jan1960) of the start of week e_w

Domain e_w: `%tw` dates 0100w1 to 9999w52 (integers −96,720 to 418,079)

Range: `%td` dates 01jan0100 to 24dec9999 (integers −679,350 to 2,936,542)

`dofy(`e_y`)`
Description: the e_d date (days since 01jan1960) of 01jan in year e_y
Domain e_y: `%ty` dates 0100 to 9999 (integers 0100 to 9999)
Range: `%td` dates 01jan0100 to 01jan9999 (integers −679,350 to 2,936,185)

`dow(`e_d`)`
Description: the numeric day of the week corresponding to date e_d; 0 = Sunday, 1 = Monday, …, 6 = Saturday
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: integers 0 to 6 or *missing*

`doy(`e_d`)`
Description: the numeric day of the year corresponding to date e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: integers 1 to 366 or *missing*

`halfyear(`e_d`)`
Description: the numeric half of the year corresponding to date e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: integers 1, 2, or *missing*

`halfyearly(`s_1`,`$s_2$$\left[\right.$`,`$Y$$\left.\right]$`)`
Description: the e_h half-yearly date (half-years since 1960h1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
Domain s_1: strings
Domain s_2: strings `"HY"` and `"YH"`; `Y` may be prefixed with *##*
Domain Y: integers 1000 to 9998 (but probably 2001 to 2099)
Range: `%th` dates 0100h1 to 9999h2 (integers −3,720 to 16,079) or *missing*

`hh(`e_{tc}`)`
Description: the hour corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
Domain e_{tc}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999)
Range: integers 0 through 23, *missing*

`hhC(`e_{tC}`)`
Description: the hour corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
Domain e_{tC}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to >253,717,919,999,999)
Range: integers 0 through 23, *missing*

`hms(`h`,`m`,`s`)`
Description: the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to h, m, s on 01jan1960
Domain h: integers 0 to 23
Domain m: integers 0 to 59
Domain s: reals 0.000 to 59.999
Range: datetimes 01jan1960 00:00:00.000 to 01jan1960 23:59:59.999 (integers 0 to 86,399,999 or *missing*)

`hofd(`e_d`)`
- Description: the e_h half-yearly date (half years since 1960h1) containing date e_d
- Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
- Range: `%th` dates 0100h1 to 9999h2 (integers −3,720 to 16,079)

`hours(`ms`)`
- Description: $ms/3{,}600{,}000$
- Domain ms: real; milliseconds
- Range: real or *missing*

`mdy(`M`,`D`,`Y`)`
- Description: the e_d date (days since 01jan1960) corresponding to M, D, Y
- Domain M: integers 1 to 12
- Domain D: integers 1 to 31
- Domain Y: integers 0100 to 9999 (but probably 1800 to 2100)
- Range: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549) or *missing*

`mdyhms(`M`,`D`,`Y`,`h`,`m`,`s`)`
- Description: the e_{tc} datetime (ms. since 01jan1960 00:00:00.000) corresponding to M, D, Y, h, m, s
- Domain M: integers 1 to 12
- Domain D: integers 1 to 31
- Domain Y: integers 0100 to 9999 (but probably 1800 to 2100)
- Domain h: integers 0 to 23
- Domain m: integers 0 to 59
- Domain s: reals 0.000 to 59.999
- Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999) or *missing*

`minutes(`ms`)`
- Description: $ms/60{,}000$
- Domain ms: real; milliseconds
- Range: real or *missing*

`mm(`e_{tc}`)`
- Description: the minute corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
- Domain e_{tc}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to 253,717,919,999,999)
- Range: integers 0 through 59, *missing*

`mmC(`e_{tC}`)`
- Description: the minute corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
- Domain e_{tC}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999 (integers −58,695,840,000,000 to $>$253,717,919,999,999)
- Range: integers 0 through 59, *missing*

`mofd(`e_d`)`
- Description: the e_m monthly date (months since 1960m1) containing date e_d
- Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
- Range: `%tm` dates 0100m1 to 9999m12 (integers −22,320 to 96,479)

`month(`e_d`)`
Description: the numeric month corresponding to date e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers $-679{,}350$ to 2,936,549)
Range: integers 1 to 12 or *missing*

`monthly(`s_1`,`s_2[`,`Y]`)`
Description: the e_m monthly date (months since 1960m1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
Domain s_1: strings
Domain s_2: strings `"MY"` and `"YM"`; `Y` may be prefixed with *##*
Domain Y: integers 1000 to 9998 (but probably 2001 to 2099)
Range: `%tm` dates 0100m1 to 9999m12 (integers $-22{,}320$ to 96,479) or *missing*

`msofhours(`h`)`
Description: $h \times 3{,}600{,}000$
Domain h: real; hours
Range: real or *missing*; milliseconds

`msofminutes(`m`)`
Description: $m \times 60{,}000$
Domain m: real; minutes
Range: real or *missing*; milliseconds

`msofseconds(`s`)`
Description: $s \times 1{,}000$
Domain s: real; seconds
Range: real or *missing*; milliseconds

`qofd(`e_d`)`
Description: the e_q quarterly date (quarters since 1960q1) containing date e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers $-679{,}350$ to 2,936,549)
Range: `%tq` dates 0100q1 to 9999q4 (integers $-7{,}440$ to 32,159)

`quarter(`e_d`)`
Description: the numeric quarter of the year corresponding to date e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers $-679{,}350$ to 2,936,549)
Range: integers 1 to 4 or *missing*

`quarterly(`s_1`,`s_2[`,`Y]`)`
Description: the e_q quarterly date (quarters since 1960q1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
Domain s_1: strings
Domain s_2: strings `"QY"` and `"YQ"`; `Y` may be prefixed with *##*
Domain Y: integers 1000 to 9998 (but probably 2001 to 2099)
Range: `%tq` dates 0100q1 to 9999q4 (integers $-7{,}440$ to 32,159) or *missing*

`seconds(`ms`)`
Description: $ms/1{,}000$
Domain ms: real; milliseconds
Range: real or *missing*

`ss(`e_{tc}`)`
Description: the second corresponding to datetime e_{tc} (ms. since 01jan1960 00:00:00.000)
Domain e_{tc}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999
(integers −58,695,840,000,000 to 253,717,919,999,999)
Range: real 0.000 through 59.999, *missing*

`ssC(`e_{tC}`)`
Description: the second corresponding to datetime e_{tC} (ms. with leap seconds since 01jan1960 00:00:00.000)
Domain e_{tC}: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999
(integers −58,695,840,000,000 to $>$253,717,919,999,999)
Range: real 0.000 through 60.999, *missing*

`tC(`l`)`
Description: convenience function to make typing dates and times in expressions easier

Same as `tc()`, except returns leap second–adjusted values; for example, typing `tc(29nov2007 9:15)` is equivalent to typing `1511946900000`, whereas `tC(29nov2007 9:15)` is `1511946923000`.
Domain l: datetime literal strings 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999
Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999
(integers −58,695,840,000,000 to $>$253,717,919,999,999)

`tc(`l`)`
Description: convenience function to make typing dates and times in expressions easier

For example, typing `tc(2jan1960 13:42)` is equivalent to typing `135720000`; the date but not the time may be omitted, and then 01jan1960 is assumed; the seconds portion of the time may be omitted and is assumed to be 0.000; `tc(11:02)` is equivalent to typing `39720000`.
Domain l: datetime literal strings 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999
Range: datetimes 01jan0100 00:00:00.000 to 31dec9999 23:59:59.999
(integers −58,695,840,000,000 to 253,717,919,999,999)

`td(`l`)`
Description: convenience function to make typing dates in expressions easier

For example, typing `td(2jan1960)` is equivalent to typing `1`.
Domain l: date literal strings 01jan0100 to 31dec9999
Range: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)

`th(`l`)`
Description: convenience function to make typing half-yearly dates in expressions easier

For example, typing `th(1960h2)` is equivalent to typing `1`.
Domain l: half-year literal strings 0100h1 to 9999h2
Range: `%th` dates 0100h1 to 9999h2 (integers −3,720 to 16,079)

`tm(`l`)`
Description: convenience function to make typing monthly dates in expressions easier

For example, typing `tm(1960m2)` is equivalent to typing `1`.
Domain l: month literal strings 0100m1 to 9999m12
Range: `%tm` dates 0100m1 to 9999m12 (integers −22,320 to 96,479)

`tq(`l`)`
Description: convenience function to make typing quarterly dates in expressions easier

For example, typing `tq(1960q2)` is equivalent to typing `1`.
Domain l: quarter literal strings 0100q1 to 9999q4
Range: `%tq` dates 0100q1 to 9999q4 (integers −7,440 to 32,159)

`tw(`l`)`
Description: convenience function to make typing weekly dates in expressions easier

For example, typing `tw(1960w2)` is equivalent to typing `1`.
Domain l: week literal strings 0100w1 to 9999w52
Range: `%tw` dates 0100w1 to 9999w52 (integers −96,720 to 418,079)

`week(`e_d`)`
Description: the numeric week of the year corresponding to date e_d, the `%td` encoded date (days since 01jan1960)

Note: The first week of a year is the first 7-day period of the year.
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range integers 1 to 52 or *missing*

`weekly(`s_1`,`s_2[`,`Y]`)`
Description: the e_w weekly date (weeks since 1960w1) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
Domain s_1: strings
Domain s_2: strings `"WY"` and `"YW"`; `Y` may be prefixed with *##*
Domain Y: integers 1000 to 9998 (but probably 2001 to 2099)
Range: `%tw` dates 0100w1 to 9999w52 (integers −96,720 to 418,079) or *missing*

`wofd(`e_d`)`
Description: the e_w weekly date (weeks since 1960w1) containing date e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: `%tw` dates 0100w1 to 9999w52 (integers −96,720 to 418,079)

`year(`e_d`)`
Description: the numeric year corresponding to date e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: integers 0100 to 9999 (but probably 1800 to 2100)

`yearly(`s_1`,`s_2[`,`Y]`)`
Description: the e_y yearly date (year) corresponding to s_1 based on s_2 and Y; Y specifies *topyear*; see `date()`
Domain s_1: strings
Domain s_2: string `"Y"`; `Y` may be prefixed with *##*
Domain Y: integers 1000 to 9998 (but probably 2001 to 2099)
Range: `%ty` dates 0100 to 9999 (integers 0100 to 9999) or *missing*

`yh(`Y`,`H`)`
Description: the e_h half-yearly date (half-years since 1960h1) corresponding to year Y, half-year H
Domain Y: integers 1000 to 9999 (but probably 1800 to 2100)
Domain H: integers 1, 2
Range: `%th` dates 1000h1 to 9999h2 (integers −1,920 to 16,079)

`ym(`Y`,`M`)`
Description: the e_m monthly date (months since 1960m1) corresponding to year Y, month M
Domain Y: integers 1000 to 9999 (but probably 1800 to 2100)
Domain M: integers 1 to 12
Range: `%tm` dates 1000m1 to 9999m12 (integers −11,520 to 96,479)

`yofd(`e_d`)`
Description: the e_y yearly date (year) containing date e_d
Domain e_d: `%td` dates 01jan0100 to 31dec9999 (integers −679,350 to 2,936,549)
Range: `%ty` dates 0100 to 9999 (integers 0100 to 9999)

`yq(`Y`,`Q`)`
Description: the e_q quarterly date (quarters since 1960q1) corresponding to year Y, quarter Q
Domain Y: integers 1000 to 9999 (but probably 1800 to 2100)
Domain Q: integers 1 to 4
Range: `%tq` dates 1000q1 to 9999q4 (integers −3,840 to 32,159)

`yw(`Y`,`W`)`
Description: the e_w weekly date (weeks since 1960w1) corresponding to year Y, week W
Domain Y: integers 1000 to 9999 (but probably 1800 to 2100)
Domain W: integers 1 to 52
Range: `%tw` dates 1000w1 to 9999w52 (integers −49,920 to 418,079)

Also see

[D] **egen** — Extensions to generate

[M-5] **date( )** — Date and time manipulation

[M-5] **intro** — Alphabetical index to functions

[U] 13.3 Functions

Title

Mathematical functions

Contents Functions References Also see

Contents

abs(x)	the absolute value of x
ceil(x)	the unique integer n such that $n-1 < x \le n$; x (not ".") if x is missing, meaning that `ceil(.a)` = `.a`
cloglog(x)	the complementary log-log of x
comb(n,k)	the combinatorial function $n!/\{k!(n-k)!\}$
digamma(x)	the `digamma()` function, $d\ln\Gamma(x)/dx$
exp(x)	the exponential function e^x
floor(x)	the unique integer n such that $n \le x < n+1$; x (not ".") if x is missing, meaning that `floor(.a)` = `.a`
int(x)	the integer obtained by truncating x toward 0 (thus, `int(5.2)` = 5 and `int(-5.8)` = -5); x (not ".") if x is missing, meaning that `int(.a)` = `.a`
invcloglog(x)	the inverse of the complementary log-log function of x
invlogit(x)	the inverse of the logit function of x
ln(x)	the natural logarithm, $\ln(x)$
lnfactorial(n)	the natural log of factorial = $\ln(n!)$
lngamma(x)	$\ln\{\Gamma(x)\}$
log(x)	the natural logarithm, $\ln(x)$; thus, a synonym for ln(x)
log10(x)	the base-10 logarithm of x
logit(x)	the log of the odds ratio of x, logit(x) = $\ln\{x/(1-x)\}$
max(x_1,x_2,...,x_n)	the maximum value of $x_1, x_2, \ldots, x_n$
min(x_1,x_2,...,x_n)	the minimum value of $x_1, x_2, \ldots, x_n$
mod(x,y)	the modulus of x with respect to y
reldif(x,y)	the "relative" difference $\lvert x-y\rvert/(\lvert y\rvert+1)$; `0` if both arguments are the same type of extended missing value; *missing* if only one argument is missing or if the two arguments are two different types of *missing*
round(x,y) or round(x)	x rounded in units of y or x rounded to the nearest integer if the argument y is omitted; x (not ".") if x is missing (meaning that `round(.a)` = `.a` and that round(.a,y) = `.a` if y is not missing) and if y is missing, then "." is returned
sign(x)	the sign of x: -1 if $x < 0$, 0 if $x = 0$, 1 if $x > 0$, or *missing* if x is missing
sqrt(x)	the square root of x
sum(x)	the running sum of x, treating missing values as zero
trigamma(x)	the second derivative of lngamma(x) = $d^2\ln\Gamma(x)/dx^2$
trunc(x)	a synonym for int(x)

Functions

`abs(`x`)`

Description: the absolute value of x
Domain: $-$8e+307 to 8e+307
Range: 0 to 8e+307

`ceil(`x`)`

Description: the unique integer n such that $n-1 < x \leq n$; x (not "`.`") if x is missing, meaning that `ceil(.a)` $=$ `.a`

Also see `floor(`x`)`, `int(`x`)`, and `round(`x`)`.
Domain: $-$8e+307 to 8e+307
Range: integers in $-$8e+307 to 8e+307

`cloglog(`x`)`

Description: the complementary log-log of x
`cloglog(`x`)` $= \ln\{-\ln(1-x)\}$
Domain: 0 to 1
Range: $-$8e+307 to 8e+307

`comb(`n`,`k`)`

Description: the combinatorial function $n!/\{k!(n-k)!\}$
Domain n: integers 1 to 1e+305
Domain k: integers 0 to n
Range: 0 to 8e+307 or *missing*

`digamma(`x`)`

Description: the `digamma()` function, $d\ln\Gamma(x)/dx$

This is the derivative of `lngamma(`x`)`. The `digamma(`x`)` function is sometimes called the psi function, $\psi(x)$.
Domain: $-$1e+15 to 8e+307
Range: $-$8e+307 to 8e+307 or *missing*

`exp(`x`)`

Description: the exponential function e^x

This function is the inverse of `ln(`x`)`.
Domain: $-$8e+307 to 709
Range: 0 to 8e+307

`floor(`x`)`

Description: the unique integer n such that $n \leq x < n+1$; x (not "`.`") if x is missing, meaning that `floor(.a)` $=$ `.a`

Also see `ceil(`x`)`, `int(`x`)`, and `round(`x`)`.
Domain: $-$8e+307 to 8e+307
Range: integers in $-$8e+307 to 8e+307

int(x)

Description: the integer obtained by truncating x toward 0 (thus, int(5.2) $=5$ and int(-5.8) $=-5$); x (not ".") if x is missing, meaning that int(.a) = .a

One way to obtain the closest integer to x is int(x+sign(x)/2), which simplifies to int(x+0.5) for $x \geq 0$. However, use of the round() function is preferred. Also see ceil(x), int(x), and round(x).

Domain: $-$8e+307 to 8e+307

Range: integers in $-$8e+307 to 8e+307

invcloglog(x)

Description: the inverse of the complementary log-log function of x

$$\texttt{invcloglog}(x) = 1 - \exp\{-\exp(x)\}$$

Domain: $-$8e+307 to 8e+307

Range: 0 to 1 or *missing*

invlogit(x)

Description: the inverse of the logit function of x

$$\texttt{invlogit}(x) = \exp(x)/\{1 + \exp(x)\}$$

Domain: $-$8e+307 to 8e+307

Range: 0 to 1 or *missing*

ln(x)

Description: the natural logarithm, $\ln(x)$

This function is the inverse of exp(x). The logarithm of x in base b can be calculated via $\log_b(x) = \log_a(x)/\log_a(b)$. Hence,

$\log_5(x) =$ ln(x)/ln(5) = log(x)/log(5) = log10(x)/log10(5)

$\log_2(x) =$ ln(x)/ln(2) = log(x)/log(2) = log10(x)/log10(2)

You can calculate $\log_b(x)$ by using the formula that best suits your needs.

Domain: 1e–323 to 8e+307

Range: $-$744 to 709

lnfactorial(n)

Description: the natural log of factorial = $\ln(n!)$

To calculate $n!$, use round(exp(lnfactorial(n)),1) to ensure that the result is an integer. Logs of factorials are generally more useful than the factorials themselves because of overflow problems.

Domain: integers 0 to 1e+305

Range: 0 to 8e+307

lngamma(x)

Description: $\ln\{\Gamma(x)\}$

Here the gamma function, $\Gamma(x)$, is defined by $\Gamma(x) = \int_0^\infty t^{x-1}e^{-t}dt$. For integer values of $x > 0$, this is $\ln((x-1)!)$.

lngamma(x) for $x < 0$ returns a number such that exp(lngamma(x)) is equal to the absolute value of the gamma function, $\Gamma(x)$. That is, lngamma(x) always returns a real (not complex) result.

Domain: $-$2,147,483,648 to 1e+305 (excluding negative integers)

Range: $-$8e+307 to 8e+307

`log(`x`)`
Description: the natural logarithm, $\ln(x)$; thus, a synonym for `ln(`x`)`
Domain: 1e–323 to 8e+307
Range: -744 to 709

`log10(`x`)`
Description: the base-10 logarithm of x
Domain: 1e–323 to 8e+307
Range: -323 to 308

`logit(`x`)`
Description: the log of the odds ratio of x, `logit(`x`)` $= \ln\{x/(1-x)\}$
Domain: 0 to 1 (exclusive)
Range: $-$8e+307 to 8e+307 or *missing*

`max(`x_1`,`x_2`,...,`x_n`)`
Description: the maximum value of $x_1, x_2, \ldots, x_n$

Unless all arguments are *missing*, missing values are ignored.
`max(2,10,.,7)` = `10`
`max(.,.,.)` = `.`
Domain x_1: $-$8e+307 to 8e+307 or *missing*
Domain x_2: $-$8e+307 to 8e+307 or *missing*
...
Domain x_n: $-$8e+307 to 8e+307 or *missing*
Range: $-$8e+307 to 8e+307 or *missing*

`min(`x_1`,`x_2`,...,`x_n`)`
Description: the minimum value of $x_1, x_2, \ldots, x_n$

Unless all arguments are *missing*, missing values are ignored.
`min(2,10,.,7)` = `2`
`min(.,.,.)` = `.`
Domain x_1: $-$8e+307 to 8e+307 or *missing*
Domain x_2: $-$8e+307 to 8e+307 or *missing*
...
Domain x_n: $-$8e+307 to 8e+307 or *missing*
Range: $-$8e+307 to 8e+307 or *missing*

`mod(`x`,`y`)`
Description: the modulus of x with respect to y

`mod(`x,y`)` $= x - y$ `floor(`x/y`)`
`mod(`x`,0)` = `.`
Domain x: $-$8e+307 to 8e+307
Domain y: 0 to 8e+307
Range: 0 to 8e+307

`reldif(`x`,`y`)`
  Description: the "relative" difference $|x - y|/(|y| + 1)$; `0` if both arguments are the same type of extended missing value; *missing* if only one argument is missing or if the two arguments are two different types of *missing*
  Domain x: $-8e+307$ to $8e+307$ or *missing*
  Domain y: $-8e+307$ to $8e+307$ or *missing*
  Range: $-8e+307$ to $8e+307$ or *missing*

`round(`x`,`y`)` or `round(`x`)`
  Description: x rounded in units of y or x rounded to the nearest integer if the argument y is omitted; x (not "`.`") if x is missing (meaning that `round(.a)` = `.a` and that `round(.a,`y`)` = `.a` if y is not missing) and if y is missing, then "`.`" is returned

  For $y = 1$, or with y omitted, this amounts to the closest integer to x; `round(5.2,1)` is 5, as is `round(4.8,1)`; `round(-5.2,1)` is -5, as is `round(-4.8,1)`. The rounding definition is generalized for $y \neq 1$. With $y = 0.01$, for instance, x is rounded to two decimal places; `round(sqrt(2),.01)` is 1.41. y may also be larger than 1; `round(28,5)` is 30, which is 28 rounded to the closest multiple of 5. For $y = 0$, the function is defined as returning x unmodified. Also see `int(`x`)`, `ceil(`x`)`, and `floor(`x`)`.
  Domain x: $-8e+307$ to $8e+307$
  Domain y: $-8e+307$ to $8e+307$
  Range: $-8e+307$ to $8e+307$

`sign(`x`)`
  Description: the sign of x: -1 if $x < 0$, 0 if $x = 0$, 1 if $x > 0$, or *missing* if x is missing
  Domain: $-8e+307$ to $8e+307$ or *missing*
  Range: -1, 0, 1 or *missing*

`sqrt(`x`)`
  Description: the square root of x
  Domain: 0 to 8e+307
  Range: 0 to 1e+154

`sum(`x`)`
  Description: the running sum of x, treating missing values as zero

  For example, following the command `generate y=sum(x)`, the jth observation on `y` contains the sum of the first through jth observations on `x`. See [D] **egen** for an alternative sum function, `total()`, that produces a constant equal to the overall sum.
  Domain: all real numbers or *missing*
  Range: $-8e+307$ to $8e+307$ (excluding *missing*)

`trigamma(`x`)`
  Description: the second derivative of `lngamma(`x`)` = $d^2 \ln\Gamma(x)/dx^2$

  The `trigamma()` function is the derivative of `digamma(`x`)`.
  Domain: $-1e+15$ to $8e+307$
  Range: 0 to 8e+307 or *missing*

`trunc(`x`)`
  Description: a synonym for `int(`x`)`

References

Abramowitz, M., and I. A. Stegun, ed. 1968. *Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables*. 7th ed. Washington, DC: National Bureau of Standards.

Cox, N. J. 2003. Stata tip 2: Building with floors and ceilings. *Stata Journal* 3: 446–447.

——. 2007. Stata tip 43: Remainders, selections, sequences, extractions: Uses of the modulus. *Stata Journal* 7: 143–145.

Oldham, K. B., J. C. Myland, and J. Spanier. 2009. *An Atlas of Functions*. 2nd ed. New York: Springer.

Also see

[D] **egen** — Extensions to generate

[M-4] **mathematical** — Important mathematical functions

[M-5] **intro** — Alphabetical index to functions

[U] **13.3 Functions**

Title

Matrix functions

Contents   Functions   Reference   Also see

Contents

`cholesky(`M`)`	the Cholesky decomposition of the matrix: if $R =$ `cholesky(`S`)`, then $RR^T = S$
`colnumb(`M`,`s`)`	the column number of M associated with column name s; *missing* if the column cannot be found
`colsof(`M`)`	the number of columns of M
`corr(`M`)`	the correlation matrix of the variance matrix
`det(`M`)`	the determinant of matrix M
`diag(`v`)`	the square, diagonal matrix created from the row or column vector
`diag0cnt(`M`)`	the number of zeros on the diagonal of M
`el(`s`,`i`,`j`)`	s`[floor(`i`),floor(`j`)]`, the i, j element of the matrix named s; *missing* if i or j are out of range or if matrix s does not exist
`get(`*systemname*`)`	a copy of Stata internal system matrix *systemname*
`hadamard(`M`,`N`)`	a matrix whose i, j element is $M[i,j] \cdot N[i,j]$ (if M and N are not the same size, this function reports a conformability error)
`I(`n`)`	an $n \times n$ identity matrix if n is an integer; otherwise, a `round(`n`)` $\times$ `round(`n`)` identity matrix
`inv(`M`)`	the inverse of the matrix M
`invsym(`M`)`	the inverse of M if M is positive definite
`issymmetric(`M`)`	`1` if the matrix is symmetric; otherwise, `0`
`J(`r`,`c`,`z`)`	the $r \times c$ matrix containing elements z
`matmissing(`M`)`	`1` if any elements of the matrix are missing; otherwise, `0`
`matuniform(`r`,`c`)`	the $r \times c$ matrices containing uniformly distributed pseudorandom numbers on the interval $(0, 1)$
`mreldif(`X`,`Y`)`	the relative difference of X and Y, where the relative difference is defined as $\max_{i,j}\{\lvert x_{ij} - y_{ij}\rvert/(\lvert y_{ij}\rvert + 1)\}$
`nullmat(`*matname*`)`	use with the row-join (`,`) and column-join (`\`) operators in programming situations
`rownumb(`M`,`s`)`	the row number of M associated with row name s; *missing* if the row cannot be found
`rowsof(`M`)`	the number of rows of M
`sweep(`M`,`i`)`	matrix M with ith row/column swept
`trace(`M`)`	the trace of matrix M
`vec(`M`)`	a column vector formed by listing the elements of M, starting with the first column and proceeding column by column
`vecdiag(`M`)`	the row vector containing the diagonal of matrix M

Functions

We divide the basic matrix functions into two groups, according to whether they return a matrix or a scalar:

Matrix functions returning a matrix
Matrix functions returning a scalar

Matrix functions returning a matrix

In addition to the functions listed below, see [P] **matrix svd** for singular value decomposition, [P] **matrix symeigen** for eigenvalues and eigenvectors of symmetric matrices, and [P] **matrix eigenvalues** for eigenvalues of nonsymmetric matrices.

`cholesky(`M`)`
Description: the Cholesky decomposition of the matrix: if $R =$ `cholesky(`S`)`, then $RR^T = S$

R^T indicates the transpose of R. Row and column names are obtained from M.
Domain: $n \times n$, positive-definite, symmetric matrices
Range: $n \times n$ lower-triangular matrices

`corr(`M`)`
Description: the correlation matrix of the variance matrix

Row and column names are obtained from M.
Domain: $n \times n$ symmetric variance matrices
Range: $n \times n$ symmetric correlation matrices

`diag(`v`)`
Description: the square, diagonal matrix created from the row or column vector

Row and column names are obtained from the column names of M if M is a row vector or from the row names of M if M is a column vector.
Domain: $1 \times n$ and $n \times 1$ vectors
Range: $n \times n$ diagonal matrices

`get(`*systemname*`)`
Description: a copy of Stata internal system matrix *systemname*

This function is included for backward compatibility with previous versions of Stata.
Domain: existing names of system matrices
Range: matrices

`hadamard(`M`,`N`)`
Description: a matrix whose i, j element is $M[i,j] \cdot N[i,j]$ (if M and N are not the same size, this function reports a conformability error)
Domain M: $m \times n$ matrices
Domain N: $m \times n$ matrices
Range: $m \times n$ matrices

`I(`n`)`
Description: an $n \times n$ identity matrix if n is an integer; otherwise, a `round(`n`)` $\times$ `round(`n`)` identity matrix
Domain: real scalars 1 to `matsize`
Range: identity matrices

`inv(`M`)`

Description: the inverse of the matrix M

If M is singular, this will result in an error.

The function `invsym()` should be used in preference to `inv()` because `invsym()` is more accurate. The row names of the result are obtained from the column names of M, and the column names of the result are obtained from the row names of M.

Domain: $n \times n$ nonsingular matrices

Range: $n \times n$ matrices

`invsym(`M`)`

Description: the inverse of M if M is positive definite

If M is not positive definite, rows will be inverted until the diagonal terms are zero or negative; the rows and columns corresponding to these terms will be set to 0, producing a g2 inverse. The row names of the result are obtained from the column names of M, and the column names of the result are obtained from the row names of M.

Domain: $n \times n$ symmetric matrices

Range: $n \times n$ symmetric matrices

`J(`r`,`c`,`z`)`

Description: the $r \times c$ matrix containing elements z

Domain r: integer scalars 1 to `matsize`

Domain c: integer scalars 1 to `matsize`

Domain z: scalars $-8e+307$ to 8e+307

Range: $r \times c$ matrices

`matuniform(`r`,`c`)`

Description: the $r \times c$ matrices containing uniformly distributed pseudorandom numbers on the interval $(0, 1)$

Domain r: integer scalars 1 to `matsize`

Domain c: integer scalars 1 to `matsize`

Range: $r \times c$ matrices

`nullmat(`*matname*`)`

Description: use with the row-join (`,`) and column-join (`\`) operators in programming situations

Consider the following code fragment, which is an attempt to create the vector $(1, 2, 3, 4)$:

```
forvalues i = 1/4 {
        mat v = (v, `i')
}
```

The above program will not work because, the first time through the loop, `v` will not yet exist, and thus forming ``(v, `i')`` makes no sense. `nullmat()` relaxes that restriction:

```
forvalues i = 1/4 {
        mat v = (nullmat(v), `i')
}
```

The `nullmat()` function informs Stata that if `v` does not exist, the function row-join is to be generalized. Joining nothing with `` `i' `` results in ``(`i')``. Thus the first time through the loop, `v` $= (1)$ is formed. The second time through, `v` does exist, so `v` $= (1, 2)$ is formed, and so on.

`nullmat()` can be used only with the `,` and `\` operators.

Domain: matrix names, existing and nonexisting

Range: matrices including null if *matname* does not exist

`sweep(`M`,`i`)`

Description: matrix M with ith row/column swept

The row and column names of the resultant matrix are obtained from M, except that the nth row and column names are interchanged. If $B =$ `sweep(`A`,`k`)`, then

$$
\begin{aligned}
B_{kk} &= \frac{1}{A_{kk}} \\
B_{ik} &= -\frac{A_{ik}}{A_{kk}}, \qquad i \neq k \\
B_{kj} &= \frac{A_{kj}}{A_{kk}}, \qquad j \neq k \\
B_{ij} &= A_{ij} - \frac{A_{ik}A_{kj}}{A_{kk}}, \qquad i \neq k, j \neq k
\end{aligned}
$$

Domain M: $n \times n$ matrices

Domain i: integer scalars 1 to n

Range: $n \times n$ matrices

`vec(`M`)`

Description: a column vector formed by listing the elements of M, starting with the first column and proceeding column by column

Domain: matrices

Range: column vectors ($n \times 1$ matrices) `vecdiag(`M`)`

Description: the row vector containing the diagonal of matrix M

`vecdiag()` is the opposite of `diag()`. The row name is set to `r1`; the column names are obtained from the column names of M.

Domain: $n \times n$ matrices

Range: $1 \times n$ vectors

Matrix functions returning a scalar

`colnumb(`M`,`s`)`

Description: the column number of M associated with column name s; *missing* if the column cannot be found

Domain M: matrices

Domain s: strings

Range: integer scalars 1 to `matsize` or *missing*

`colsof(`M`)`

Description: the number of columns of M

Domain: matrices

Range: integer scalars 1 to `matsize`

`det(`M`)`

Description: the determinant of matrix M

Domain: $n \times n$ (square) matrices

Range: scalars −8e+307 to 8e+307

`diag0cnt(`M`)`

Description: the number of zeros on the diagonal of M

Domain: $n \times n$ (square) matrices

Range: integer scalars 0 to n

`el(`s`,`i`,`j`)`

Description: s`[floor(`i`),floor(`j`)]`, the i, j element of the matrix named s; *missing* if i or j are out of range or if matrix s does not exist

Domain s: strings containing matrix name

Domain i: scalars 1 to `matsize`

Domain j: scalars 1 to `matsize`

Range: scalars −8e+307 to 8e+307 or *missing*

`issymmetric(`M`)`

Description: `1` if the matrix is symmetric; otherwise, `0`

Domain M: matrices

Range: integers 0 and 1

`matmissing(`M`)`

Description: `1` if any elements of the matrix are missing; otherwise, `0`

Domain M: matrices

Range: integers 0 and 1

`mreldif(`X`,`Y`)`

Description: the relative difference of X and Y, where the relative difference is defined as $\max_{i,j}\{|x_{ij} - y_{ij}|/(|y_{ij}| + 1)\}$

Domain X: matrices

Domain Y: matrices with same number of rows and columns as X

Range: scalars $-8\text{e}{+}307$ to 8e+307

`rownumb(`M`,`s`)`

Description: the row number of M associated with row name s; *missing* if the row cannot be found

Domain M: matrices

Domain s: strings

Range: integer scalars 1 to `matsize` or *missing*

`rowsof(`M`)`

Description: the number of rows of M

Domain: matrices

Range: integer scalars 1 to `matsize`

`trace(`M`)`

Description: the trace of matrix M

Domain: $n \times n$ (square) matrices

Range: scalars $-8\text{e}{+}307$ to 8e+307

Jacques Salomon Hadamard (1865–1963) was born in Versailles, France. He studied at the Ecole Normale Supérieure in Paris and obtained a doctorate in 1892 for a thesis on functions defined by Taylor series. Hadamard taught at Bordeaux for 4 years and in a productive period published an outstanding theorem on prime numbers, proved independently by Charles de la Vallée Poussin, and worked on what are now called Hadamard matrices. In 1897, he returned to Paris, where he held a series of prominent posts. In his later career, his interests extended from pure mathematics toward mathematical physics. Hadamard produced papers and books in many different areas. He campaigned actively against anti-Semitism at the time of the Dreyfus affair. After the fall of France in 1940, he spent some time in the United States and then Great Britain.

Reference

Mazýa, V. G., and T. O. Shaposhnikova. 1998. *Jacques Hadamard, A Universal mathematician*. Providence, RI: American Mathematical Society.

Also see

[D] **egen** — Extensions to generate

[M-5] **intro** — Alphabetical index to functions

[U] **13.3 Functions**

[U] **14.8 Matrix functions**

Title

Programming functions

Contents Functions References Also see

Contents

`maxfloat()`	the largest value that can be stored in storage type `float`
`maxint()`	the largest value that can be stored in storage type `int`
`maxlong()`	the largest value that can be stored in storage type `long`
`mi(`x_1`,`x_2`,`...`,`x_n`)`	a synonym for `missing(`x_1`,`x_2`,`...`,`x_n`)`
`minbyte()`	the smallest value that can be stored in storage type `byte`
`mindouble()`	the smallest value that can be stored in storage type `double`
`minfloat()`	the smallest value that can be stored in storage type `float`
`minint()`	the smallest value that can be stored in storage type `int`
`minlong()`	the smallest value that can be stored in storage type `long`
`missing(`x_1`,`x_2`,`...`,`x_n`)`	`1` if any x_i evaluates to *missing*; otherwise, `0`
`r(`*name*`)`	the value of the stored result `r(`*name*`)`; see [U] **18.8 Accessing results calculated by other programs**
`recode(`x`,`x_1`,`...`,`x_n`)`	*missing* if $x_1, \ldots, x_n$ is not weakly increasing; x if x is missing; x_1 if $x \leq x_1$; x_2 if $x \leq x_2$, ...; otherwise, x_n if $x > x_1$, x_2, ..., x_{n-1} or $x_i \geq .$ is interpreted as $x_i = +\infty$
`replay()`	`1` if the first nonblank character of local macro `` `0' `` is a comma, or if `` `0' `` is empty
`return(`*name*`)`	the value of the to-be-stored result `r(`*name*`)`; see [P] **return**
`s(`*name*`)`	the value of stored result `s(`*name*`)`; see [U] **18.8 Accessing results calculated by other programs**
`scalar(`*exp*`)`	restricts name interpretation to scalars and matrices
`smallestdouble()`	the smallest double-precision number greater than zero

Functions

`autocode(`x`,`n`,`x_0`,`x_1`)`

Description: partitions the interval from x_0 to x_1 into n equal-length intervals and returns the upper bound of the interval that contains x

This function is an automated version of `recode()`. See [U] **25 Working with categorical data and factor variables** for an example.

The algorithm for `autocode()` is

if $(n \geq . \,|\, x_0 \geq . \,|\, x_1 \geq . \,|\, n \leq 0 \,|\, x_0 \geq x_1)$
  then return *missing*
  if $x \geq .$, then return x
otherwise
  for $i = 1$ to $n - 1$
    $xmap = x_0 + i * (x_1 - x_0)/n$
    if $x \leq xmap$ then return $xmap$
  end
  otherwise
    return x_1

Domain x: $-8\text{e}{+}307$ to 8e+307
Domain n: integers 1 to 8e+307
Domain x_0: $-8\text{e}{+}307$ to 8e+307
Domain x_1: x_0 to 8e+307
Range: x_0 to x_1

`byteorder()`

Description: `1` if your computer stores numbers by using a hilo byte order and evaluates to `2` if your computer stores numbers by using a lohi byte order

Consider the number 1 written as a 2-byte integer. On some computers (called hilo), it is written as "00 01", and on other computers (called lohi), it is written as "01 00" (with the least significant byte written first). There are similar issues for 4-byte integers, 4-byte floats, and 8-byte floats. Stata automatically handles byte-order differences for Stata-created files. Users need not be concerned about this issue. Programmers producing customary binary files can use `byteorder()` to determine the native byte ordering; see [P] **file**.

Range: 1 and 2

`c(`*name*`)`

Description: the value of the system or constant result `c(`*name*`)` (see [P] **creturn**)

Referencing `c(`*name*`)` will return an error if the result does not exist.

Domain: names

Range: real values, strings, or *missing*

`_caller()`

Description: `version` of the program or session that invoked the currently running program; see [P] **version**

The current version at the time of this writing is 14, so 14 is the upper end of this range. If Stata 14.1 were the current version, 14.1 would be the upper end of this range, and likewise, if Stata 15 were the current version, 15 would be the upper end of this range. This is a function for use by programmers.

Range: 1 to 14.2

`chop(`x`, `ϵ`)`

Description: `round(`x`)` if `abs(`x $-$ `round(`x`))` $< \epsilon$; otherwise, x; or x if x is missing

Domain x: $-$8e+307 to 8e+307

Domain ϵ: $-$8e+307 to 8e+307

Range: $-$8e+307 to 8e+307

`clip(`x`,`a`,`b`)`

Description: x if $a < x < b$, b if $x \geq b$, a if $x \leq a$, or *missing* if x is missing or if $a > b$; x if x is missing

If a or b is missing, this is interpreted as $a = -\infty$ or $b = +\infty$, respectively.

Domain x: $-$8e+307 to 8e+307

Domain a: $-$8e+307 to 8e+307

Domain b: $-$8e+307 to 8e+307

Range: $-$8e+307 to 8e+307

`cond(`x`,`a`,`b`[,`c`])`

Description: a if x is *true* and nonmissing, b if x is *false*, and c if x is *missing*; a if c is not specified and x evaluates to *missing*

Note that expressions such as $x > 2$ will never evaluate to *missing*.

`cond(x>2,50,70)` returns `50` if `x` $>$ `2` (includes `x` $\geq$ `.`)
`cond(x>2,50,70)` returns `70` if `x` $\leq$ `2`

If you need a case for missing values in the above examples, try

`cond(missing(x), ., cond(x>2,50,70))` returns `.` if `x` is *missing*,
returns `50` if `x` $>$ `2`, and returns `70` if `x` $\leq$ `2`

If the first argument is a scalar that may contain a missing value or a variable containing missing values, the fourth argument has an effect.

`cond(wage,1,0,.)` returns `1` if `wage` is not zero and not missing
`cond(wage,1,0,.)` returns `0` if `wage` is zero
`cond(wage,1,0,.)` returns `.` if `wage` is *missing*

Caution: If the first argument to `cond()` is a logical expression, that is, `cond(x>2,50,70,.)`, the fourth argument is never reached.

Domain x: $-8e{+}307$ to $8e{+}307$ or *missing*; $0 \Rightarrow$ *false*, otherwise interpreted as *true*
Domain a: numbers and strings
Domain b: numbers if a is a number; strings if a is a string
Domain c: numbers if a is a number; strings if a is a string
Range: a, b, and c

`e(`*name*`)`

Description: the value of stored result `e(`*name*`)`; see **[U] 18.8 Accessing results calculated by other programs**

`e(`*name*`)` = scalar missing if the stored result does not exist
`e(`*name*`)` = specified matrix if the stored result is a matrix
`e(`*name*`)` = scalar numeric value if the stored result is a scalar

Domain: names
Range: strings, scalars, matrices, or *missing*

`e(sample)`

Description: `1` if the observation is in the estimation sample and `0` otherwise
Range: 0 and 1

`epsdouble()`

Description: the machine precision of a double-precision number

If $d <$ `epsdouble()` and (double) $x = 1$, then $x + d =$ (double) 1. This function takes no arguments, but the parentheses must be included.

Range: a double-precision number close to 0

`epsfloat()`

Description: the machine precision of a floating-point number

If $d <$ `epsfloat()` and (float) $x = 1$, then $x + d =$ (float) 1. This function takes no arguments, but the parentheses must be included.

Range: a floating-point number close to 0 `fileexists(`*f*`)`

Description: `1` if the file specified by *f* exists; otherwise, `0`

If the file exists but is not readable, `fileexists()` will still return `1`, because it does exist. If the "file" is a directory, `fileexists()` will return `0`.

Domain: filenames

Range: 0 and 1

`fileread(`*f*`)`

Description: the contents of the file specified by *f*

If the file does not exist or an I/O error occurs while reading the file, then "`fileread() error` #" is returned, where # is a standard Stata error return code.

Domain: filenames

Range: strings

`filereaderror(`*f*`)`

Description: `0` or positive integer, said value having the interpretation of a return code

It is used like this

```
. generate strL s = fileread(filename) if fileexists(filename)
. assert filereaderror(s)==0
```

or this

```
. generate strL s = fileread(filename) if fileexists(filename)
. generate rc = filereaderror(s)
```

That is, `filereaderror(`*s*`)` is used on the result returned by `fileread(`*filename*`)` to determine whether an I/O error occurred.

In the example, we only `fileread()` files that `fileexists()`. That is not required. If the file does not exist, that will be detected by `filereaderror()` as an error. The way we showed the example, we did not want to read missing files as errors. If we wanted to treat missing files as errors, we would have coded

```
. generate strL s = fileread(filename)
. assert filereaderror(s)==0
```

or

```
. generate strL s = fileread(filename)
. generate rc = filereaderror(s)
```

Domain: strings

Range: integers

`filewrite(`f`,`s[`,`r]`)`

Description: writes the string specified by s to the file specified by f and returns the number of bytes in the resulting file

If the optional argument r is specified as 1, the file specified by f will be replaced if it exists. If r is specified as 2, the file specified by f will be appended to if it exists. Any other values of r are treated as if r were not specified; that is, f will only be written to if it does not already exist.

When the file f is freshly created or is replaced, the value returned by `filewrite()` is the number of bytes written to the file, `strlen(`s`)`. If r is specified as 2, and thus `filewrite()` is appending to an existing file, the value returned is the total number of bytes in the resulting file; that is, the value is the sum of the number of the bytes in the file as it existed before `filewrite()` was called and the number of bytes newly written to it, `strlen(`s`)`.

If the file exists and r is not specified as 1 or 2, or an error occurs while writing to the file, then a negative number (#) is returned, where `abs(`#`)` is a standard Stata error return code.

Domain f: filenames

Domain s: strings

Domain r: integers 1 or 2

Range: integers

`float(`x`)`

Description: the value of x rounded to `float` precision

Although you may store your numeric variables as `byte`, `int`, `long`, `float`, or `double`, Stata converts all numbers to `double` before performing any calculations. Consequently, difficulties can arise in comparing numbers that have no finite binary representation.

For example, if the variable `x` is stored as a `float` and contains the value `1.1` (a repeating "decimal" in binary), the expression `x==1.1` will evaluate to *false* because the literal `1.1` is the `double` representation of 1.1, which is different from the `float` representation stored in `x`. (They differ by 2.384×10^{-8}.) The expression `x==float(1.1)` will evaluate to *true* because the `float()` function converts the literal `1.1` to its `float` representation before it is compared with `x`. (See **[U] 13.12 Precision and problems therein** for more information.)

Domain: $-1e+38$ to $1e+38$

Range: $-1e+38$ to $1e+38$

`fmtwidth(`*fmtstr*`)`

Description: the output length of the *%fmt* contained in *fmtstr*; *missing* if *fmtstr* does not contain a valid *%fmt*

For example, `fmtwidth("%9.2f")` returns `9` and `fmtwidth("%tc")` returns `18`.

Range: strings

`has_eprop(`*name*`)`

Description: `1` if *name* appears as a word in `e(properties)`; otherwise, `0`

Domain: names

Range: 0 or 1

`inlist(`z`,`a`,`b`,...)`
Description: `1` if z is a member of the remaining arguments; otherwise, `0`

All arguments must be reals or all must be strings. The number of arguments is between 2 and 255 for reals and between 2 and 10 for strings.
Domain: all reals or all strings
Range: 0 or 1

`inrange(`z`,`a`,`b`)`
Description: `1` if it is known that $a \leq z \leq b$; otherwise, `0`

The following ordered rules apply:
$z \geq$ `.` returns `0`.
$a \geq$ `.` and $b =$ `.` returns `1`.
$a \geq$ `.` returns `1` if $z \leq b$; otherwise, it returns `0`.
$b \geq$ `.` returns `1` if $a \leq z$; otherwise, it returns `0`.
Otherwise, `1` is returned if $a \leq z \leq b$.
If the arguments are strings, "`.`" is interpreted as `""`.
Domain: all reals or all strings
Range: 0 or 1

`irecode(`x`,`x_1`,`x_2`,`x_3`,...,`x_n`)`
Description: *missing* if x is missing or $x_1, \ldots, x_n$ is not weakly increasing; `0` if $x \leq x_1$; `1` if $x_1 < x \leq x_2$; `2` if $x_2 < x \leq x_3$; ...; n if $x > x_n$

Also see `autocode()` and `recode()` for other styles of recode functions.

`irecode(3, -10, -5, -3, -3, 0, 15, .)` = `5`
Domain x: −8e+307 to 8e+307
Domain x_i: −8e+307 to 8e+307
Range: nonnegative integers

`matrix(`*exp*`)`
Description: restricts name interpretation to scalars and matrices; see `scalar()`
Domain: any valid expression
Range: evaluation of *exp*

`maxbyte()`
Description: the largest value that can be stored in storage type `byte`

This function takes no arguments, but the parentheses must be included.
Range: one integer number

`maxdouble()`
Description: the largest value that can be stored in storage type `double`

This function takes no arguments, but the parentheses must be included.
Range: one double-precision number

`maxfloat()`
Description: the largest value that can be stored in storage type `float`

This function takes no arguments, but the parentheses must be included.
Range: one floating-point number

`maxint()`

Description: the largest value that can be stored in storage type `int`

This function takes no arguments, but the parentheses must be included.

Range: one integer number

`maxlong()`

Description: the largest value that can be stored in storage type `long`

This function takes no arguments, but the parentheses must be included.

Range: one integer number

`mi(`x_1`,`x_2`,...,`x_n`)`

Description: a synonym for `missing(`x_1`,`x_2`,...,`x_n`)`

`minbyte()`

Description: the smallest value that can be stored in storage type `byte`

This function takes no arguments, but the parentheses must be included.

Range: one integer number

`mindouble()`

Description: the smallest value that can be stored in storage type `double`

This function takes no arguments, but the parentheses must be included.

Range: one double-precision number

`minfloat()`

Description: the smallest value that can be stored in storage type `float`

This function takes no arguments, but the parentheses must be included.

Range: one floating-point number

`minint()`

Description: the smallest value that can be stored in storage type `int`

This function takes no arguments, but the parentheses must be included.

Range: one integer number

`minlong()`

Description: the smallest value that can be stored in storage type `long`

This function takes no arguments, but the parentheses must be included.

Range: one integer number

`missing(`x_1`,`x_2`,...,`x_n`)`

Description: `1` if any x_i evaluates to *missing*; otherwise, `0`

Stata has two concepts of missing values: a numeric missing value (`.`, `.a`, `.b`, ..., `.z`) and a string missing value (`""`). `missing()` returns `1` (meaning *true*) if any expression x_i evaluates to *missing*. If x is numeric, `missing(`x`)` is equivalent to $x \geq$ `.`. If x is string, `missing(`x`)` is equivalent to x`==""`.

Domain x_i: any string or numeric expression

Range: 0 and 1

`r(`*name*`)`

Description: the value of the stored result `r(`*name*`)`; see [U] **18.8 Accessing results calculated by other programs**

`r(`*name*`)` = scalar missing if the stored result does not exist
`r(`*name*`)` = specified matrix if the stored result is a matrix
`r(`*name*`)` = scalar numeric value if the stored result is a scalar that can be interpreted as a number

Domain: names
Range: strings, scalars, matrices, or *missing*

`recode(`x`,`x_1`,`x_2`,...,`x_n`)`

Description: *missing* if $x_1, \ldots, x_n$ is not weakly increasing; x if x is missing; x_1 if $x \leq x_1$; x_2 if $x \leq x_2$, ...; otherwise, x_n if $x > x_1$, x_2, ..., x_{n-1} or $x_i \geq .$ is interpreted as $x_i = +\infty$

Also see `autocode()` and `irecode()` for other styles of recode functions.

Domain x: −8e+307 to 8e+307 or *missing*
Domain x_1: −8e+307 to 8e+307
Domain x_2: x_1 to 8e+307
...
Domain x_n: x_{n-1} to 8e+307
Range: x_1, x_2, ..., x_n or *missing*

`replay()`

Description: `1` if the first nonblank character of local macro `‘0’` is a comma, or if `‘0’` is empty

This is a function for use by programmers writing estimation commands; see [P] **ereturn**.

Range: integers 0 and 1, meaning *false* and *true*, respectively

`return(`*name*`)`

Description: the value of the to-be-stored result `r(`*name*`)`; see [P] **return**

`return(`*name*`)` = scalar missing if the stored result does not exist
`return(`*name*`)` = specified matrix if the stored result is a matrix
`return(`*name*`)` = scalar numeric value if the stored result is a scalar

Domain: names
Range: strings, scalars, matrices, or *missing*

`s(`*name*`)`

Description: the value of stored result `s(`*name*`)`; see [U] **18.8 Accessing results calculated by other programs**

`s(`*name*`)` = . if the stored result does not exist

Domain: names
Range: strings or *missing*

`scalar(`*exp*`)`

Description: restricts name interpretation to scalars and matrices

Names in expressions can refer to names of variables in the dataset, names of matrices, or names of scalars. Matrices and scalars can have the same names as variables in the dataset. If names conflict, Stata assumes that you are referring to the name of the variable in the dataset.

`matrix()` and `scalar()` explicitly state that you are referring to matrices and scalars. `matrix()` and `scalar()` are the same function; scalars and matrices may not have the same names and so cannot be confused. Typing `scalar(x)` makes it clear that you are referring to the scalar or matrix named `x` and not the variable named `x`, should there happen to be a variable of that name.

Domain: any valid expression

Range: evaluation of *exp*

`smallestdouble()`

Description: the smallest double-precision number greater than zero

If $0 < d <$ `smallestdouble()`, then d does not have full double precision; these are called the denormalized numbers. This function takes no arguments, but the parentheses must be included.

Range: a double-precision number close to 0

References

Kantor, D., and N. J. Cox. 2005. Depending on conditions: A tutorial on the cond() function. *Stata Journal* 5: 413–420.

Rising, W. R. 2010. Stata tip 86: The missing() function. *Stata Journal* 10: 303–304.

Also see

[D] **egen** — Extensions to generate

[M-4] **programming** — Programming functions

[M-5] **intro** — Alphabetical index to functions

[U] 13.3 Functions

Title

Random-number functions

Contents Functions Remarks and examples Methods and formulas
Acknowledgments References Also see

Contents

Functions

The term "pseudorandom number" is used to emphasize that the numbers are generated by formulas and are thus not truly random. From now on, we will drop the "pseudo" and just say random numbers.

For information on setting the random-number seed, see [R] **set seed**.

`runiform()`

Description: uniformly distributed random variates over the interval $(0, 1)$

`runiform()` can be seeded with the `set seed` command; see [R] **set seed**.

Range: `c(epsdouble)` to $1-$ `c(epsdouble)`

`runiform(`a`,`b`)`

Description: uniformly distributed random variates over the interval (a, b)

Domain a: `c(mindouble)` to `c(maxdouble)`

Domain b: `c(mindouble)` to `c(maxdouble)`

Range: $a+$ `c(epsdouble)` to $b-$ `c(epsdouble)`

`runiformint(`a`,`b`)`

Description: uniformly distributed random integer variates on the interval $[a, b]$

If a or b is nonintegral, `runiformint(`a`,`b`)` returns `runiformint(floor(`a`), floor(`b`))`.

Domain a: -2^{53} to 2^{53} (may be nonintegral)

Domain b: -2^{53} to 2^{53} (may be nonintegral)

Range: -2^{53} to 2^{53}

`rbeta(`a`,`b`)`

Description: beta(a,b) random variates, where a and b are the beta distribution shape parameters

Besides using the standard methodology for generating random variates from a given distribution, `rbeta()` uses the specialized algorithms of Johnk (Gentle 2003), Atkinson and Whittaker (1970, 1976), Devroye (1986), and Schmeiser and Babu (1980).

Domain a: 0.05 to 1e+5

Domain b: 0.15 to 1e+5

Range: 0 to 1 (exclusive)

`rbinomial(`n`,`p`)`

Description: binomial(n,p) random variates, where n is the number of trials and p is the success probability

Besides using the standard methodology for generating random variates from a given distribution, `rbinomial()` uses the specialized algorithms of Kachitvichyanukul (1982), Kachitvichyanukul and Schmeiser (1988), and Kemp (1986).

Domain n: 1 to 1e+11

Domain p: 1e–8 to 1−1e–8

Range: 0 to n

`rchi2(`df`)`

Description: chi-squared, with df degrees of freedom, random variates

Domain df: 2e–4 to 2e+8

Range: 0 to `c(maxdouble)`

`rexponential(`b`)`

Description: exponential random variates with scale b

Domain b: 1e–323 to 8e+307

Range: 1e–323 to 8e+307

`rgamma(`a`,`b`)`

Description: gamma(a,b) random variates, where a is the gamma shape parameter and b is the scale parameter

Methods for generating gamma variates are taken from Ahrens and Dieter (1974), Best (1983), and Schmeiser and Lal (1980).

Domain a: 1e–4 to 1e+8

Domain b: `c(smallestdouble)` to `c(maxdouble)`

Range: 0 to `c(maxdouble)`

`rhypergeometric(`N`,`K`,`n`)`

Description: hypergeometric random variates

The distribution parameters are integer valued, where N is the population size, K is the number of elements in the population that have the attribute of interest, and n is the sample size.

Besides using the standard methodology for generating random variates from a given distribution, `rhypergeometric()` uses the specialized algorithms of Kachitvichyanukul (1982) and Kachitvichyanukul and Schmeiser (1985).

Domain N: 2 to 1e+6

Domain K: 1 to $N-1$

Domain n: 1 to $N-1$

Range: `max(`$0,n-N+K$`)` to `min(`K`,`n`)`

`rigaussian(`m`,`a`)`

Description: inverse Gaussian random variates with mean m and shape parameter a

`rigaussian()` is based on a method proposed by Michael, Schucany, and Haas (1976).

Domain m: 1e–10 to 1000

Domain a: 0.001 to 1e+10

Range: 0 to `c(maxdouble)`

`rlogistic()`

Description: logistic variates with mean 0 and standard deviation $\pi/\sqrt{3}$

The variates x are generated by x = `invlogistic(0,1,`u`)`, where u is a random uniform(0,1) variate.

Range: `c(mindouble)` to `c(maxdouble)`

`rlogistic(`s`)`

Description: logistic variates with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$

The variates x are generated by $x =$ `invlogistic(0,`s`,`u`)`, where u is a random uniform(0,1) variate.

Domain s: 0 to `c(maxdouble)`

Range: `c(mindouble)` to `c(maxdouble)`

`rlogistic(`m`,`s`)`

Description: logistic variates with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$

The variates x are generated by $x =$ `invlogistic(`m`,`s`,`u`)`, where u is a random uniform(0,1) variate.

Domain m: `c(mindouble)` to `c(maxdouble)`

Domain s: 0 to `c(maxdouble)`

Range: `c(mindouble)` to `c(maxdouble)`

`rnbinomial(`n`,`p`)`

Description: negative binomial random variates

If n is integer valued, `rnbinomial()` returns the number of failures before the nth success, where the probability of success on a single trial is p. n can also be nonintegral.

Domain n: 1e–4 to 1e+5

Domain p: 1e–4 to 1−1e–4

Range: 0 to $2^{53} - 1$

`rnormal()`

Description: standard normal (Gaussian) random variates, that is, variates from a normal distribution with a mean of 0 and a standard deviation of 1

Range: `c(mindouble)` to `c(maxdouble)`

`rnormal(`m`)`

Description: normal(m,1) (Gaussian) random variates, where m is the mean and the standard deviation is 1

Domain m: `c(mindouble)` to `c(maxdouble)`

Range: `c(mindouble)` to `c(maxdouble)`

`rnormal(`m`,`s`)`

Description: normal(m,s) (Gaussian) random variates, where m is the mean and s is the standard deviation

The methods for generating normal (Gaussian) random variates are taken from Knuth (1998, 122–128); Marsaglia, MacLaren, and Bray (1964); and Walker (1977).

Domain m: `c(mindouble)` to `c(maxdouble)`

Domain s: 0 to `c(maxdouble)`

Range: `c(mindouble)` to `c(maxdouble)`

`rpoisson(`m`)`

Description: Poisson(m) random variates, where m is the distribution mean

Poisson variates are generated using the probability integral transform methods of Kemp and Kemp (1990, 1991) and the method of Kachitvichyanukul (1982).

Domain m: 1e–6 to 1e+11

Range: 0 to $2^{53} - 1$

`rt(`df`)`

Description: Student's t random variates, where df is the degrees of freedom

Student's t variates are generated using the method of Kinderman and Monahan (1977, 1980).

Domain df: 1 to $2^{53} - 1$

Range: `c(mindouble)` to `c(maxdouble)`

`rweibull(`a`,`b`)`

Description: Weibull variates with shape a and scale b

The variates x are generated by $x =$ `invweibull(`a`,`b`,0,`u`)`, where u is a random uniform(0,1) variate.

Domain a: 0.01 to 1e+6

Domain b: 1e–323 to 8e+307

Range: 1e–323 to 8e+307

`rweibull(`a`,`b`,`g`)`

Description: Weibull variates with shape a, scale b, and location g

The variates x are generated by $x =$ `invweibull(`a`,`b`,`g`,`u`)`, where u is a random uniform(0,1) variate.

Domain a: 0.01 to 1e+6

Domain b: 1e–323 to 8e+307

Domain g: −8e+307 to 8e+307

Range: $g +$ `c(epsdouble)` to 8e+307

`rweibullph(`a`,`b`)`

Description: Weibull (proportional hazards) variates with shape a and scale b

The variates x are generated by $x =$ `invweibullph(`a`,`b`,0,`u`)`, where u is a random uniform(0,1) variate.

Domain a: 0.01 to 1e+6

Domain b: 1e–323 to 8e+307

Range: 1e–323 to 8e+307

`rweibullph(`a`,`b`,`g`)`

Description: Weibull (proportional hazards) variates with shape a, scale b, and location g

The variates x are generated by $x =$ `invweibullph(`a`,`b`,`g`,`u`)`, where u is a random uniform(0,1) variate.

Domain a: 0.01 to 1e+6

Domain b: 1e–323 to 8e+307

Domain g: −8e+307 to 8e+307

Range: $g +$ `c(epsdouble)` to 8e+307

Remarks and examples

It is ironic that the first thing to note about random numbers is how to make them reproducible. Before using a random-number function, type

```
set seed #
```

where # is any integer between 0 and $2^{31} - 1$, inclusive, to draw the same sequence of random numbers. It does not matter which integer you choose as your seed; they are all equally good. See [R] **set seed**.

`runiform()` is the basis for all the other random-number functions because all the other random-number functions transform uniform $(0, 1)$ random numbers to the specified distribution.

`runiform()` implements the Mersenne Twister 64-bit (MT64) and the "keep it simple stupid" 32-bit (KISS32) algorithms for generating uniform $(0, 1)$ random numbers. `runiform()` uses the MT64 algorithm by default.

`runiform()` uses the KISS32 algorithm only when the user version is less than 14 or when the random-number generator has been set to `kiss32`; see [P] **version** for details about setting the user version. We recommend that you do not change the default random-number generator, but see [R] **set rng** for details.

❑ Technical note

Although we recommend that you use `runiform()`, we made generator-specific versions of `runiform()` available for advanced users who want to hardcode their generator choice. The function `runiform_mt64()` always uses the MT64 algorithm to generate uniform $(0, 1)$ random numbers, and the function `runiform_kiss32()` always uses the KISS32 algorithm to generate uniform $(0, 1)$ random numbers. In fact, generator-specific versions are available for all the implemented distributions. For example, `rnormal_mt64()` and `rnormal_kiss32()` use transforms of MT64 and KISS32 uniform variates, respectively, to generate standard normal variates.

❑

❑ Technical note

Both the MT64 and the KISS32 generators produce uniform variates that pass many tests for randomness. Many researchers prefer the MT64 to the KISS32 generator because the MT64 generator has a longer period and a finer resolution and requires a higher dimension before patterns appear; see Matsumoto and Nishimura (1998).

The MT64 generator has a period of $2^{19937} - 1$ and a resolution of 2^{-53}; see Matsumoto and Nishimura (1998). The KISS32 generator has a period of about 2^{126} and a resolution of 2^{-32}; see *Methods and formulas* below.

❑

❑ Technical note

This technical note explains how to restart a random-number generator from its current spot.

The current spot in the sequence of a random-number generator is part of the state of a random-number generator. If you tell me the state of a random-number generator, I know where it is in its sequence, and I can compute the next random number. The state of a random-number generator is a complicated object that requires more space than the integers used to seed a generator. For instance, an MT64 state is a 5008-digit, base-16 number preceded by three letters.

If you want to restart a random-number generator from where it left off, you should store the current state in a macro and then set the state of the random-number generator when you want to restart it. For example, suppose we set a seed and draw some random numbers.

```
. set obs 3
number of observations (_N) was 0, now 3
. set seed 12345
. generate x = runiform()
. list x

     +----------+
     |        x |
     |----------|
  1. | .3576297 |
  2. | .4004426 |
  3. | .6893833 |
     +----------+
```

We store the state of the random-number generator so that we can pick up right here in the sequence.

```
. local rngstate "`c(rngstate)'"
```

We draw some more random numbers.

```
. replace x = runiform()
(3 real changes made)
. list x

     +----------+
     |        x |
     |----------|
  1. | .5597356 |
  2. | .5744513 |
  3. | .2076905 |
     +----------+
```

Now, we set the state of the random-number generator to where it was and draw those same random numbers again.

```
. set rngstate `rngstate'
. replace x = runiform()
(0 real changes made)
. list x

     +----------+
     |        x |
     |----------|
  1. | .5597356 |
  2. | .5744513 |
  3. | .2076905 |
     +----------+
```

❏

Methods and formulas

All the nonuniform generators are based on the uniform MT64 and KISS32 generators.

The MT64 generator is well documented in Matsumoto and Nishimura (1998) and on their website http://www.math.sci.hiroshima-u.ac.jp/~m-mat/MT/emt.html. The MT64 implements the 64-bit version discussed at http://www.math.sci.hiroshima-u.ac.jp/~m-mat/MT/emt64.html. The default seed for the MT64 generator is 123456789.

KISS32 generator

The KISS32 uniform generator implemented in `runiform()` is based on George Marsaglia's (G. Marsaglia, 1994, pers. comm.) 32-bit pseudorandom-integer generator KISS32. The integer KISS32 generator is composed of two 32-bit pseudorandom-integer generators and two 16-bit integer generators (combined to make one 32-bit integer generator). The four generators are defined by the recursions

$$
\begin{aligned}
x_n &= 69069\, x_{n-1} + 1234567 \quad \mod 2^{32} && (1)\\
y_n &= y_{n-1}(I + L^{13})(I + R^{17})(I + L^5) && (2)\\
z_n &= 65184\big(z_{n-1} \bmod 2^{16}\big) + \mathrm{int}\big(z_{n-1}/2^{16}\big) && (3)\\
w_n &= 63663\big(w_{n-1} \bmod 2^{16}\big) + \mathrm{int}\big(w_{n-1}/2^{16}\big) && (4)
\end{aligned}
$$

In (2), the 32-bit word y_n is viewed as a 1×32 binary vector; L is the 32×32 matrix that produces a left shift of one (L has 1s on the first left subdiagonal, 0s elsewhere); and R is L transpose, affecting a right shift by one. In (3) and (4), int(x) is the integer part of x.

The integer KISS32 generator produces the 32-bit random integer

$$R_n = x_n + y_n + z_n + 2^{16} w_n \quad \mod 2^{32}$$

The KISS32 uniform implemented in `runiform()` takes the output from the integer KISS32 generator and divides it by 2^{32} to produce a real number on the interval $(0, 1)$. (Zeros are discarded, and the first nonzero result is returned.)

The recursion (5)–(8) have, respectively, the periods

$$
\begin{aligned}
&2^{32} && (5)\\
&2^{32} - 1 && (6)\\
&(65184 \cdot 2^{16} - 2)/2 \approx 2^{31} && (7)\\
&(63663 \cdot 2^{16} - 2)/2 \approx 2^{31} && (8)
\end{aligned}
$$

Thus the overall period for the integer KISS32 generator is

$$2^{32} \cdot (2^{32} - 1) \cdot (65184 \cdot 2^{15} - 1) \cdot (63663 \cdot 2^{15} - 1) \approx 2^{126}$$

When Stata first comes up, it initializes the four recursions in KISS32 by using the seeds

$$
\begin{aligned}
x_0 &= 123456789\\
y_0 &= 521288629\\
z_0 &= 362436069\\
w_0 &= 2262615
\end{aligned}
$$

Successive calls to the KISS32 uniform implemented in `runiform()` then produce the sequence

$$\frac{R_1}{2^{32}}, \frac{R_2}{2^{32}}, \frac{R_3}{2^{32}}, \ldots$$

Hence, the KISS32 uniform implemented in `runiform()` gives the same sequence of random numbers in every Stata session (measured from the start of the session) unless you reinitialize the seed. The full seed is the set of four numbers (x, y, z, w), but you can reinitialize the seed by simply issuing the command

```
. set seed #
```

where # is any integer between 0 and $2^{31} - 1$, inclusive. When this command is issued, the initial value x_0 is set equal to #, and the other three recursions are restarted at the seeds y_0, z_0, and w_0 given above. The first 100 random numbers are discarded, and successive calls to the KISS32 uniform implemented in `runiform()` give the sequence

$$\frac{R'_{101}}{2^{32}}, \frac{R'_{102}}{2^{32}}, \frac{R'_{103}}{2^{32}}, \ldots$$

However, if the command

```
. set seed 123456789
```

is given, the first 100 random numbers are not discarded, and you get the same sequence of random numbers that the KISS32 generator produces when Stata restarts; also see [R] **set seed**.

Acknowledgments

We thank the late George Marsaglia, formerly of Florida State University, for providing his KISS32 random-number generator.

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Also see

[D] **egen** — Extensions to generate

[M-5] **intro** — Alphabetical index to functions

[M-5] **runiform()** — Uniform and nonuniform pseudorandom variates

[R] **set rng** — Set which random-number generator (RNG) to use

[R] **set seed** — Specify random-number seed and state

[U] 13.3 Functions

Title

Selecting time-span functions

Contents Functions Also see

Contents

Functions

`tin(`d_1`,`d_2`)`

Description: *true* if $d_1 \leq t \leq d_2$, where t is the time variable previously `tsset`

You must have previously `tsset` the data to use `tin()`; see [TS] **tsset**. When you `tsset` the data, you specify a time variable, t, and the format on t states how it is recorded. You type d_1 and d_2 according to that format.

If t has a `%tc` format, you could type `tin(5jan1992 11:15, 14apr2002 12:25)`.

If t has a `%td` format, you could type `tin(5jan1992, 14apr2002)`.

If t has a `%tw` format, you could type `tin(1985w1, 2002w15)`.

If t has a `%tm` format, you could type `tin(1985m1, 2002m4)`.

If t has a `%tq` format, you could type `tin(1985q1, 2002q2)`.

If t has a `%th` format, you could type `tin(1985h1, 2002h1)`.

If t has a `%ty` format, you could type `tin(1985, 2002)`.

Otherwise, t is just a set of integers, and you could type `tin(12, 38)`.

The details of the `%t` format do not matter. If your t is formatted `%tdnn/dd/yy` so that 5jan1992 displays as 1/5/92, you would still type the date in day–month–year order: `tin(5jan1992, 14apr2002)`.

Domain d_1: date or time literals or strings recorded in units of t previously `tsset` or blank to indicate no minimum date

Domain d_2: date or time literals or strings recorded in units of t previously `tsset` or blank to indicate no maximum date

Range: 0 and 1, 1 $\Rightarrow$ *true*

`twithin(`d_1`,`d_2`)`

Description: *true* if $d_1 < t < d_2$, where t is the time variable previously `tsset`

See `tin()` above; `twithin()` is similar, except the range is exclusive.

Domain d_1: date or time literals or strings recorded in units of t previously `tsset` or blank to indicate no minimum date

Domain d_2: date or time literals or strings recorded in units of t previously `tsset` or blank to indicate no maximum date

Range: 0 and 1, 1 $\Rightarrow$ *true*

Also see

[D] **egen** — Extensions to generate

[M-5] **intro** — Alphabetical index to functions

[U] 13.3 Functions

Title

Statistical functions

Contents Functions References Also see

Contents

betaden(a,b,x)	the probability density of the beta distribution, where a and b are the shape parameters; 0 if $x < 0$ or $x > 1$
binomial(n,k,θ)	the probability of observing floor(k) or fewer successes in floor(n) trials when the probability of a success on one trial is θ; 0 if $k < 0$; or 1 if $k > n$
binomialp(n,k,p)	the probability of observing floor(k) successes in floor(n) trials when the probability of a success on one trial is p
binomialtail(n,k,θ)	the probability of observing floor(k) or more successes in floor(n) trials when the probability of a success on one trial is θ; 1 if $k < 0$; or 0 if $k > n$
binormal(h,k,ρ)	the joint cumulative distribution $\Phi(h,k,\rho)$ of bivariate normal with correlation ρ
chi2(df,x)	the cumulative χ^2 distribution with df degrees of freedom; 0 if $x < 0$
chi2den(df,x)	the probability density of the chi-squared distribution with df degrees of freedom; 0 if $x < 0$
chi2tail(df,x)	the reverse cumulative (upper tail or survivor) χ^2 distribution with df degrees of freedom; 1 if $x < 0$
dgammapda(a,x)	$\frac{\partial P(a,x)}{\partial a}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dgammapdada(a,x)	$\frac{\partial^2 P(a,x)}{\partial a^2}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dgammapdadx(a,x)	$\frac{\partial^2 P(a,x)}{\partial a \partial x}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dgammapdx(a,x)	$\frac{\partial P(a,x)}{\partial x}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dgammapdxdx(a,x)	$\frac{\partial^2 P(a,x)}{\partial x^2}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$
dunnettprob(k,df,x)	the cumulative multiple range distribution that is used in Dunnett's multiple-comparison method with k ranges and df degrees of freedom; 0 if $x < 0$
exponential(b,x)	the cumulative exponential distribution with scale b
exponentialden(b,x)	the probability density function of the exponential distribution with scale b
exponentialtail(b,x)	the reverse cumulative exponential distribution with scale b
F(df_1,df_2,f)	the cumulative F distribution with df_1 numerator and df_2 denominator degrees of freedom: F(df_1,df_2,f) $= \int_0^f$ Fden(df_1,df_2,t) dt; 0 if $f < 0$
Fden(df_1,df_2,f)	the probability density function of the F distribution with df_1 numerator and df_2 denominator degrees of freedom; 0 if $f < 0$

`Ftail(`df_1`,`df_2`,`f`)` the reverse cumulative (upper tail or survivor) F distribution with df_1 numerator and df_2 denominator degrees of freedom; `1` if $f < 0$

`gammaden(`a`,`b`,`g`,`x`)` the probability density function of the gamma distribution; `0` if $x < g$

`gammap(`a`,`x`)` the cumulative gamma distribution with shape parameter a; `0` if $x < 0$

`gammaptail(`a`,`x`)` the reverse cumulative (upper tail or survivor) gamma distribution with shape parameter a; `1` if $x < 0$

`hypergeometric(`N`,`K`,`n`,`k`)` the cumulative probability of the hypergeometric distribution

`hypergeometricp(`N`,`K`,`n`,`k`)` the hypergeometric probability of k successes out of a sample of size n, from a population of size N containing K elements that have the attribute of interest

`ibeta(`a`,`b`,`x`)` the cumulative beta distribution with shape parameters a and b; `0` if $x < 0$; or `1` if $x > 1$

`ibetatail(`a`,`b`,`x`)` the reverse cumulative (upper tail or survivor) beta distribution with shape parameters a and b; `1` if $x < 0$; or `0` if $x > 1$

`igaussian(`m`,`a`,`x`)` the cumulative inverse Gaussian distribution with mean m and shape parameter a; `0` if $x \leq 0$

`igaussianden(`m`,`a`,`x`)` the probability density of the inverse Gaussian distribution with mean m and shape parameter a; `0` if $x \leq 0$

`igaussiantail(`m`,`a`,`x`)` the reverse cumulative (upper tail or survivor) inverse Gaussian distribution with mean m and shape parameter a; `1` if $x \leq 0$

`invbinomial(`n`,`k`,`p`)` the inverse of the cumulative binomial; that is, θ (θ = probability of success on one trial) such that the probability of observing `floor(`k`)` or fewer successes in `floor(`n`)` trials is p

`invbinomialtail(`n`,`k`,`p`)` the inverse of the right cumulative binomial; that is, θ (θ = probability of success on one trial) such that the probability of observing `floor(`k`)` or more successes in `floor(`n`)` trials is p

`invchi2(`df`,`p`)` the inverse of `chi2()`: if `chi2(`df`,`x`)` $= p$, then `invchi2(`df`,`p`)` $= x$

`invchi2tail(`df`,`p`)` the inverse of `chi2tail()`: if `chi2tail(`df`,`x`)` $= p$, then `invchi2tail(`df`,`p`)` $= x$

`invdunnettprob(`k`,`df`,`p`)` the inverse cumulative multiple range distribution that is used in Dunnett's multiple-comparison method with k ranges and df degrees of freedom

`invexponential(`b`,`p`)` the inverse cumulative exponential distribution with scale b: if `exponential(`b`,`x`)` $= p$, then `invexponential(`b`,`p`)` $= x$

`invexponentialtail(`b`,`p`)` the inverse reverse cumulative exponential distribution with scale b: if `exponentialtail(`b`,`x`)` $= p$, then `invexponentialtail(`b`,`p`)` $= x$

`invF(`df_1`,`df_2`,`p`)` the inverse cumulative F distribution: if `F(`df_1`,`df_2`,`f`)` $= p$, then `invF(`df_1`,`df_2`,`p`)` $= f$

`invFtail(`df_1`,`df_2`,`p`)` the inverse reverse cumulative (upper tail or survivor) F distribution: if `Ftail(`df_1`,`df_2`,`f`)` $= p$, then `invFtail(`df_1`,`df_2`,`p`)` $= f$

`invgammap(`a`,`p`)` the inverse cumulative gamma distribution: if `gammap(`a`,`x`)` $= p$, then `invgammap(`a`,`p`)` $= x$

`invgammaptail(`a`,`p`)` the inverse reverse cumulative (upper tail or survivor) gamma distribution: if `gammaptail(`a`,`x`)` $= p$, then `invgammaptail(`a`,`p`)` $= x$

invibeta(a,b,p)	the inverse cumulative beta distribution: if ibeta(a,b,x) $= p$, then invibeta(a,b,p) $= x$
invibetatail(a,b,p)	the inverse reverse cumulative (upper tail or survivor) beta distribution: if ibetatail(a,b,x) $= p$, then invibetatail(a,b,p) $= x$
invigaussian(m,a,p)	the inverse of igaussian(): if igaussian(m,a,x) $= p$, then invigaussian(m,a,p) $= x$
invigaussiantail(m,a,p)	the inverse of igaussiantail(): if igaussiantail(m,a,x) $= p$, then invigaussiantail(m,a,p x
invlogistic(p)	the inverse cumulative logistic distribution: if logistic(x) $= p$, then invlogistic(p) $= x$
invlogistic(s,p)	the inverse cumulative logistic distribution: if logistic(s,x) $= p$, then invlogistic(s,p) $= x$
invlogistic(m,s,p)	the inverse cumulative logistic distribution: if logistic(m,s,x) $= p$, then invlogistic(m,s,p) $= x$
invlogistictail(p)	the inverse reverse cumulative logistic distribution: if logistictail(x) $= p$, then invlogistictail(p) $= x$
invlogistictail(s,p)	the inverse reverse cumulative logistic distribution: if logistictail(s,x) $= p$, then invlogistictail(s,p) $= x$
invlogistictail(m,s,p)	the inverse reverse cumulative logistic distribution: if logistictail(m,s,x) $= p$, then invlogistictail(m,s,p) $= x$
invnbinomial(n,k,q)	the value of the negative binomial parameter, p, such that $q =$ nbinomial(n,k,p)
invnbinomialtail(n,k,q)	the value of the negative binomial parameter, p, such that $q =$ nbinomialtail(n,k,p)
invnchi2(df,np,p)	the inverse cumulative noncentral χ^2 distribution: if nchi2(df,np,x) $= p$, then invnchi2(df,np,p) $= x$
invnchi2tail(df,np,p)	the inverse reverse cumulative (upper tail or survivor) non-central χ^2 distribution: if nchi2tail(df,np,x) $= p$, then invnchi2tail(df,np,p) $= x$
invnF(df_1,df_2,np,p)	the inverse cumulative noncentral F distribution: if nF(df_1,df_2,np,f) $= p$, then invnF(df_1,df_2,np,p) $= f$
invnFtail(df_1,df_2,np,p)	the inverse reverse cumulative (upper tail or survivor) noncentral F distribution: if nFtail(df_1,df_2,np,x) $= p$, then invnFtail(df_1,df_2,np,p) $= x$
invnibeta(a,b,np,p)	the inverse cumulative noncentral beta distribution: if nibeta(a,b,np,x) $= p$, then invibeta(a,b,np,p) $= x$
invnormal(p)	the inverse cumulative standard normal distribution: if normal(z) $= p$, then invnormal(p) $= z$
invnt(df,np,p)	the inverse cumulative noncentral Student's t distribution: if nt(df,np,t) $= p$, then invnt(df,np,p) $= t$
invnttail(df,np,p)	the inverse reverse cumulative (upper tail or survivor) noncentral Student's t distribution: if nttail(df,np,t) $= p$, then invnttail(df,np,p) $= t$
invpoisson(k,p)	the Poisson mean such that the cumulative Poisson distribution evaluated at k is p: if poisson(m,k) $= p$, then invpoisson(k,p) $= m$

`invpoissontail(`k`,`q`)` — the Poisson mean such that the reverse cumulative Poisson distribution evaluated at k is q: if `poissontail(`m`,`k`)` $= q$, then `invpoissontail(`k`,`q`)` $= m$

`invt(`df`,`p`)` — the inverse cumulative Student's t distribution: if `t(`df`,`t`)` $= p$, then `invt(`df`,`p`)` $= t$

`invttail(`df`,`p`)` — the inverse reverse cumulative (upper tail or survivor) Student's t distribution: if `ttail(`df`,`t`)` $= p$, then `invttail(`df`,`p`)` $= t$

`invtukeyprob(`k`,`df`,`p`)` — the inverse cumulative Tukey's Studentized range distribution with k ranges and df degrees of freedom

`invweibull(`a`,`b`,`p`)` — the inverse cumulative Weibull distribution with shape a and scale b: if `weibull(`a`,`b`,`x`)` $= p$, then `invweibull(`a`,`b`,`p`)` $= x$

`invweibull(`a`,`b`,`g`,`p`)` — the inverse cumulative Weibull distribution with shape a, scale b, and location g: if `weibull(`a`,`b`,`g`,`x`)` $= p$, then `invweibull(`a`,`b`,`g`,`p`)` $= x$

`invweibullph(`a`,`b`,`p`)` — the inverse cumulative Weibull (proportional hazards) distribution with shape a and scale b: if `weibullph(`a`,`b`,`x`)` $= p$, then `invweibullph(`a`,`b`,`p`)` $= x$

`invweibullph(`a`,`b`,`g`,`p`)` — the inverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g: if `weibullph(`a`,`b`,`g`,`x`)` $=$ p, then `invweibullph(`a`,`b`,`g`,`p`)` $= x$

`invweibullphtail(`a`,`b`,`p`)` — the inverse reverse cumulative Weibull (proportional hazards) distribution with shape a and scale b: if `weibullphtail(`a`,`b`,`x`)` $= p$, then `invweibullphtail(`a`,`b`,`p`)` $= x$

`invweibullphtail(`a`,`b`,`g`,`p`)` — the inverse reverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g: if `weibullphtail(`a`,`b`,`g`,`x`)` $= p$, then `invweibullphtail(`a`,`b`,`g`,`p`)` $= x$

`invweibulltail(`a`,`b`,`p`)` — the inverse reverse cumulative Weibull distribution with shape a and scale b: if `weibulltail(`a`,`b`,`x`)` $= p$, then `invweibulltail(`a`,`b`,`p`)` $= x$

`invweibulltail(`a`,`b`,`g`,`p`)` — the inverse reverse cumulative Weibull distribution with shape a, scale b, and location g: if `weibulltail(`a`,`b`,`g`,`x`)` $= p$, then `invweibulltail(`a`,`b`,`g`,`p`)` $= x$

`lnigammaden(`a`,`b`,`x`)` — the natural logarithm of the inverse gamma density, where a is the shape parameter and b is the scale parameter

`lnigaussianden(`m`,`a`,`x`)` — the natural logarithm of the inverse Gaussian density with mean m and shape parameter a

`lniwishartden(`df`,`V`,`X`)` — the natural logarithm of the density of the inverse Wishart distribution; missing if $df \leq n-1$

`lnmvnormalden(`M`,`V`,`X`)` — the natural logarithm of the multivariate normal density

`lnnormal(`z`)` — the natural logarithm of the cumulative standard normal distribution

`lnnormalden(`z`)` — the natural logarithm of the standard normal density, $N(0,1)$

`lnnormalden(`x`,`σ`)` — the natural logarithm of the normal density with mean 0 and standard deviation σ

`lnnormalden(`x`,`μ`,`σ`)` — the natural logarithm of the normal density with mean μ and standard deviation σ, $N(\mu,\sigma^2)$

`lnwishartden(`df`,`V`,`X`)` — the natural logarithm of the density of the Wishart distribution; missing if $df \leq n-1$

logistic(x)	the cumulative logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$
logistic(s,x)	the cumulative logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
logistic(m,s,x)	the cumulative logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
logisticden(x)	the density of the logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$
logisticden(s,x)	the density of the logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
logisticden(m,s,x)	the density of the logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
logistictail(x)	the reverse cumulative logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$
logistictail(s,x)	the reverse cumulative logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$
logistictail(m,s,x)	the reverse cumulative logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$
nbetaden(a,b,np,x)	the probability density function of the noncentral beta distribution; 0 if $x < 0$ or $x > 1$
nbinomial(n,k,p)	the cumulative probability of the negative binomial distribution
nbinomialp(n,k,p)	the negative binomial probability
nbinomialtail(n,k,p)	the reverse cumulative probability of the negative binomial distribution
nchi2(df,np,x)	the cumulative noncentral χ^2 distribution; 0 if $x < 0$
nchi2den(df,np,x)	the probability density of the noncentral χ^2 distribution; 0 if $x < 0$
nchi2tail(df,np,x)	the reverse cumulative (upper tail or survivor) noncentral χ^2 distribution; 1 if $x < 0$
nF(df_1,df_2,np,f)	the cumulative noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; 0 if $f < 0$
nFden(df_1,df_2,np,f)	the probability density function of the noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; 0 if $f < 0$
nFtail(df_1,df_2,np,f)	the reverse cumulative (upper tail or survivor) noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; 1 if $f < 0$
nibeta(a,b,np,x)	the cumulative noncentral beta distribution; 0 if $x < 0$; or 1 if $x > 1$
normal(z)	the cumulative standard normal distribution
normalden(z)	the standard normal density, $N(0,1)$
normalden(x,σ)	the normal density with mean 0 and standard deviation σ
normalden(x,μ,σ)	the normal density with mean μ and standard deviation σ, $N(\mu,\sigma^2)$
npnchi2(df,x,p)	the noncentrality parameter, np, for noncentral χ^2: if nchi2(df,np,x) $= p$, then npnchi2(df,x,p) $= np$

`npnF(`df_1`,`df_2`,`f`,`p`)`	the noncentrality parameter, np, for the noncentral F: if `nF(`df_1`,`df_2`,`np`,`f`)` $= p$, then `npnF(`df_1`,`df_2`,`f`,`p`)` $= np$
`npnt(`df`,`t`,`p`)`	the noncentrality parameter, np, for the noncentral Student's t distribution: if `nt(`df`,`np`,`t`)` $= p$, then `npnt(`df`,`t`,`p`)` $= np$
`nt(`df`,`np`,`t`)`	the cumulative noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np
`ntden(`df`,`np`,`t`)`	the probability density function of the noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np
`nttail(`df`,`np`,`t`)`	the reverse cumulative (upper tail or survivor) noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np
`poisson(`m`,`k`)`	the probability of observing `floor(`k`)` or fewer outcomes that are distributed as Poisson with mean m
`poissonp(`m`,`k`)`	the probability of observing `floor(`k`)` outcomes that are distributed as Poisson with mean m
`poissontail(`m`,`k`)`	the probability of observing `floor(`k`)` or more outcomes that are distributed as Poisson with mean m
`t(`df`,`t`)`	the cumulative Student's t distribution with df degrees of freedom
`tden(`df`,`t`)`	the probability density function of Student's t distribution
`ttail(`df`,`t`)`	the reverse cumulative (upper tail or survivor) Student's t distribution; the probability $T > t$
`tukeyprob(`k`,`df`,`x`)`	the cumulative Tukey's Studentized range distribution with k ranges and df degrees of freedom; `0` if $x < 0$
`weibull(`a`,`b`,`x`)`	the cumulative Weibull distribution with shape a and scale b
`weibull(`a`,`b`,`g`,`x`)`	the cumulative Weibull distribution with shape a, scale b, and location g
`weibullden(`a`,`b`,`x`)`	the probability density function of the Weibull distribution with shape a and scale b
`weibullden(`a`,`b`,`g`,`x`)`	the probability density function of the Weibull distribution with shape a, scale b, and location g
`weibullph(`a`,`b`,`x`)`	the cumulative Weibull (proportional hazards) distribution with shape a and scale b
`weibullph(`a`,`b`,`g`,`x`)`	the cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g
`weibullphden(`a`,`b`,`x`)`	the probability density function of the Weibull (proportional hazards) distribution with shape a and scale b
`weibullphden(`a`,`b`,`g`,`x`)`	the probability density function of the Weibull (proportional hazards) distribution with shape a, scale b, and location g
`weibullphtail(`a`,`b`,`x`)`	the reverse cumulative Weibull (proportional hazards) distribution with shape a and scale b
`weibullphtail(`a`,`b`,`g`,`x`)`	the reverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g
`weibulltail(`a`,`b`,`x`)`	the reverse cumulative Weibull distribution with shape a and scale b
`weibulltail(`a`,`b`,`g`,`x`)`	the reverse cumulative Weibull distribution with shape a, scale b, and location g

Functions

Statistical functions are listed alphabetically under the following headings:

Beta and noncentral beta distributions

`betaden(`a`,`b`,`x`)`

Description: the probability density of the beta distribution, where a and b are the shape parameters; 0 if $x < 0$ or $x > 1$

The probability density of the beta distribution is

$$\texttt{betaden}(a,b,x) = \frac{x^{a-1}(1-x)^{b-1}}{\int_0^\infty t^{a-1}(1-t)^{b-1}dt} = \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)}x^{a-1}(1-x)^{b-1}$$

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $0 \le x \le 1$
Range: 0 to 8e+307

ibeta(a,b,x)

Description: the cumulative beta distribution with shape parameters a and b; 0 if $x < 0$; or 1 if $x > 1$

The cumulative beta distribution with shape parameters a and b is defined by

$$I_x(a,b) = \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)} \int_0^x t^{a-1}(1-t)^{b-1}\,dt$$

ibeta() returns the regularized incomplete beta function, also known as the incomplete beta function ratio. The incomplete beta function without regularization is given by (gamma(a)*gamma(b)/gamma(a+b))*ibeta(a,b,x) or, better when a or b might be large, exp(lngamma(a)+lngamma(b)-lngamma(a+b))*ibeta(a,b,x).

Here is an example of the use of the regularized incomplete beta function. Although Stata has a cumulative binomial function (see binomial()), the probability that an event occurs k or fewer times in n trials, when the probability of one event is p, can be evaluated as cond(k==n,1,1-ibeta(k+1,n-k,p)). The reverse cumulative binomial (the probability that an event occurs k or more times) can be evaluated as cond(k==0,1,ibeta(k,n-k+1,p)). See Press et al. (2007, 270–273) for a more complete description and for suggested uses for this function.

Domain a: 1e–10 to 1e+17
Domain b: 1e–10 to 1e+17
Domain x: −8e+307 to 8e+307; interesting domain is $0 \le x \le 1$
Range: 0 to 1

ibetatail(a,b,x)

Description: the reverse cumulative (upper tail or survivor) beta distribution with shape parameters a and b; 1 if $x < 0$; or 0 if $x > 1$

The reverse cumulative (upper tail or survivor) beta distribution with shape parameters a and b is defined by

$$\texttt{ibetatail}(a,b,x) = 1 - \texttt{ibeta}(a,b,x) = \int_x^1 \texttt{betaden}(a,b,t)\,dt$$

ibetatail() is also known as the complement to the incomplete beta function (ratio).

Domain a: 1e–10 to 1e+17
Domain b: 1e–10 to 1e+17
Domain x: −8e+307 to 8e+307; interesting domain is $0 \le x \le 1$
Range: 0 to 1

invibeta(a,b,p)

Description: the inverse cumulative beta distribution: if ibeta(a,b,x) $= p$, then invibeta(a,b,p) $= x$

Domain a: 1e–10 to 1e+17
Domain b: 1e–10 to 1e+17
Domain p: 0 to 1
Range: 0 to 1

`invibetatail(`a`,`b`,`p`)`

Description: the inverse reverse cumulative (upper tail or survivor) beta distribution: if `ibetatail(`a`,`b`,`x`)` $= p$, then `invibetatail(`a`,`b`,`p`)` $= x$

Domain a: 1e–10 to 1e+17

Domain b: 1e–10 to 1e+17

Domain p: 0 to 1

Range: 0 to 1

`nbetaden(`a`,`b`,`np`,`x`)`

Description: the probability density function of the noncentral beta distribution; `0` if $x < 0$ or $x > 1$

The probability density function of the noncentral beta distribution is defined as

$$\sum_{j=0}^{\infty} \frac{e^{-np/2}(np/2)^j}{\Gamma(j+1)} \left\{ \frac{\Gamma(a+b+j)}{\Gamma(a+j)\Gamma(b)} x^{a+j-1}(1-x)^{b-1} \right\}$$

where a and b are shape parameters, np is the noncentrality parameter, and x is the value of a beta random variable.

`nbetaden(`a`,`b`,0,`x`)` = `betaden(`a`,`b`,`x`)`, but `betaden()` is the preferred function to use for the central beta distribution. `nbetaden()` is computed using an algorithm described in Johnson, Kotz, and Balakrishnan (1995).

Domain a: 1e–323 to 8e+307

Domain b: 1e–323 to 8e+307

Domain np: 0 to 1,000

Domain x: $-$8e+307 to 8e+307; interesting domain is $0 \le x \le 1$

Range: 0 to 8e+307

`nibeta(`a`,`b`,`np`,`x`)`

Description: the cumulative noncentral beta distribution; `0` if $x < 0$; or `1` if $x > 1$

The cumulative noncentral beta distribution is defined as

$$I_x(a,b,np) = \sum_{j=0}^{\infty} \frac{e^{-np/2}(np/2)^j}{\Gamma(j+1)} I_x(a+j,b)$$

where a and b are shape parameters, np is the noncentrality parameter, x is the value of a beta random variable, and $I_x(a,b)$ is the cumulative beta distribution, `ibeta()`.

`nibeta(`a`,`b`,0,`x`)` = `ibeta(`a`,`b`,`x`)`, but `ibeta()` is the preferred function to use for the central beta distribution. `nibeta()` is computed using an algorithm described in Johnson, Kotz, and Balakrishnan (1995).

Domain a: 1e–323 to 8e+307

Domain b: 1e–323 to 8e+307

Domain np: 0 to 10,000

Domain x: $-$8e+307 to 8e+307; interesting domain is $0 \le x \le 1$

Range: 0 to 1

`invnibeta(`a`,`b`,`np`,`p`)`
Description: the inverse cumulative noncentral beta distribution: if `nibeta(`a`,`b`,`np`,`x`)` $= p$, then `invibeta(`a`,`b`,`np`,`p`)` $= x$
Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain np: 0 to 1,000
Domain p: 0 to 1
Range: 0 to 1

Binomial distributions

`binomialp(`n`,`k`,`p`)`
Description: the probability of observing `floor(`k`)` successes in `floor(`n`)` trials when the probability of a success on one trial is p
Domain n: 1 to 1e+6
Domain k: 0 to n
Domain p: 0 to 1
Range: 0 to 1

`binomial(`n`,`k`,`θ`)`
Description: the probability of observing `floor(`k`)` or fewer successes in `floor(`n`)` trials when the probability of a success on one trial is θ; `0` if $k < 0$; or `1` if $k > n$
Domain n: 0 to 1e+17
Domain k: $-$8e+307 to 8e+307; interesting domain is $0 \leq k < n$
Domain θ: 0 to 1
Range: 0 to 1

`binomialtail(`n`,`k`,`θ`)`
Description: the probability of observing `floor(`k`)` or more successes in `floor(`n`)` trials when the probability of a success on one trial is θ; `1` if $k < 0$; or `0` if $k > n$
Domain n: 0 to 1e+17
Domain k: $-$8e+307 to 8e+307; interesting domain is $0 \leq k < n$
Domain θ: 0 to 1
Range: 0 to 1

`invbinomial(`n`,`k`,`p`)`
Description: the inverse of the cumulative binomial; that is, θ (θ = probability of success on one trial) such that the probability of observing `floor(`k`)` or fewer successes in `floor(`n`)` trials is p
Domain n: 1 to 1e+17
Domain k: 0 to $n-1$
Domain p: 0 to 1 (exclusive)
Range: 0 to 1

invbinomialtail(n,k,p)
Description: the inverse of the right cumulative binomial; that is, θ (θ = probability of success on one trial) such that the probability of observing floor(k) or more successes in floor(n) trials is p
Domain n: 1 to 1e+17
Domain k: 1 to n
Domain p: 0 to 1 (exclusive)
Range: 0 to 1

Chi-squared and noncentral chi-squared distributions

chi2den(df,x)
Description: the probability density of the chi-squared distribution with df degrees of freedom; 0 if $x < 0$
chi2den(df,x) = gammaden($df/2$,2,0,x)
Domain df: 2e–10 to 2e+17 (may be nonintegral)
Domain x: $-$8e+307 to 8e+307
Range: 0 to 8e+307

chi2(df,x)
Description: the cumulative χ^2 distribution with df degrees of freedom; 0 if $x < 0$
chi2(df,x) = gammap($df/2$,$x/2$)
Domain df: 2e–10 to 2e+17 (may be nonintegral)
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 0 to 1

chi2tail(df,x)
Description: the reverse cumulative (upper tail or survivor) χ^2 distribution with df degrees of freedom; 1 if $x < 0$
chi2tail(df,x) = 1 $-$ chi2(df,x)
Domain df: 2e–10 to 2e+17 (may be nonintegral)
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 0 to 1

invchi2(df,p)
Description: the inverse of chi2(): if chi2(df,x) = p, then invchi2(df,p) = x
Domain df: 2e–10 to 2e+17 (may be nonintegral)
Domain p: 0 to 1
Range: 0 to 8e+307

invchi2tail(df,p)
Description: the inverse of chi2tail(): if chi2tail(df,x) = p, then invchi2tail(df,p) = x
Domain df: 2e–10 to 2e+17 (may be nonintegral)
Domain p: 0 to 1
Range: 0 to 8e+307

`nchi2den(`df`,`np`,`x`)`

Description: the probability density of the noncentral χ^2 distribution; `0` if $x < 0$

df denotes the degrees of freedom, np is the noncentrality parameter, and x is the value of χ^2.

`nchi2den(`df`,0,`x`)` $=$ `chi2den(`df`,`x`)`, but `chi2den()` is the preferred function to use for the central χ^2 distribution.

Domain df: 2e–10 to 1e+6 (may be nonintegral)
Domain np: 0 to 10,000
Domain x: $-$8e+307 to 8e+307
Range: 0 to 8e+307

`nchi2(`df`,`np`,`x`)`

Description: the cumulative noncentral χ^2 distribution; `0` if $x < 0$

The cumulative noncentral χ^2 distribution is defined as

$$\int_0^x \frac{e^{-t/2}\, e^{-np/2}}{2^{df/2}} \sum_{j=0}^{\infty} \frac{t^{\,df/2+j-1}\, np^j}{\Gamma(df/2+j)\, 2^{2j}\, j!}\, dt$$

where df denotes the degrees of freedom, np is the noncentrality parameter, and x is the value of χ^2.

`nchi2(`df`,0,`x`)` $=$ `chi2(`df`,`x`)`, but `chi2()` is the preferred function to use for the central χ^2 distribution.

Domain df: 2e–10 to 1e+6 (may be nonintegral)
Domain np: 0 to 10,000
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 0 to 1

`nchi2tail(`df`,`np`,`x`)`

Description: the reverse cumulative (upper tail or survivor) noncentral χ^2 distribution; `1` if $x < 0$
df denotes the degrees of freedom, np is the noncentrality parameter, and x is the value of χ^2.

Domain df: 2e–10 to 1e+6 (may be nonintegral)
Domain np: 0 to 10,000
Domain x: $-$8e+307 to 8e+307
Range: 0 to 1

`invnchi2(`df`,`np`,`p`)`

Description: the inverse cumulative noncentral χ^2 distribution: if
`nchi2(`df`,`np`,`x`)` $= p$, then `invnchi2(`df`,`np`,`p`)` $= x$

Domain df: 2e–10 to 1e+6 (may be nonintegral)
Domain np: 0 to 10,000
Domain p: 0 to 1
Range: 0 to 8e+307

`invnchi2tail(`df`,`np`,`p`)`

Description: the inverse reverse cumulative (upper tail or survivor) noncentral χ^2 distribution: if `nchi2tail(`df`,`np`,`x`)` $= p$, then `invnchi2tail(`df`,`np`,`p`)` $= x$

Domain df: 2e–10 to 1e+6 (may be nonintegral)

Domain np: 0 to 10,000

Domain p: 0 to 1

Range: 0 to 8e+307

`npnchi2(`df`,`x`,`p`)`

Description: the noncentrality parameter, np, for noncentral χ^2: if `nchi2(`df`,`np`,`x`)` $= p$, then `npnchi2(`df`,`x`,`p`)` $= np$

Domain df: 2e–10 to 1e+6 (may be nonintegral)

Domain x: 0 to 8e+307

Domain p: 0 to 1

Range: 0 to 10,000

Dunnett's multiple range distributions

`dunnettprob(`k`,`df`,`x`)`

Description: the cumulative multiple range distribution that is used in Dunnett's multiple-comparison method with k ranges and df degrees of freedom; `0` if $x < 0$

`dunnettprob()` is computed using an algorithm described in Miller (1981).

Domain k: 2 to 1e+6

Domain df: 2 to 1e+6

Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$

Range: 0 to 1

`invdunnettprob(`k`,`df`,`p`)`

Description: the inverse cumulative multiple range distribution that is used in Dunnett's multiple-comparison method with k ranges and df degrees of freedom

If `dunnettprob(`k`,`df`,`x`)` $= p$, then `invdunnettprob(`k`,`df`,`p`)` $= x$.

`invdunnettprob()` is computed using an algorithm described in Miller (1981).

Domain k: 2 to 1e+6

Domain df: 2 to 1e+6

Domain p: 0 to 1 (right exclusive)

Range: 0 to 8e+307

Charles William Dunnett (1921–2007) was a Canadian statistician best known for his work on multiple-comparison procedures. He was born in Windsor, Ontario, and graduated in mathematics and physics from McMaster University. After naval service in World War II, Dunnett's career included further graduate work, teaching, and research at Toronto, Columbia, the New York State Maritime College, the Department of National Health and Welfare in Ottawa, Cornell, Lederle Laboratories, and Aberdeen before he became Professor of Clinical Epidemiology and Biostatistics at McMaster University in 1974. He was President and Gold Medalist of the Statistical Society of Canada. Throughout his career, Dunnett took a keen interest in computing. According to Google Scholar, his 1955 paper on comparing treatments with a control has been cited over 4,000 times.

Exponential distributions

`exponentialden(`b`,`x`)`

Description: the probability density function of the exponential distribution with scale b

The probability density function of the exponential distribution is

$$\frac{1}{b}\exp(-x/b)$$

where b is the scale and x is the value of an exponential variate.

Domain b: 1e–323 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 1e–323 to 8e+307

`exponential(`b`,`x`)`

Description: the cumulative exponential distribution with scale b

The cumulative distribution function of the exponential distribution is

$$1 - \exp(-x/b)$$

for $x \geq 0$ and 0 for $x < 0$, where b is the scale and x is the value of an exponential variate.
The mean of the exponential distribution is b and its variance is b^2.

Domain b: 1e–323 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 0 to 1

`exponentialtail(`b`,`x`)`

Description: the reverse cumulative exponential distribution with scale b

The reverse cumulative distribution function of the exponential distribution is

$$\exp(-x/b)$$

where b is the scale and x is the value of an exponential variate.

Domain b: 1e–323 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 0 to 1

`invexponential(`b`,`p`)`

Description: the inverse cumulative exponential distribution with scale b: if `exponential(`b`,`x`)` $= p$, then `invexponential(`b`,`p`)` $= x$

Domain b: 1e–323 to 8e+307

Domain p: 0 to 1

Range: 1e–323 to 8e+307

`invexponentialtail(`b`,`p`)`

Description: the inverse reverse cumulative exponential distribution with scale b: if `exponentialtail(`b`,`x`)` $= p$, then `invexponentialtail(`b`,`p`)` $= x$

Domain b: 1e–323 to 8e+307

Domain p: 0 to 1

Range: 1e–323 to 8e+307

F and noncentral F distributions

`Fden(`df_1`,`df_2`,`f`)`

Description: the probability density function of the F distribution with df_1 numerator and df_2 denominator degrees of freedom; `0` if $f < 0$

The probability density function of the F distribution with df_1 numerator and df_2 denominator degrees of freedom is defined as

$$\texttt{Fden}(df_1,df_2,f) = \frac{\Gamma(\frac{df_1+df_2}{2})}{\Gamma(\frac{df_1}{2})\Gamma(\frac{df_2}{2})}\left(\frac{df_1}{df_2}\right)^{\frac{df_1}{2}} \cdot f^{\frac{df_1}{2}-1}\left(1+\frac{df_1}{df_2}f\right)^{-\frac{1}{2}(df_1+df_2)}$$

Domain df_1: 1e–323 to 8e+307 (may be nonintegral)

Domain df_2: 1e–323 to 8e+307 (may be nonintegral)

Domain f: $-$8e+307 to 8e+307; interesting domain is $f \geq 0$

Range: 0 to 8e+307

`F(`df_1`,`df_2`,`f`)`

Description: the cumulative F distribution with df_1 numerator and df_2 denominator degrees of freedom: `F(`df_1`,`df_2`,`f`)` $= \int_0^f$ `Fden(`df_1`,`df_2`,`t`)` dt; `0` if $f < 0$

Domain df_1: 2e–10 to 2e+17 (may be nonintegral)

Domain df_2: 2e–10 to 2e+17 (may be nonintegral)

Domain f: $-$8e+307 to 8e+307; interesting domain is $f \geq 0$

Range: 0 to 1

`Ftail(`df_1`,`df_2`,`f`)`

Description: the reverse cumulative (upper tail or survivor) F distribution with df_1 numerator and df_2 denominator degrees of freedom; `1` if $f < 0$

`Ftail(`df_1`,`df_2`,`f`)` $= 1 -$ `F(`df_1`,`df_2`,`f`)`.

Domain df_1: 2e–10 to 2e+17 (may be nonintegral)

Domain df_2: 2e–10 to 2e+17 (may be nonintegral)

Domain f: $-$8e+307 to 8e+307; interesting domain is $f \geq 0$

Range: 0 to 1

`invF(`df_1`,`df_2`,`p`)`

Description: the inverse cumulative F distribution: if `F(`df_1`,`df_2`,`f`)` $= p$, then `invF(`df_1`,`df_2`,`p`)` $= f$
Domain df_1: 2e–10 to 2e+17 (may be nonintegral)
Domain df_2: 2e–10 to 2e+17 (may be nonintegral)
Domain p: 0 to 1
Range: 0 to 8e+307

`invFtail(`df_1`,`df_2`,`p`)`

Description: the inverse reverse cumulative (upper tail or survivor) F distribution: if `Ftail(`df_1`,`df_2`,`f`)` $= p$, then `invFtail(`df_1`,`df_2`,`p`)` $= f$
Domain df_1: 2e–10 to 2e+17 (may be nonintegral)
Domain df_2: 2e–10 to 2e+17 (may be nonintegral)
Domain p: 0 to 1
Range: 0 to 8e+307

`nFden(`df_1`,`df_2`,`np`,`f`)`

Description: the probability density function of the noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `0` if $f < 0$

`nFden(`df_1`,`df_2`,0,`f`)` $=$ `Fden(`df_1`,`df_2`,`f`)`, but `Fden()` is the preferred function to use for the central F distribution.

Also, if F follows the noncentral F distribution with df_1 and df_2 degrees of freedom and noncentrality parameter np, then

$$\frac{df_1 F}{df_2 + df_1 F}$$

follows a noncentral beta distribution with shape parameters $a = df_1/2$, $b = df_2/2$, and noncentrality parameter np, as given in `nbetaden()`. `nFden()` is computed based on this relationship.
Domain df_1: 1e–323 to 8e+307 (may be nonintegral)
Domain df_2: 1e–323 to 8e+307 (may be nonintegral)
Domain np: 0 to 1,000
Domain f: $-$8e+307 to 8e+307; interesting domain is $f \geq 0$
Range: 0 to 8e+307

`nF(`df_1`,`df_2`,`np`,`f`)`

Description: the cumulative noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `0` if $f < 0$

`nF(`df_1`,`df_2`,0,`f`)` $=$ `F(`df_1`,`df_2`,`f`)`

`nF()` is computed using `nibeta()` based on the relationship between the noncentral beta and noncentral F distributions: `nF(`df_1`,`df_2`,`np`,`f`)` $=$ `nibeta(`$df_1/2$`,`$df_2/2$`,`np`,`$df_1 \times f/\{(df_1 \times f) + df_2\}$`)`.
Domain df_1: 2e–10 to 1e+8
Domain df_2: 2e–10 to 1e+8
Domain np: 0 to 10,000
Domain f: $-$8e+307 to 8e+307
Range: 0 to 1

`nFtail(`df_1`,`df_2`,`np`,`f`)`
Description: the reverse cumulative (upper tail or survivor) noncentral F distribution with df_1 numerator and df_2 denominator degrees of freedom and noncentrality parameter np; `1` if $f < 0$

`nFtail()` is computed using `nibeta()` based on the relationship between the noncentral beta and F distributions. See Johnson, Kotz, and Balakrishnan (1995) for more details.

Domain df_1: 1e–323 to 8e+307 (may be nonintegral)
Domain df_2: 1e–323 to 8e+307 (may be nonintegral)
Domain np: 0 to 1,000
Domain f: $-$8e+307 to 8e+307; interesting domain is $f \geq 0$
Range: 0 to 1

`invnF(`df_1`,`df_2`,`np`,`p`)`
Description: the inverse cumulative noncentral F distribution: if `nF(`df_1`,`df_2`,`np`,`f`)` $= p$, then `invnF(`df_1`,`df_2`,`np`,`p`)` $= f$
Domain df_1: 1e–6 to 1e+6 (may be nonintegral)
Domain df_2: 1e–6 to 1e+6 (may be nonintegral)
Domain np: 0 to 10,000
Domain p: 0 to 1
Range: 0 to 8e+307

`invnFtail(`df_1`,`df_2`,`np`,`p`)`
Description: the inverse reverse cumulative (upper tail or survivor) noncentral F distribution: if `nFtail(`df_1`,`df_2`,`np`,`x`)` $= p$, then `invnFtail(`df_1`,`df_2`,`np`,`p`)` $= x$
Domain df_1: 1e–323 to 8e+307 (may be nonintegral)
Domain df_2: 1e–323 to 8e+307 (may be nonintegral)
Domain np: 0 to 1,000
Domain p: 0 to 1
Range: 0 to 8e+307

`npnF(`df_1`,`df_2`,`f`,`p`)`
Description: the noncentrality parameter, np, for the noncentral F: if `nF(`df_1`,`df_2`,`np`,`f`)` $= p$, then `npnF(`df_1`,`df_2`,`f`,`p`)` $= np$
Domain df_1: 2e–10 to 1e+6 (may be nonintegral)
Domain df_2: 2e–10 to 1e+6 (may be nonintegral)
Domain f: 0 to 8e+307
Domain p: 0 to 1
Range: 0 to 1,000

Gamma and inverse gamma distributions

`gammaden(`a`,`b`,`g`,`x`)`

Description: the probability density function of the gamma distribution; `0` if $x < g$

The probability density function of the gamma distribution is defined by

$$\frac{1}{\Gamma(a)b^a}(x-g)^{a-1}e^{-(x-g)/b}$$

where a is the shape parameter, b is the scale parameter, and g is the location parameter.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain g: $-$8e+307 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq g$
Range: 0 to 8e+307

`gammap(`a`,`x`)`

Description: the cumulative gamma distribution with shape parameter a; `0` if $x < 0$

The cumulative gamma distribution with shape parameter a is defined by

$$\frac{1}{\Gamma(a)}\int_0^x e^{-t}t^{a-1}\,dt$$

The cumulative Poisson (the probability of observing k or fewer events if the expected is x) can be evaluated as `1-gammap(`k`+1,`x`)`. The reverse cumulative (the probability of observing k or more events) can be evaluated as `gammap(`k`,`x`)`. See Press et al. (2007, 259–266) for a more complete description and for suggested uses for this function.

`gammap()` is also known as the incomplete gamma function (ratio).

Probabilities for the three-parameter gamma distribution (see `gammaden()`) can be calculated by shifting and scaling x; that is, `gammap(`a`,`$(x-g)/b$`)`.

Domain a: 1e–10 to 1e+17
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 0 to 1

gammaptail(a,x)

Description: the reverse cumulative (upper tail or survivor) gamma distribution with shape parameter a; 1 if $x < 0$

The reverse cumulative (upper tail or survivor) gamma distribution with shape parameter a is defined by

$$\texttt{gammaptail}(a,x) = 1 - \texttt{gammap}(a,x) = \int_x^\infty \texttt{gammaden}(a,t)\, dt$$

gammaptail() is also known as the complement to the incomplete gamma function (ratio).

Domain a: 1e–10 to 1e+17

Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$

Range: 0 to 1

invgammap(a,p)

Description: the inverse cumulative gamma distribution: if gammap(a,x) $= p$, then invgammap(a,p) $= x$

Domain a: 1e–10 to 1e+17

Domain p: 0 to 1

Range: 0 to 8e+307

invgammaptail(a,p)

Description: the inverse reverse cumulative (upper tail or survivor) gamma distribution: if gammaptail(a,x) $= p$, then invgammaptail(a,p) $= x$

Domain a: 1e–10 to 1e+17

Domain p: 0 to 1

Range: 0 to 8e+307

dgammapda(a,x)

Description: $\frac{\partial P(a,x)}{\partial a}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$

Domain a: 1e–7 to 1e+17

Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$

Range: $-$16 to 0

dgammapdada(a,x)

Description: $\frac{\partial^2 P(a,x)}{\partial a^2}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$

Domain a: 1e–7 to 1e+17

Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$

Range: $-$0.02 to 4.77e+5

dgammapdadx(a,x)

Description: $\frac{\partial^2 P(a,x)}{\partial a \partial x}$, where $P(a,x) =$ gammap(a,x); 0 if $x < 0$

Domain a: 1e–7 to 1e+17

Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$

Range: $-$0.04 to 8e+307

`dgammapdx(`a`,`x`)`

Description: $\frac{\partial P(a,x)}{\partial x}$, where $P(a,x) =$ `gammap(`a`,`x`)`; `0` if $x < 0$
Domain a: 1e–10 to 1e+17
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 0 to 8e+307

`dgammapdxdx(`a`,`x`)`

Description: $\frac{\partial^2 P(a,x)}{\partial x^2}$, where $P(a,x) =$ `gammap(`a`,`x`)`; `0` if $x < 0$
Domain a: 1e–10 to 1e+17
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq 0$
Range: 0 to 1e+40

`lnigammaden(`a`,`b`,`x`)`

Description: the natural logarithm of the inverse gamma density, where a is the shape parameter and b is the scale parameter
Domain a: 1e–300 to 1e+300
Domain b: 1e–300 to 1e+300
Domain x: $-$8e+307 to 8e+307
Range: 1e–300 to 8e+307

Hypergeometric distributions

`hypergeometricp(`N`,`K`,`n`,`k`)`

Description: the hypergeometric probability of k successes out of a sample of size n, from a population of size N containing K elements that have the attribute of interest

Success is obtaining an element with the attribute of interest.
Domain N: 2 to 1e+5
Domain K: 1 to $N-1$
Domain n: 1 to $N-1$
Domain k: `max(0,`$n - N + K$`)` to `min(`K`,`n`)`
Range: 0 to 1 (right exclusive)

`hypergeometric(`N`,`K`,`n`,`k`)`

Description: the cumulative probability of the hypergeometric distribution

N is the population size, K is the number of elements in the population that have the attribute of interest, and n is the sample size. Returned is the probability of observing k or fewer elements from a sample of size n that have the attribute of interest.
Domain N: 2 to 1e+5
Domain K: 1 to $N-1$
Domain n: 1 to $N-1$
Domain k: `max(0,`$n - N + K$`)` to `min(`K`,`n`)`
Range: 0 to 1

Inverse Gaussian distributions

`igaussianden(`m`,`a`,`x`)`
- Description: the probability density of the inverse Gaussian distribution with mean m and shape parameter a; `0` if $x \leq 0$
- Domain m: 1e–323 to 8e+307
- Domain a: 1e–323 to 8e+307
- Domain x: $-$8e+307 to 8e+307
- Range: 0 to 8e+307

`igaussian(`m`,`a`,`x`)`
- Description: the cumulative inverse Gaussian distribution with mean m and shape parameter a; `0` if $x \leq 0$
- Domain m: 1e–323 to 8e+307
- Domain a: 1e–323 to 8e+307
- Domain x: $-$8e+307 to 8e+307
- Range: 0 to 1

`igaussiantail(`m`,`a`,`x`)`
- Description: the reverse cumulative (upper tail or survivor) inverse Gaussian distribution with mean m and shape parameter a; `1` if $x \leq 0$

  `igaussiantail(`m`,`a`,`x`)` $= 1 -$ `igaussian(`m`,`a`,`x`)`
- Domain m: 1e–323 to 8e+307
- Domain a: 1e–323 to 8e+307
- Domain x: $-$8e+307 to 8e+307
- Range: 0 to 1

`invigaussian(`m`,`a`,`p`)`
- Description: the inverse of `igaussian()`: if
  `igaussian(`m`,`a`,`x`)` $= p$, then `invigaussian(`m`,`a`,`p`)` $= x$
- Domain m: 1e–323 to 8e+307
- Domain a: 1e–323 to 1e+8
- Domain p: 0 to 1 (exclusive)
- Range: 0 to 8e+307

`invigaussiantail(`m`,`a`,`p`)`
- Description: the inverse of `igaussiantail()`: if
  `igaussiantail(`m`,`a`,`x`)` $= p$, then `invigaussiantail(`m`,`a`,`p`)` $= x$
- Domain m: 1e–323 to 8e+307
- Domain a: 1e–323 to 1e+8
- Domain p: 0 to 1 (exclusive)
- Range: 0 to 1

`lnigaussianden(`m`,`a`,`x`)`
- Description: the natural logarithm of the inverse Gaussian density with mean m and shape parameter a
- Domain m: 1e–323 to 8e+307
- Domain a: 1e–323 to 8e+307
- Domain x: 1e–323 to 8e+307
- Range: $-$8e+307 to 8e+307

Logistic distributions

`logisticden(`x`)`

Description: the density of the logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$

`logisticden(`x`)` = `logisticden(1,`x`)` = `logisticden(0,1,`x`)`, where x is the value of a logistic random variable.

Domain x: −8e+307 to 8e+307
Range: 0 to 0.25

`logisticden(`s`,`x`)`

Description: the density of the logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$

`logisticden(`s`,`x`)` = `logisticden(0,`s`,`x`)`, where s is the scale and x is the value of a logistic random variable.

Domain s: 1e–323 to 8e+307
Domain x: −8e+307 to 8e+307
Range: 0 to 8e+307

`logisticden(`m`,`s`,`x`)`

Description: the density of the logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$

The density of the logistic distribution is defined as

$$\frac{\exp\{-(x-m)/s\}}{s[1+\exp\{-(x-m)/s\}]^2}$$

where m is the mean, s is the scale, and x is the value of a logistic random variable.

Domain m: −8e+307 to 8e+307
Domain s: 1e–323 to 8e+307
Domain x: −8e+307 to 8e+307
Range: 0 to 8e+307

`logistic(`x`)`

Description: the cumulative logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$

`logistic(`x`)` = `logistic(1,`x`)` = `logistic(0,1,`x`)`, where x is the value of a logistic random variable.

Domain x: −8e+307 to 8e+307
Range: 0 to 1

`logistic(`s`,`x`)`

Description: the cumulative logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$

`logistic(`s`, `x`)` $=$ `logistic(0,`s`,`x`)`, where s is the scale and x is the value of a logistic random variable.

Domain s: 1e–323 to 8e+307
Domain x: $-$8e+307 to 8e+307
Range: 0 to 1

`logistic(`m`,`s`,`x`)`

Description: the cumulative logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$

The cumulative logistic distribution is defined as

$$[1 + \exp\{-(x-m)/s\}]^{-1}$$

where m is the mean, s is the scale, and x is the value of a logistic random variable.

Domain m: $-$8e+307 to 8e+307
Domain s: 1e–323 to 8e+307
Domain x: $-$8e+307 to 8e+307
Range: 0 to 1

`logistictail(`x`)`

Description: the reverse cumulative logistic distribution with mean 0 and standard deviation $\pi/\sqrt{3}$

`logistictail(`x`)` $=$ `logistictail(1,`x`)` $=$ `logistictail(0,1,`x`)`, where x is the value of a logistic random variable.

Domain x: $-$8e+307 to 8e+307
Range: 0 to 1

`logistictail(`s`,`x`)`

Description: the reverse cumulative logistic distribution with mean 0, scale s, and standard deviation $s\pi/\sqrt{3}$

`logistictail(`s`,`x`)` $=$ `logistictail(0,`s`,`x`)`, where s is the scale and x is the value of a logistic random variable.

Domain s: 1e–323 to 8e+307
Domain x: $-$8e+307 to 8e+307
Range: 0 to 1

`logistictail(`m`,`s`,`x`)`

Description: the reverse cumulative logistic distribution with mean m, scale s, and standard deviation $s\pi/\sqrt{3}$

The reverse cumulative logistic distribution is defined as

$$[1+\exp\{(x-m)/s\}]^{-1}$$

where m is the mean, s is the scale, and x is the value of a logistic random variable.

Domain m: −8e+307 to 8e+307
Domain s: 1e–323 to 8e+307
Domain x: −8e+307 to 8e+307
Range: 0 to 1

`invlogistic(`p`)`

Description: the inverse cumulative logistic distribution: if `logistic(`x`)` $= p$, then `invlogistic(`p`)` $= x$

Domain p: 0 to 1
Range: −8e+307 to 8e+307

`invlogistic(`s`,`p`)`

Description: the inverse cumulative logistic distribution: if `logistic(`s`,`x`)` $= p$, then `invlogistic(`s`,`p`)` $= x$

Domain s: 1e–323 to 8e+307
Domain p: 0 to 1
Range: −8e+307 to 8e+307

`invlogistic(`m`,`s`,`p`)`

Description: the inverse cumulative logistic distribution: if `logistic(`m`,`s`,`x`)` $= p$, then `invlogistic(`m`,`s`,`p`)` $= x$

Domain m: −8e+307 to 8e+307
Domain s: 1e–323 to 8e+307
Domain p: 0 to 1
Range: −8e+307 to 8e+307

`invlogistictail(`p`)`

Description: the inverse reverse cumulative logistic distribution: if `logistictail(`x`)` $= p$, then `invlogistictail(`p`)` $= x$

Domain p: 0 to 1
Range: −8e+307 to 8e+307

`invlogistictail(`s`,`p`)`

Description: the inverse reverse cumulative logistic distribution: if `logistictail(`s`,`x`)` $= p$, then `invlogistictail(`s`,`p`)` $= x$

Domain s: 1e–323 to 8e+307
Domain p: 0 to 1
Range: −8e+307 to 8e+307

`invlogistictail(`m`,`s`,`p`)`

Description: the inverse reverse cumulative logistic distribution: if `logistictail(`m`,`s`,`x`)` $= p$, then `invlogistictail(`m`,`s`,`p`)` $= x$

Domain m: $-$8e+307 to 8e+307
Domain s: 1e–323 to 8e+307
Domain p: 0 to 1
Range: $-$8e+307 to 8e+307

Negative binomial distributions

`nbinomialp(`n`,`k`,`p`)`

Description: the negative binomial probability

When n is an integer, `nbinomialp()` returns the probability of observing exactly `floor(`k`)` failures before the nth success when the probability of a success on one trial is p.

Domain n: 1e–10 to 1e+6 (can be nonintegral)
Domain k: 0 to 1e+10
Domain p: 0 to 1 (left exclusive)
Range: 0 to 1

`nbinomial(`n`,`k`,`p`)`

Description: the cumulative probability of the negative binomial distribution

n can be nonintegral. When n is an integer, `nbinomial()` returns the probability of observing k or fewer failures before the nth success, when the probability of a success on one trial is p.

The negative binomial distribution function is evaluated using `ibeta()`.

Domain n: 1e–10 to 1e+17 (can be nonintegral)
Domain k: 0 to $2^{53} - 1$
Domain p: 0 to 1 (left exclusive)
Range: 0 to 1

`nbinomialtail(`n`,`k`,`p`)`

Description: the reverse cumulative probability of the negative binomial distribution

When n is an integer, `nbinomialtail()` returns the probability of observing k or more failures before the nth success, when the probability of a success on one trial is p.

The reverse negative binomial distribution function is evaluated using `ibetatail()`.

Domain n: 1e–10 to 1e+17 (can be nonintegral)
Domain k: 0 to $2^{53} - 1$
Domain p: 0 to 1 (left exclusive)
Range: 0 to 1

`invnbinomial(`n`,`k`,`q`)`

Description: the value of the negative binomial parameter, p, such that $q =$ `nbinomial(`n`,`k`,`p`)`

`invnbinomial()` is evaluated using `invibeta()`.

Domain n: 1e–10 to 1e+17 (can be nonintegral)

Domain k: 0 to $2^{53} - 1$

Domain q: 0 to 1 (exclusive)

Range: 0 to 1

`invnbinomialtail(`n`,`k`,`q`)`

Description: the value of the negative binomial parameter, p, such that $q =$ `nbinomialtail(`n`,`k`,`p`)`

`invnbinomialtail()` is evaluated using `invibetatail()`.

Domain n: 1e–10 to 1e+17 (can be nonintegral)

Domain k: 1 to $2^{53} - 1$

Domain q: 0 to 1 (exclusive)

Range: 0 to 1 (exclusive)

Normal (Gaussian), log of the normal, binormal, and multivariate normal distributions

`normalden(`z`)`

Description: the standard normal density, $N(0, 1)$

Domain: $-$8e+307 to 8e+307

Range: 0 to 0.39894 ...

`normalden(`x`,`σ`)`

Description: the normal density with mean 0 and standard deviation σ

`normalden(`x`,1)` $=$ `normalden(`x`)` and `normalden(`x`,`σ`)` $=$ `normalden(`x/σ`)`$/\sigma$.

Domain x: $-$8e+307 to 8e+307

Domain σ: 1e–308 to 8e+307

Range: 0 to 8e+307

`normalden(`x`,`μ`,`σ`)`

Description: the normal density with mean μ and standard deviation σ, $N(\mu, \sigma^2)$

`normalden(`x`,0,`s`)` $=$ `normalden(`x`,`s`)` and `normalden(`x`,`μ`,`σ`)` $=$ `normalden(`$(x-\mu)/\sigma$`)`$/\sigma$. In general,

$$\texttt{normalden}(z,\mu,\sigma) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left\{\frac{(z-\mu)}{\sigma}\right\}^2}$$

Domain x: $-$8e+307 to 8e+307

Domain μ: $-$8e+307 to 8e+307

Domain σ: 1e–308 to 8e+307

Range: 0 to 8e+307

`normal(`z`)`

Description: the cumulative standard normal distribution

$$\texttt{normal(}z\texttt{)} = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} e^{-x^2/2} dx$$

Domain: $-8\text{e}{+}307$ to 8e+307

Range: 0 to 1

`invnormal(`p`)`

Description: the inverse cumulative standard normal distribution: if `normal(`z`)` $= p$, then `invnormal(`p`)` $= z$

Domain: 1e–323 to $1 - 2^{-53}$

Range: -38.449394 to 8.2095362

`lnnormalden(`z`)`

Description: the natural logarithm of the standard normal density, $N(0,1)$

Domain: $-1\text{e}{+}154$ to 1e+154

Range: $-5\text{e}{+}307$ to -0.91893853 = `lnnormalden(0)`

`lnnormalden(`x`,`σ`)`

Description: the natural logarithm of the normal density with mean 0 and standard deviation σ

`lnnormalden(`x`,1)` = `lnnormalden(`x`)` and
`lnnormalden(`x`,`σ`)` = `lnnormalden(`x/σ`)` $-$ $\ln(\sigma)$.

Domain x: $-8\text{e}{+}307$ to 8e+307

Domain σ: 1e–323 to 8e+307

Range: $-5\text{e}{+}307$ to 742.82799

`lnnormalden(`x`,`μ`,`σ`)`

Description: the natural logarithm of the normal density with mean μ and standard deviation σ, $N(\mu, \sigma^2)$

`lnnormalden(`x`,0,`s`)` = `lnnormalden(`x`,`s`)` and
`lnnormalden(`x`,`μ`,`σ`)` = `lnnormalden((`$x-\mu$`)/`σ`)` $-$ $\ln(\sigma)$. In general,

$$\texttt{lnnormalden(}z\texttt{,}\mu\texttt{,}\sigma\texttt{)} = \ln\left[\frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left\{\frac{(z-\mu)}{\sigma}\right\}^2}\right]$$

Domain x: $-8\text{e}{+}307$ to 8e+307

Domain μ: $-8\text{e}{+}307$ to 8e+307

Domain σ: 1e–323 to 8e+307

Range: 1e–323 to 8e+307

`lnnormal(`z`)`

Description: the natural logarithm of the cumulative standard normal distribution

$$\texttt{lnnormal(}z\texttt{)} = \ln\left(\int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} e^{-x^2/2} dx\right)$$

Domain: $-1\text{e}{+}99$ to 8e+307

Range: $-5\text{e}{+}197$ to 0

`binormal(`h`,`k`,`ρ`)`

Description: the joint cumulative distribution $\Phi(h, k, \rho)$ of bivariate normal with correlation ρ

Cumulative over $(-\infty, h\,] \times (-\infty, k\,]$:

$$\Phi(h, k, \rho) = \frac{1}{2\pi\sqrt{1-\rho^2}} \int_{-\infty}^{h} \int_{-\infty}^{k} \exp\left\{ -\frac{1}{2(1-\rho^2)} \left(x_1^2 - 2\rho x_1 x_2 + x_2^2 \right) \right\} dx_1\, dx_2$$

Domain h: $-8e+307$ to $8e+307$
Domain k: $-8e+307$ to $8e+307$
Domain ρ: -1 to 1
Range: 0 to 1

`lnmvnormalden(`M`,`V`,`X`)`

Description: the natural logarithm of the multivariate normal density

M is the mean vector, V is the covariance matrix, and X is the random vector.
Domain M: $1 \times n$ and $n \times 1$ vectors
Domain V: $n \times n$, positive-definite, symmetric matrices
Domain X: $1 \times n$ and $n \times 1$ vectors
Range: $-8e+307$ to $8e+307$

Poisson distributions

`poissonp(`m`,`k`)`

Description: the probability of observing `floor(`k`)` outcomes that are distributed as Poisson with mean m

The Poisson probability function is evaluated using `gammaden()`.
Domain m: 1e–10 to 1e+8
Domain k: 0 to 1e+9
Range: 0 to 1

`poisson(`m`,`k`)`

Description: the probability of observing `floor(`k`)` or fewer outcomes that are distributed as Poisson with mean m

The Poisson distribution function is evaluated using `gammaptail()`.
Domain m: 1e–10 to $2^{53} - 1$
Domain k: 0 to $2^{53} - 1$
Range: 0 to 1

`poissontail(`m`,`k`)`

Description: the probability of observing `floor(`k`)` or more outcomes that are distributed as Poisson with mean m

The reverse cumulative Poisson distribution function is evaluated using `gammap()`.
Domain m: 1e–10 to $2^{53} - 1$
Domain k: 0 to $2^{53} - 1$
Range: 0 to 1

`invpoisson(`k`,`p`)`

Description: the Poisson mean such that the cumulative Poisson distribution evaluated at k is p: if `poisson(`m`,`k`)` $= p$, then `invpoisson(`k`,`p`)` $= m$

The inverse Poisson distribution function is evaluated using `invgammaptail()`.

Domain k: 0 to $2^{53} - 1$

Domain p: 0 to 1 (exclusive)

Range: 1.110e–16 to 2^{53}

`invpoissontail(`k`,`q`)`

Description: the Poisson mean such that the reverse cumulative Poisson distribution evaluated at k is q: if `poissontail(`m`,`k`)` $= q$, then `invpoissontail(`k`,`q`)` $= m$

The inverse of the reverse cumulative Poisson distribution function is evaluated using `invgammap()`.

Domain k: 0 to $2^{53} - 1$

Domain q: 0 to 1 (exclusive)

Range: 0 to 2^{53} (left exclusive)

Student's t and noncentral Student's t distributions

`tden(`df`,`t`)`

Description: the probability density function of Student's t distribution

$$\texttt{tden}(df,t) = \frac{\Gamma\{(df+1)/2\}}{\sqrt{\pi df}\,\Gamma(df/2)} \cdot \left(1 + t^2/df\right)^{-(df+1)/2}$$

Domain df: 1e–323 to 8e+307(may be nonintegral)

Domain t: $-8\text{e}+307$ to 8e+307

Range: 0 to 0.39894 ...

`t(`df`,`t`)`

Description: the cumulative Student's t distribution with df degrees of freedom

Domain df: 2e+10 to 2e+17 (may be nonintegral)

Domain t; $-8\text{e}+307$ to 8e+307

Range: 0 to 1

`ttail(`df`,`t`)`

Description: the reverse cumulative (upper tail or survivor) Student's t distribution; the probability $T > t$

$$\texttt{ttail}(df,t) = \int_t^{\infty} \frac{\Gamma\{(df+1)/2\}}{\sqrt{\pi df}\,\Gamma(df/2)} \cdot \left(1 + x^2/df\right)^{-(df+1)/2}\,dx$$

Domain df: 2e–10 to 2e+17 (may be nonintegral)

Domain t: $-8\text{e}+307$ to 8e+307

Range: 0 to 1

`invt(`df`,`p`)`
- Description: the inverse cumulative Student's t distribution: if `t(`df`,`t`)` $= p$, then `invt(`df`,`p`)` $= t$
- Domain df: 2e–10 to 2e+17 (may be nonintegral)
- Domain p: 0 to 1
- Range: $-$8e+307 to 8e+307

`invttail(`df`,`p`)`
- Description: the inverse reverse cumulative (upper tail or survivor) Student's t distribution: if `ttail(`df`,`t`)` $= p$, then `invttail(`df`,`p`)` $= t$
- Domain df: 2e–10 to 2e+17 (may be nonintegral)
- Domain p: 0 to 1
- Range: $-$8e+307 to 8e+307

`invnt(`df`,`np`,`p`)`
- Description: the inverse cumulative noncentral Student's t distribution: if `nt(`df`,`np`,`t`)` $= p$, then `invnt(`df`,`np`,`p`)` $= t$
- Domain df: 1 to 1e+6 (may be nonintegral)
- Domain np: $-$1,000 to 1,000
- Domain p: 0 to 1
- Range: $-$8e+307 to 8e+307

`invnttail(`df`,`np`,`p`)`
- Description: the inverse reverse cumulative (upper tail or survivor) noncentral Student's t distribution: if `nttail(`df`,`np`,`t`)` $= p$, then `invnttail(`df`,`np`,`p`)` $= t$
- Domain df: 1 to 1e+6 (may be nonintegral)
- Domain np: $-$1,000 to 1,000
- Domain p: 0 to 1
- Range: $-$8e+10 to 8e+10

`ntden(`df`,`np`,`t`)`
- Description: the probability density function of the noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np
- Domain df: 1e–100 to 1e+10 (may be nonintegral)
- Domain np: $-$1,000 to 1,000
- Domain t: $-$8e+307 to 8e+307
- Range: 0 to 0.39894 ...

`nt(`df`,`np`,`t`)`
- Description: the cumulative noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np

  `nt(`df`,0,`t`)` = `t(`df`,`t`)`.
- Domain df: 1e–100 to 1e+10 (may be nonintegral)
- Domain np: $-$1,000 to 1,000
- Domain t: $-$8e+307 to 8e+307
- Range: 0 to 1

`nttail(`df`,`np`,`t`)`
Description: the reverse cumulative (upper tail or survivor) noncentral Student's t distribution with df degrees of freedom and noncentrality parameter np
Domain df: 1e–100 to 1e+10 (may be nonintegral)
Domain np: $-1{,}000$ to 1,000
Domain t: $-8\text{e}{+}307$ to 8e+307
Range: 0 to 1

`npnt(`df`,`t`,`p`)`
Description: the noncentrality parameter, np, for the noncentral Student's t distribution: if `nt(`df`,`np`,`t`)` $= p$, then `npnt(`df`,`t`,`p`)` $= np$
Domain df: 1e–100 to 1e+8 (may be nonintegral)
Domain t: $-8\text{e}{+}307$ to 8e+307
Domain p: 0 to 1
Range: $-1{,}000$ to 1,000

Tukey's Studentized range distributions

`tukeyprob(`k`,`df`,`x`)`
Description: the cumulative Tukey's Studentized range distribution with k ranges and df degrees of freedom; `0` if $x < 0$

If df is a missing value, then the normal distribution is used instead of Student's t.

`tukeyprob()` is computed using an algorithm described in Miller (1981).
Domain k: 2 to 1e+6
Domain df: 2 to 1e+6
Domain x: $-8\text{e}{+}307$ to 8e+307
Range: 0 to 1

`invtukeyprob(`k`,`df`,`p`)`
Description: the inverse cumulative Tukey's Studentized range distribution with k ranges and df degrees of freedom

If df is a missing value, then the normal distribution is used instead of Student's t. If `tukeyprob(`k`,`df`,`x`)` $= p$, then `invtukeyprob(`k`,`df`,`p`)` $= x$.

`invtukeyprob()` is computed using an algorithm described in Miller (1981).
Domain k: 2 to 1e+6
Domain df: 2 to 1e+6
Domain p: 0 to 1
Range: 0 to 8e+307

Weibull distributions

`weibullden(`a`,`b`,`x`)`

Description: the probability density function of the Weibull distribution with shape a and scale b

`weibullden(`a`,`b`,`x`)` = `weibullden(`a`, `b`, 0, `x`)`, where a is the shape, b is the scale, and x is the value of Weibull random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain x: 1e–323 to 8e+307
Range: 0 to 1

`weibullden(`a`,`b`,`g`,`x`)`

Description: the probability density function of the Weibull distribution with shape a, scale b, and location g

The probability density function of the generalized Weibull distribution is defined as

$$\frac{a}{b}\left(\frac{x-g}{b}\right)^{a-1}\exp\left\{-\left(\frac{x-g}{b}\right)^{a}\right\}$$

for $x \geq g$ and 0 for $x < g$, where a is the shape, b is the scale, g is the location parameter, and x is the value of a generalized Weibull random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain g: $-$8e+307 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq g$
Range: 0 to 1

`weibull(`a`,`b`,`x`)`

Description: the cumulative Weibull distribution with shape a and scale b

`weibull(`a`,`b`,`x`)` = `weibull(`a`, `b`, 0, `x`)`, where a is the shape, b is the scale, and x is the value of Weibull random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain x: 1e–323 to 8e+307
Range: 0 to 1

`weibull(`a`,`b`,`g`,`x`)`

Description: the cumulative Weibull distribution with shape a, scale b, and location g

The cumulative Weibull distribution is defined as

$$1 - \exp\left[-\left(\frac{x-g}{b}\right)^a\right]$$

for $x \geq g$ and 0 for $x < g$, where a is the shape, b is the scale, g is the location parameter, and x is the value of a Weibull random variable.
The mean of the Weibull distribution is $g + b\Gamma\{(a+1)/a)\}$ and its variance is $b^2\left(\Gamma\{(a+2)/a\} - [\Gamma\{(a+1)/a\}]^2\right)$ where $\Gamma()$ is the gamma function described in `lngamma()`.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain g: $-$8e+307 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq g$
Range: 0 to 1

`weibulltail(`a`,`b`,`x`)`

Description: the reverse cumulative Weibull distribution with shape a and scale b

`weibulltail(`a`,`b`,`x`)` $=$ `weibulltail(`a`,`b`,0,`x`)`, where a is the shape, b is the scale, and x is the value of a Weibull random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain x: 1e–323 to 8e+307
Range: 0 to 1

`weibulltail(`a`,`b`,`g`,`x`)`

Description: the reverse cumulative Weibull distribution with shape a, scale b, and location g

The reverse cumulative Weibull distribution is defined as

$$\exp\left\{-\left(\frac{x-g}{b}\right)^a\right\}$$

for $x \geq g$ and 0 if $x < g$, where a is the shape, b is the scale, g is the location parameter, and x is the value of a generalized Weibull random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain g: $-$8e+307 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq g$
Range: 0 to 1

`invweibull(`a`,`b`,`p`)`

Description: the inverse cumulative Weibull distribution with shape a and scale b: if `weibull(`a`,`b`,`x`)` $= p$, then `invweibull(`a`,`b`,`p`)` $= x$

Domain a: 1e–323 to 8e+307

Domain b: 1e–323 to 8e+307

Domain p: 0 to 1

Range: 1e–323 to 8e+307

`invweibull(`a`,`b`,`g`,`p`)`

Description: the inverse cumulative Weibull distribution with shape a, scale b, and location g: if `weibull(`a`,`b`,`g`,`x`)` $= p$, then `invweibull(`a`,`b`,`g`,`p`)` $= x$

Domain a: 1e–323 to 8e+307

Domain b: 1e–323 to 8e+307

Domain g: $-$8e+307 to 8e+307

Domain p: 0 to 1

Range: $g +$ `c(epsdouble)` to 8e+307

`invweibulltail(`a`,`b`,`p`)`

Description: the inverse reverse cumulative Weibull distribution with shape a and scale b: if `weibulltail(`a`,`b`,`x`)` $= p$, then `invweibulltail(`a`,`b`,`p`)` $= x$

Domain a: 1e–323 to 8e+307

Domain b: 1e–323 to 8e+307

Domain p: 0 to 1

Range: 1e–323 to 8e+307

`invweibulltail(`a`,`b`,`g`,`p`)`

Description: the inverse reverse cumulative Weibull distribution with shape a, scale b, and location g: if `weibulltail(`a`,`b`,`g`,`x`)` $= p$, then `invweibulltail(`a`,`b`,`g`,`p`)` $= x$

Domain a: 1e–323 to 8e+307

Domain b: 1e–323 to 8e+307

Domain g: $-$8e+307 to 8e+307

Domain p: 0 to 1

Range: $g +$ `c(epsdouble)` to 8e+307

Weibull (proportional hazards) distributions

`weibullphden(`a`,`b`,`x`)`

Description: the probability density function of the Weibull (proportional hazards) distribution with shape a and scale b

`weibullphden(`a`,`b`,`x`)` $=$ `weibullphden(`a`, `b`, 0, `x`)`, where a is the shape, b is the scale, and x is the value of Weibull (proportional hazards) random variable.

Domain a: 1e–323 to 8e+307

Domain b: 1e–323 to 8e+307

Domain x: 1e–323 to 8e+307

Range: 0 to 1

`weibullphden(`a`,`b`,`g`,`x`)`

Description: the probability density function of the Weibull (proportional hazards) distribution with shape a, scale b, and location g

The probability density function of the Weibull (proportional hazards) distribution is defined as

$$ba(x-g)^{a-1}\exp\{-b(x-g)^a\}$$

for $x \geq g$ and 0 for $x < g$, where a is the shape, b is the scale, g is the location parameter, and x is the value of a Weibull (proportional hazards) random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain g: −8e+307 to 8e+307
Domain x: −8e+307 to 8e+307; interesting domain is $x \geq g$
Range: 0 to 1

`weibullph(`a`,`b`,`x`)`

Description: the cumulative Weibull (proportional hazards) distribution with shape a and scale b

`weibullph(`a`,`b`,`x`)` = `weibullph(`a`, `b`, 0, `x`)`, where a is the shape, b is the scale, and x is the value of Weibull random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain x: 1e–323 to 8e+307
Range: 0 to 1

`weibullph(`a`,`b`,`g`,`x`)`

Description: the cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g

The cumulative Weibull (proportional hazards) distribution is defined as

$$1-\exp\{-b(x-g)^a\}$$

for $x \geq g$ and 0 if $x < g$, where a is the shape, b is the scale, g is the location parameter, and x is the value of a Weibull (proportional hazards) random variable. The mean of the Weibull (proportional hazards) distribution is

$$g+b^{-\frac{1}{a}}\Gamma\{(a+1)/a)\}$$

and its variance is

$$b^{-\frac{2}{a}}\left(\Gamma\{(a+2)/a\}-[\Gamma\{(a+1)/a\}]^2\right)$$

where $\Gamma()$ is the gamma function described in `lngamma(`x`)` .

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain g: −8e+307 to 8e+307
Domain x: −8e+307 to 8e+307; interesting domain is $x \geq g$
Range: 0 to 1

`weibullphtail(`a`,`b`,`x`)`

Description: the reverse cumulative Weibull (proportional hazards) distribution with shape a and scale b

`weibullphtail(`a`,`b`,`x`)` $=$ `weibullphtail(`a`,`b`,0,`x`)`, where a is the shape, b is the scale, and x is the value of a Weibull (proportional hazards) random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain x: 1e–323 to 8e+307
Range: 0 to 1

`weibullphtail(`a`,`b`,`g`,`x`)`

Description: the reverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g

The reverse cumulative Weibull (proportional hazards) distribution is defined as

$$\exp\left\{-b(x-g)^a\right\}$$

for $x \geq g$ and 0 of $x < g$, where a is the shape, b is the scale, g is the location parameter, and x is the value of a Weibull (proportional hazards) random variable.

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain g: $-$8e+307 to 8e+307
Domain x: $-$8e+307 to 8e+307; interesting domain is $x \geq g$
Range: 0 to 1

`invweibullph(`a`,`b`,`p`)`

Description: the inverse cumulative Weibull (proportional hazards) distribution with shape a and scale b: if `weibullph(`a`,`b`,`x`)` $= p$, then `invweibullph(`a`,`b`,`p`)` $= x$

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain p: 0 to 1
Range: 1e–323 to 8e+307

`invweibullph(`a`,`b`,`g`,`p`)`

Description: the inverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g: if `weibullph(`a`,`b`,`g`,`x`)` $= p$, then `invweibullph(`a`,`b`,`g`,`p`)` $= x$

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain g: $-$8e+307 to 8e+307
Domain p: 0 to 1
Range: $g +$ `c(epsdouble)` to 8e+307

`invweibullphtail(`a`,`b`,`p`)`

Description: the inverse reverse cumulative Weibull (proportional hazards) distribution with shape a and scale b: if `weibullphtail(`a`,`b`,`x`)` $= p$, then `invweibullphtail(`a`,`b`,`p`)` $= x$

Domain a: 1e–323 to 8e+307
Domain b: 1e–323 to 8e+307
Domain p: 0 to 1
Range: 1e–323 to 8e+307

`invweibullphtail(`a`,`b`,`g`,`p`)`

Description: the inverse reverse cumulative Weibull (proportional hazards) distribution with shape a, scale b, and location g: if `weibullphtail(`a`,`b`,`g`,`x`)` $= p$, then `invweibullphtail(`a`,`b`,`g`,`p`)` $= x$

Domain a: 1e–323 to 8e+307

Domain b: 1e–323 to 8e+307

Domain g: $-$8e+307 to 8e+307

Domain p: 0 to 1

Range: $g +$ `c(epsdouble)` to 8e+307

Wishart and inverse Wishart distributions

`lnwishartden(`*df*`,`V`,`X`)`

Description: the natural logarithm of the density of the Wishart distribution; missing if $df \leq n-1$

df denotes the degrees of freedom, V is the scale matrix, and X is the Wishart random matrix.

Domain *df*: 1 to 1e+100 (may be nonintegral)

Domain V: $n \times n$, positive-definite, symmetric matrices

Domain X: $n \times n$, positive-definite, symmetric matrices

Range: $-$8e+307 to 8e+307

`lniwishartden(`*df*`,`V`,`X`)`

Description: the natural logarithm of the density of the inverse Wishart distribution; missing if $df \leq n-1$

df denotes the degrees of freedom, V is the scale matrix, and X is the inverse Wishart random matrix.

Domain *df*: 1 to 1e+100 (may be nonintegral)

Domain V: $n \times n$, positive-definite, symmetric matrices

Domain X: $n \times n$, positive-definite, symmetric matrices

Range: $-$8e+307 to 8e+307

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Also see

[D] **egen** — Extensions to generate

[M-4] **statistical** — Statistical functions

[M-5] **intro** — Alphabetical index to functions

[U] 13.3 Functions

Title

String functions

Contents Functions References Also see

Contents

abbrev(s,n)	name s, abbreviated to a length of n
char(n)	the character corresponding to ASCII or extended ASCII code n; "" if n is not in the domain
collatorlocale(loc,$type$)	the most closely related locale supported by ICU from loc if $type$ is 1; the actual locale where the collation data comes from if $type$ is 2
collatorversion(loc)	the version string of a collator based on locale loc
indexnot(s_1,s_2)	the position in ASCII string s_1 of the first character of s_1 not found in ASCII string s_2, or 0 if all characters of s_1 are found in s_2
plural(n,s)	the plural of s if $n \neq \pm 1$
plural(n,s_1,s_2)	the plural of s_1, as modified by or replaced with s_2, if $n \neq \pm 1$
real(s)	s converted to numeric or *missing*
regexm(s,re)	performs a match of a regular expression and evaluates to 1 if regular expression re is satisfied by the ASCII string s; otherwise, 0
regexr(s_1,re,s_2)	replaces the first substring within ASCII string s_1 that matches re with ASCII string s_2 and returns the resulting string
regexs(n)	subexpression n from a previous `regexm()` match, where $0 \leq n < 10$
soundex(s)	the soundex code for a string, s
soundex_nara(s)	the U.S. Census soundex code for a string, s
strcat(s_1,s_2)	there is no `strcat()` function; instead the addition operator is used to concatenate strings
strdup(s_1,n)	there is no `strdup()` function; instead the multiplication operator is used to create multiple copies of strings
string(n)	a synonym for strofreal(n)
string(n,s)	a synonym for strofreal(n,s)
stritrim(s)	s with multiple, consecutive internal blanks (ASCII space character `char(32)`) collapsed to one blank
strlen(s)	the number of characters in ASCII s or length in bytes
strlower(s)	lowercase ASCII characters in string s
strltrim(s)	s without leading blanks (ASCII space character `char(32)`)
strmatch(s_1,s_2)	1 if s_1 matches the pattern s_2; otherwise, 0
strofreal(n)	n converted to a string
strofreal(n,s)	n converted to a string using the specified display format
strpos(s_1,s_2)	the position in s_1 at which s_2 is first found; otherwise, 0
strproper(s)	a string with the first ASCII letter and any other letters immediately following characters that are not letters; all other ASCII letters converted to lowercase

`strreverse(`s`)`	reverses the ASCII string s
`strrpos(`s_1`,`s_2`)`	the position in s_1 at which s_2 is last found; otherwise, `0`
`strrtrim(`s`)`	s without trailing blanks (ASCII space character `char(32)`)
`strtoname(`s[`,`p]`)`	s translated into a Stata 13 compatible name
`strtrim(`s`)`	s without leading and trailing blanks (ASCII space character `char(32)`); equivalent to `strltrim(strrtrim(`s`))`
`strupper(`s`)`	uppercase ASCII characters in string s
`subinstr(`s_1`,`s_2`,`s_3`,`n`)`	s_1, where the first n occurrences in s_1 of s_2 have been replaced with s_3
`subinword(`s_1`,`s_2`,`s_3`,`n`)`	s_1, where the first n occurrences in s_1 of s_2 as a word have been replaced with s_3
`substr(`s`,`n_1`,`n_2`)`	the substring of s, starting at n_1, for a length of n_2
`tobytes(`s[`,`n]`)`	escaped decimal or hex digit strings of up to 200 bytes of s
`uchar(`n`)`	the Unicode character corresponding to Unicode code point n or an empty string if n is beyond the Unicode code-point range
`udstrlen(`s`)`	the number of display columns needed to display the Unicode string s in the Stata Results window
`udsubstr(`s`,`n_1`,`n_2`)`	the Unicode substring of s, starting at character n_1, for n_2 display columns
`uisdigit(`s`)`	`1` if the first Unicode character in s is a Unicode decimal digit; otherwise, `0`
`uisletter(`s`)`	`1` if the first Unicode character in s is a Unicode letter; otherwise, `0`
`ustrcompare(`s_1`,`s_2[`,`loc]`)`	compares two Unicode strings
`ustrcompareex(`s_1`,`s_2`,`loc`,`st`,`$case$`,`$cslv$`,`$norm$`,`num`,`alt`,`fr`)`	compares two Unicode strings
`ustrpos(`s_1`,`s_2[`,`n]`)`	the position in s_1 at which s_2 is first found; otherwise, `0`
`ustrrpos(`s_1`,`s_2`,`[`,`n]`)`	the position in s_1 at which s_2 is last found; otherwise, `0`
`ustrfix(`s[`,`rep]`)`	replaces each invalid UTF-8 sequence with a Unicode character
`ustrfrom(`s`,`enc`,`$mode$`)`	converts the string s in encoding enc to a UTF-8 encoded Unicode string
`ustrinvalidcnt(`s`)`	the number of invalid UTF-8 sequences in s
`ustrleft(`s`,`n`)`	the first n Unicode characters of the Unicode string s
`ustrlen(`s`)`	the number of characters in the Unicode string s
`ustrlower(`s[`,`loc]`)`	lowercase all characters of Unicode string s under the given locale loc
`ustrltrim(`s`)`	removes the leading Unicode whitespace characters and blanks from the Unicode string s
`ustrnormalize(`s`,`$norm$`)`	normalizes Unicode string s to one of the five normalization forms specified by $norm$
`ustrregexm(`s`,`re[`,`noc]`)`	performs a match of a regular expression and evaluates to `1` if regular expression re is satisfied by the Unicode string s; otherwise, `0`
`ustrregexra(`s_1`,`re`,`s_2[`,`noc]`)`	replaces all substrings within the Unicode string s_1 that match re with s_2 and returns the resulting string
`ustrregexrf(`s_1`,`re`,`s_2[`,`noc]`)`	replaces the first substring within the Unicode string s_1 that matches re with s_2 and returns the resulting string

`ustrregexs(`n`)`	subexpression n from a previous `ustrregexm()` match
`ustrreverse(`s`)`	reverses the Unicode string s
`ustrright(`s`,`n`)`	the last n Unicode characters of the Unicode string s
`ustrrtrim(`s`)`	remove trailing Unicode whitespace characters and blanks from the Unicode string s
`ustrsortkey(`s[`,`*loc*]`)`	generates a null-terminated byte array that can be used by the `sort` command to produce the same order as `ustrcompare()`
`ustrsortkeyex(`s`,`*loc*`,`*st*`,`*case*`,`*cslv*`,`*norm*`,`*num*`,`*alt*`,`*fr*`)`	generates a null-terminated byte array that can be used by the `sort` command to produce the same order as `ustrcompare()`
`ustrtitle(`s[`,`*loc*]`)`	a string with the first characters of Unicode words titlecased and other characters lowercased
`ustrto(`s`,`*enc*`,`*mode*`)`	converts the Unicode string s in UTF-8 encoding to a string in encoding *enc*
`ustrtohex(`s[`,`n]`)`	escaped hex digit string of s up to 200 Unicode characters
`ustrtoname(`s[`,`p]`)`	string s translated into a Stata name
`ustrtrim(`s`)`	removes leading and trailing Unicode whitespace characters and blanks from the Unicode string s
`ustrunescape(`s`)`	the Unicode string corresponding to the escaped sequences of s
`ustrupper(`s[`,`*loc*]`)`	uppercase all characters in string s under the given locale *loc*
`ustrword(`s`,`n[`,`*noc*]`)`	the nth Unicode word in the Unicode string s
`ustrwordcount(`s[`,`*loc*]`)`	the number of nonempty Unicode words in the Unicode string s
`usubinstr(`s_1`,`s_2`,`s_3`,`n`)`	replaces the first n occurrences of the Unicode string s_2 with the Unicode string s_3 in s_1
`usubstr(`s`,`n_1`,`n_2`)`	the Unicode substring of s, starting at n_1, for a length of n_2
`word(`s`,`n`)`	the nth word in s; *missing* (`""`) if n is missing
`wordbreaklocale(`*loc*`,`*type*`)`	the most closely related locale supported by ICU from *loc* if *type* is `1`, the actual locale where the word-boundary analysis data come from if *type* is `2`; or an empty string is returned for any other *type*
`wordcount(`s`)`	the number of words in s

Functions

In the display below, s indicates a string subexpression (a string literal, a string variable, or another string expression) and n indicates a numeric subexpression (a number, a numeric variable, or another numeric expression).

If your strings contain Unicode characters or you are writing programs that will be used by others who might use Unicode strings, read **[U] 12.4.2 Handling Unicode strings**.

`abbrev(`s`,`n`)`

Description: name s, abbreviated to a length of n

Length is measured in the number of display columns, not in the number of characters. For most users, the number of display columns equals the number of characters. For a detailed discussion of display columns, see **[U] 12.4.2.2 Displaying Unicode characters**.

If any of the characters of s are a period, "`.`", and $n < 8$, then the value of n defaults to a value of 8. Otherwise, if $n < 5$, then n defaults to a value of 5. If n is *missing*, `abbrev()` will return the entire string s. `abbrev()` is typically used with variable names and variable names with factor-variable or time-series operators (the period case).

`abbrev("displacement",8)` is `displa~t`.

Domain s: strings

Domain n: integers 5 to 32

Range: strings

`char(`n`)`

Description: the character corresponding to ASCII or extended ASCII code n; `""` if n is not in the domain

Note: ASCII codes are from 0 to 127; extended ASCII codes are from 128 to 255. Prior to Stata 14, the display of extended ASCII characters was encoding dependent. For example, `char(128)` on Microsoft Windows using Windows-1252 encoding displayed the Euro symbol, but on Linux using ISO-Latin-1 encoding, `char(128)` displayed an invalid character symbol. Beginning with Stata 14, Stata's display encoding is UTF-8 on all platforms. The `char(128)` function is an invalid UTF-8 sequence and thus will display a question mark. There are two Unicode functions corresponding to `char()`: `uchar()` and `ustrunescape()`. You can use `uchar(8364)` or `ustrunescape("\u20AC")` to display a Euro sign on all platforms.

Domain n: integers 0 to 255

Range: ASCII characters

`uchar(`n`)`

Description: the Unicode character corresponding to Unicode code point n or an empty string if n is beyond the Unicode code-point range

Note that `uchar()` takes the decimal value of the Unicode code point. `ustrunescape()` takes an escaped hex digit string of the Unicode code point. For example, both `uchar(8364)` and `ustrunescape("\u20ac")` produce the Euro sign.

Domain n: integers ≥ 0

Range: Unicode characters

`collatorlocale(`*loc*`,`*type*`)`

Description: the most closely related locale supported by ICU from *loc* if *type* is `1`; the actual locale where the collation data comes from if *type* is `2`

For any other *type*, *loc* is returned in a canonicalized form.

`collatorlocale("en_us_texas", 0)` = `en_US_TEXAS`
`collatorlocale("en_us_texas", 1)` = `en_US`
`collatorlocale("en_us_texas", 2)` = `root`

Domain *loc*: strings of locale name
Domain *type*: integers
Range: strings

`collatorversion(`*loc*`)`

Description: the version string of a collator based on locale *loc*

The Unicode standard is constantly adding more characters and the sort key format may change as well. This can cause `ustrsortkey()` and `ustrsortkeyex()` to produce incompatible sort keys between different versions of International Components for Unicode. The version string can be used for versioning the sort keys to indicate when saved sort keys must be regenerated.

Range: strings

`indexnot(`s_1`,`s_2`)`

Description: the position in ASCII string s_1 of the first character of s_1 not found in ASCII string s_2, or `0` if all characters of s_1 are found in s_2

`indexnot()` is intended for use with only plain ASCII strings. For Unicode characters beyond the plain ASCII range, the position and character are given in bytes, not characters.

Domain s_1: ASCII strings (to be searched)
Domain s_2: ASCII strings (to search for)
Range: integers ≥ 0

`plural(`n`,`s`)`

Description: the plural of s if $n \neq \pm 1$

The plural is formed by adding "s" to s.

`plural(1, "horse")` = `"horse"`
`plural(2, "horse")` = `"horses"`

Domain n: real numbers
Domain s: strings
Range: strings

`plural(`n`,`s_1`,`s_2`)`

Description: the plural of s_1, as modified by or replaced with s_2, if $n \neq \pm 1$

If s_2 begins with the character "+", the plural is formed by adding the remainder of s_2 to s_1. If s_2 begins with the character "-", the plural is formed by subtracting the remainder of s_2 from s_1. If s_2 begins with neither "+" nor "-", then the plural is formed by returning s_2.

`plural(2, "glass", "+es")` = `"glasses"`
`plural(1, "mouse", "mice")` = `"mouse"`
`plural(2, "mouse", "mice")` = `"mice"`
`plural(2, "abcdefg", "-efg")` = `"abcd"`

Domain n: real numbers
Domain s_1: strings
Domain s_2: strings
Range: strings

`real(`s`)`

Description: s converted to numeric or *missing*

Also see `strofreal()`.

`real("5.2")+1` = 6.2
`real("hello")` = .

Domain s: strings
Range: $-$8e+307 to 8e+307 or *missing*

`regexm(`s`,`re`)`

Description: performs a match of a regular expression and evaluates to `1` if regular expression re is satisfied by the ASCII string s; otherwise, `0`

Regular expression syntax is based on Henry Spencer's NFA algorithm, and this is nearly identical to the POSIX.2 standard. s and re may not contain binary 0 (`\0`).

`regexm()` is intended for use with only plain ASCII characters. For Unicode characters beyond the plain ASCII range, the match is based on bytes. For a character-based match, see `ustrregexm()`.

Domain s: ASCII strings
Domain re: regular expressions
Range: ASCII strings

`regexr(`s_1`,`re`,`s_2`)`

Description: replaces the first substring within ASCII string s_1 that matches re with ASCII string s_2 and returns the resulting string

If s_1 contains no substring that matches re, the unaltered s_1 is returned. s_1 and the result of `regexr()` may be at most 1,100,000 characters long. s_1, re, and s_2 may not contain binary 0 (`\0`).

`regexr()` is intended for use with only plain ASCII characters. For Unicode characters beyond the plain ASCII range, the match is based on bytes and the result is restricted to 1,100,000 bytes. For a character-based match, see `ustrregexrf()` or `ustrregexra()`.

Domain s_1: ASCII strings
Domain re: regular expressions
Domain s_2: ASCII strings
Range: ASCII strings

`regexs(`n`)`

Description: subexpression n from a previous `regexm()` match, where $0 \leq n < 10$

Subexpression 0 is reserved for the entire string that satisfied the regular expression. The returned subexpression may be at most 1,100,000 characters (bytes) long.

Domain n: 0 to 9
Range: ASCII strings

`ustrregexm(`s`,`re[`,`noc]`)`

Description: performs a match of a regular expression and evaluates to `1` if regular expression re is satisfied by the Unicode string s; otherwise, `0`

If noc is specified and not 0, a case-insensitive match is performed. The function may return a negative integer if an error occurs.

`ustrregexm("12345", "([0-9]){5}")` = `1`
`ustrregexm("de TRÈS près", "rès")` = `1`
`ustrregexm("de TRÈS près", "Rès")` = `0`
`ustrregexm("de TRÈS près", "Rès", 1)` = `1`

Domain s: Unicode strings
Domain re: Unicode regular expressions
Domain noc: integers
Range: integers

`ustrregexrf(`s_1`,`re`,`s_2[`, `*noc*]`)`

Description: replaces the first substring within the Unicode string s_1 that matches re with s_2 and returns the resulting string

If *noc* is specified and not 0, a case-insensitive match is performed. The function may return an empty string if an error occurs.

`ustrregexrf("très près", "rès", "X")` = `"tX près"`
`ustrregexrf("TRÈS près", "Rès", "X")` = `"TRÈS près"`
`ustrregexrf("TRÈS près", "Rès", "X", 1)` = `"TX près"`

Domain s_1: Unicode strings
Domain re: Unicode regular expressions
Domain s_2: Unicode strings
Domain *noc*: integers
Range: Unicode strings

`ustrregexra(`s_1`,`re`,`s_2[`, `*noc*]`)`

Description: replaces all substrings within the Unicode string s_1 that match re with s_2 and returns the resulting string

If *noc* is specified and not 0, a case-insensitive match is performed. The function may return an empty string if an error occurs.

`ustrregexra("très près", "rès", "X")` = `"tX pX"`
`ustrregexra("TRÈS près", "Rès", "X")` = `"TRÈS près"`
`ustrregexra("TRÈS près", "Rès", "X", 1)` = `"TX pX"`

Domain s_1: Unicode strings
Domain re: Unicode regular expressions
Domain s_2: Unicode strings
Domain *noc*: integers
Range: Unicode strings

`ustrregexs(`n`)`

Description: subexpression n from a previous `ustrregexm()` match

Subexpression 0 is reserved for the entire string that satisfied the regular expression. The function may return an empty string if n is larger than the maximum count of subexpressions from the previous match or if an error occurs.

Domain n: integers $\geq$ 0
Range: strings

`soundex(`s`)`

Description: the soundex code for a string, s

The soundex code consists of a letter followed by three numbers: the letter is the first ASCII letter of the name and the numbers encode the remaining consonants. Similar sounding consonants are encoded by the same number. Unicode characters beyond the plain ASCII range are ignored.

```
soundex("Ashcraft") = "A226"
soundex("Robert") = "R163"
soundex("Rupert") = "R163"
```

Domain s: strings
Range: strings

`soundex_nara(`s`)`

Description: the U.S. Census soundex code for a string, s

The soundex code consists of a letter followed by three numbers: the letter is the first ASCII letter of the name and the numbers encode the remaining consonants. Similar sounding consonants are encoded by the same number. Unicode characters beyond the plain ASCII range are ignored.

```
soundex_nara("Ashcraft") = "A261"
```

Domain s: strings
Range: strings

`strcat(`s_1`,`s_2`)`

Description: there is no `strcat()` function; instead the addition operator is used to concatenate strings

```
"hello " + "world" = "hello world"
"a" + "b" = "ab"
"Café " + "de Flore" = "Café de Flore"
```

Domain s_1: strings
Domain s_2: strings
Range: strings

`strdup(`s_1`,`n`)`

Description: there is no `strdup()` function; instead the multiplication operator is used to create multiple copies of strings

```
"hello" * 3 = "hellohellohello"
3 * "hello" = "hellohellohello"
0 * "hello" = ""
"hello" * 1 = "hello"
"Здравствуйте " * 2 = "Здравствуйте Здравствуйте "
```

Domain s_1: strings
Domain n: nonnegative integers 0, 1, 2, ...
Range: strings

`string(`n`)`

Description: a synonym for `strofreal(`n`)`

`string(`n`,`s`)`

Description: a synonym for `strofreal(`n`,`s`)`

`stritrim(`s`)`

Description: s with multiple, consecutive internal blanks (ASCII space character `char(32)`) collapsed to one blank

`stritrim("hello     there")` = `"hello there"`

Domain s: strings

Range: strings with no multiple, consecutive internal blanks

`strlen(`s`)`

Description: the number of characters in ASCII s or length in bytes

`strlen()` is intended for use with only plain ASCII characters and for use by programmers who want to obtain the byte-length of a string. Note that any Unicode character beyond ASCII range (code point greater than 127) takes more than 1 byte in the UTF-8 encoding; for example, `é` takes 2 bytes.

For the number of characters in a Unicode string, see `ustrlen()`.

`strlen("ab")` = `2`

`strlen("é")` = `2`

Domain s: strings

Range: integers ≥ 0

`ustrlen(`s`)`

Description: the number of characters in the Unicode string s

An invalid UTF-8 sequence is counted as one Unicode character. An invalid UTF-8 sequence may contain one byte or multiple bytes. Note that any Unicode character beyond the plain ASCII range (code point greater than 127) takes more than 1 byte in the UTF-8 encoding; for example, `é` takes 2 bytes.

`ustrlen("médiane")` = `7`

`strlen("médiane")` = `8`

Domain s: Unicode strings

Range: integers ≥ 0

`udstrlen(`*s*`)`

Description: the number of display columns needed to display the Unicode string *s* in the Stata Results window

A Unicode character in the CJK (Chinese, Japanese, and Korean) encoding usually requires two display columns; a Latin character usually requires one column. Any invalid UTF-8 sequence requires one column.

```
udstrlen("中值") = 4
ustrlen("中值") = 2
strlen("中值") = 6
```

Domain *s*: Unicode strings

Range: integers ≥ 0

`strlower(`*s*`)`

Description: lowercase ASCII characters in string *s*

Unicode characters beyond the plain ASCII range are ignored.

```
strlower("THIS") = "this"
strlower("CAFÉ") = "cafÉ"
```

Domain *s*: strings

Range: strings with lowercased characters

`ustrlower(`*s*[`,`*loc*]`)`

Description: lowercase all characters of Unicode string *s* under the given locale *loc*

If *loc* is not specified, the default locale is used. The same *s* but different *loc* may produce different results; for example, the lowercase letter of "I" is "i" in English but a dotless "i" in Turkish. The same Unicode character can be mapped to different Unicode characters based on its surrounding characters; for example, Greek capital letter sigma Σ has two lowercases: ς, if it is the final character of a word, or σ. The result can be longer or shorter than the input Unicode string in bytes.

```
ustrlower("MÉDIANE","fr") = "médiane"
ustrlower("ISTANBUL","tr") = "ıstanbul"
ustrlower("ὈΔΥΣΣΕΎΣ") = "ὀδυσσεύς"
```

Domain *s*: Unicode strings

Domain *loc*: locale name

Range: Unicode strings

`strltrim(`*s*`)`

Description: *s* without leading blanks (ASCII space character `char(32)`)

```
strltrim(" this") = "this"
```

Domain *s*: strings

Range: strings without leading blanks

`ustrltrim(`x`)`

Description: removes the leading Unicode whitespace characters and blanks from the Unicode string s

Note that, in addition to `char(32)`, ASCII characters `char(9)`, `char(10)`, `char(11)`, `char(12)`, and `char(13)` are whitespace characters in Unicode standard.

`ustrltrim(" this")` = `"this"`
`ustrltrim(char(9)+"this")` = `"this"`
`ustrltrim(ustrunescape("\u1680")+" this")` = `"this"`

Domain s: Unicode strings
Range: Unicode strings

`strmatch(`s_1`,`s_2`)`

Description: `1` if s_1 matches the pattern s_2; otherwise, `0`

`strmatch("17.4","1??4")` returns `1`. In s_2, `"?"` means that one character goes here, and `"*"` means that zero or more bytes go here. Note that a Unicode character may contain multiple bytes; thus, using `"*"` with Unicode characters can infrequently result in matches that do not occur at a character boundary.

Also see `regexm()`, `regexr()`, and `regexs()`.

`strmatch("café", "caf?")` = `1`

Domain s_1: strings
Domain s_2: strings
Range: integers 0 or 1

`strofreal(`n`)`

Description: n converted to a string

Also see `real()`.

`strofreal(4)+"F"` = `"4F"`
`strofreal(1234567)` = `"1234567"`
`strofreal(12345678)` = `"1.23e+07"`
`strofreal(.)` = `"."`

Domain n: −8e+307 to 8e+307 or *missing*
Range: strings

`strofreal(`n`,`s`)`

Description: n converted to a string using the specified display format

Also see `real()`.

```
strofreal(4,"%9.2f") = "4.00"
strofreal(123456789,"%11.0g") = "123456789"
strofreal(123456789,"%13.0gc") = "123,456,789"
strofreal(0,"%td") = "01jan1960"
strofreal(225,"%tq") = "2016q2"
strofreal(225,"not a format") = ""
```

Domain n: $-8\text{e}+307$ to 8e+307 or *missing*
Domain s: strings containing %*fmt* numeric display format
Range: strings

`strpos(`s_1`,`s_2`)`

Description: the position in s_1 at which s_2 is first found; otherwise, `0`

`strpos()` is intended for use with only plain ASCII characters and for use by programmers who want to obtain the byte-position of s_2. Note that any Unicode character beyond ASCII range (code point greater than 127) takes more than 1 byte in the UTF-8 encoding; for example, `é` takes 2 bytes.

To find the character position of s_2 in a Unicode string, see `ustrpos()`.

```
strpos("this","is") = 3
strpos("this","it") = 0
```

Domain s_1: strings (to be searched)
Domain s_2: strings (to search for)
Range: integers ≥ 0

`ustrpos(`s_1`,`s_2[`,`n]`)`

Description: the position in s_1 at which s_2 is first found; otherwise, `0`

If *n* is specified and is greater than 0, the search starts at the nth Unicode character of s_1. An invalid UTF-8 sequence in either s_1 or s_2 is replaced with a Unicode replacement character `\ufffd` before the search is performed.

```
ustrpos("médiane", "édi") = 2
ustrpos("médiane", "édi", 3) = 0
ustrpos("médiane", "éci") = 0
```

Domain s_1: Unicode strings (to be searched)
Domain s_2: Unicode strings (to search for)
Domain n: integers
Range: integers

`strproper(`*s*`)`

Description: a string with the first ASCII letter and any other letters immediately following characters that are not letters; all other ASCII letters converted to lowercase

`strproper()` implements a form of titlecasing and is intended for use with only plain ASCII strings. Unicode characters beyond ASCII are treated as characters that are not letters. To titlecase strings with Unicode characters beyond the plain ASCII range or to implement language-sensitive rules for titlecasing, see `ustrtitle()`.

`strproper("mR. joHn a. sMitH")` = `"Mr. John A. Smith"`
`strproper("jack o'reilly")` = `"Jack O'Reilly"`
`strproper("2-cent's worth")` = `"2-Cent'S Worth"`
`strproper("vous êtes")` = `"Vous êTes"`

Domain *s*: strings

Range: strings

`ustrtitle(`*s*[`,`*loc*]`)`

Description: a string with the first characters of Unicode words titlecased and other characters lowercased

If *loc* is not specified, the default locale is used. Note that a Unicode word is different from a Stata word produced by function `word()`. The Stata word is a space-separated token. A Unicode word is a language unit based on either a set of word-boundary rules or dictionaries for some languages (Chinese, Japanese, and Thai). The titlecase is also locale dependent and context sensitive; for example, lowercase "ij" is considered a digraph in Dutch. Its titlecase is "IJ".

`ustrtitle("vous êtes", "fr")` = `"Vous Êtes"`
`ustrtitle("mR. joHn a. sMitH")` = `"Mr. John A. Smith"`
`ustrtitle("ijmuiden", "en")` = `"Ijmuiden"`
`ustrtitle("ijmuiden", "nl")` = `"IJmuiden"`

Domain *s*: Unicode strings

Domain *loc*: Unicode strings

Range: Unicode strings

`strreverse(`*s*`)`

Description: reverses the ASCII string *s*

`strreverse()` is intended for use with only plain ASCII characters. For Unicode characters beyond ASCII range (code point greater than 127), the encoded bytes are reversed.

To reverse the characters of Unicode string, see `ustrreverse()`.

`strreverse("hello")` = `"olleh"`

Domain *s*: ASCII strings

Range: ASCII reversed strings

`ustrreverse(`s`)`

Description: reverses the Unicode string s

The function does not take Unicode character equivalence into consideration. Hence, a Unicode character in a decomposed form will not be reversed as one unit. An invalid UTF-8 sequence is replaced with a Unicode replacement character `\ufffd`.

`ustrreverse("médiane")` = `"enaidém"`

Domain s: Unicode strings

Range: reversed Unicode strings

`strrpos(`s_1`,`s_2`)`

Description: the position in s_1 at which s_2 is last found; otherwise, `0`

`strrpos()` is intended for use with only plain ASCII characters and for use by programmers who want to obtain the last byte-position of s_2. Note that any Unicode character beyond ASCII range (code point greater than 127) takes more than 1 byte in the UTF-8 encoding; for example, `é` takes 2 bytes.

To find the last character position of s_2 in a Unicode string, see `ustrrpos()`.

`strrpos("this","is")` = `3`
`strrpos("this is","is")` = `6`
`strrpos("this is","it")` = `0`

Domain s_1: strings (to be searched)

Domain s_2: strings (to search for)

Range: integers ≥ 0

`ustrrpos(`s_1`,`s_2[`,`n]`)`

Description: the position in s_1 at which s_2 is last found; otherwise, `0`

If n is specified and is greater than 0, only the part between the first Unicode character and the nth Unicode character of s_1 is searched. An invalid UTF-8 sequence in either s_1 or s_2 is replaced with a Unicode replacement character `\ufffd` before the search is performed.

`ustrrpos("enchanté", "n")` = `6`
`ustrrpos("enchanté", "n", 5)` = `2`
`ustrrpos("enchanté", "n", 6)` = `6`
`ustrrpos("enchanté", "ne")` = `0`

Domain s_1: Unicode strings (to be searched)

Domain s_2: Unicode strings (to search for)

Domain n: integers

Range: integers

`strrtrim(`s`)`

Description: s without trailing blanks (ASCII space character `char(32)`)

`strrtrim("this ")` = `"this"`

Domain s: strings

Range: strings without trailing blanks

`ustrrtrim(`s`)`

Description: remove trailing Unicode whitespace characters and blanks from the Unicode string s

Note that, in addition to `char(32)`, ASCII characters `char(9)`, `char(10)`, `char(11)`, `char(12)`, and `char(13)` are considered whitespace characters in the Unicode standard.

```
ustrrtrim("this ") = "this"
ustrltrim("this"+char(10)) = "this"
ustrrtrim("this "+ustrunescape("\u2000")) = "this"
```

Domain s: Unicode strings
Range: Unicode strings

`strtoname(`s[`,`p]`)`

Description: s translated into a Stata 13 compatible name

`strtoname()` results in a name that is truncated to 32 bytes. Each character in s that is not allowed in a Stata name is converted to an underscore character, _. If the first character in s is a numeric character and p is not 0, then the result is prefixed with an underscore. Stata 14 names may be 32 characters; see **[U] 11.3 Naming conventions**.

```
strtoname("name") = "name"
strtoname("a name") = "a_name"
strtoname("5",1) = "_5"
strtoname("5:30",1) = "_5_30"
strtoname("5",0) = "5"
strtoname("5:30",0) = "5_30"
```

Domain s: strings
Domain p: integers 0 or 1
Range: strings

`ustrtoname(`s[`,`p]`)`

Description: string s translated into a Stata name

`ustrtoname()` results in a name that is truncated to 32 characters. Each character in s that is not allowed in a Stata name is converted to an underscore character, _. If the first character in s is a numeric character and p is not 0, then the result is prefixed with an underscore.

```
ustrtoname("name",1) = "name"
ustrtoname("the médiane") = "the_médiane"
ustrtoname("0médiane") = "_0médiane"
ustrtoname("0médiane", 1) = "_0médiane"
ustrtoname("0médiane", 0) = "0médiane"
```

Domain s: Unicode strings
Domain p: integers 0 or 1
Range: Unicode strings

`strtrim(`*s*`)`

Description: *s* without leading and trailing blanks (ASCII space character `char(32)`); equivalent to `strltrim(strrtrim(`*s*`))`

`strtrim(" this ")` = `"this"`

Domain *s*: strings

Range: strings without leading or trailing blanks

`ustrtrim(`*s*`)`

Description: removes leading and trailing Unicode whitespace characters and blanks from the Unicode string *s*

Note that, in addition to `char(32)`, ASCII characters `char(9)`, `char(10)`, `char(11)`, `char(12)`, and `char(13)` are considered whitespace characters in the Unicode standard.

`ustrtrim(" this ")` = `"this"`
`ustrtrim(char(11)+" this ")+char(13)` = `"this"`
`ustrtrim(" this "+ustrunescape("\u2000"))` = `"this"`

Domain *s*: Unicode strings

Range: Unicode strings

`strupper(`*s*`)`

Description: uppercase ASCII characters in string *s*

Unicode characters beyond the plain ASCII range are ignored.

`strupper("this")` = `"THIS"`
`strupper("café")` = `"CAFé"`

Domain *s*: strings

Range: strings with uppercased characters

`ustrupper(`*s*[`,`*loc*]`)`

Description: uppercase all characters in string *s* under the given locale *loc*

If *loc* is not specified, the default locale is used. The same *s* but a different *loc* may produce different results; for example, the uppercase letter of "i" is "I" in English, but "I" with a dot in Turkish. The result can be longer or shorter than the input string in bytes; for example, the uppercase form of the German letter ß (code point `\u00df`) is two capital letters "SS".

`ustrupper("médiane","fr")` = `"MÉDIANE"`
`ustrupper("Rußland", "de")` = `"RUSSLAND"`
`ustrupper("istanbul", "tr")` = `"İSTANBUL"`

Domain *s*: Unicode strings

Domain *loc*: locale name

Range: Unicode strings

`subinstr(`s_1`,`s_2`,`s_3`,`n`)`

Description: s_1, where the first n occurrences in s_1 of s_2 have been replaced with s_3

`subinstr()` is intended for use with only plain ASCII characters and for use by programmers who want to perform byte-based substitution. Note that any Unicode character beyond ASCII range (code point greater than 127) takes more than 1 byte in the UTF-8 encoding; for example, é takes 2 bytes.

To perform character-based replacement in Unicode strings, see `usubinstr()`.

If n is *missing*, all occurrences are replaced.

Also see `regexm()`, `regexr()`, and `regexs()`.

`subinstr("this is the day","is","X",1)` = `"thX is the day"`
`subinstr("this is the hour","is","X",2)` = `"thX X the hour"`
`subinstr("this is this","is","X",.)` = `"thX X thX"`

Domain s_1: strings (to be substituted into)
Domain s_2: strings (to be substituted from)
Domain s_3: strings (to be substituted with)
Domain n: integers ≥ 0 or *missing*
Range: strings

`usubinstr(`s_1`,`s_2`,`s_3`,`n`)`

Description: replaces the first n occurrences of the Unicode string s_2 with the Unicode string s_3 in s_1

If n is *missing*, all occurrences are replaced. An invalid UTF-8 sequence in s_1, s_2, or s_3 is replaced with a Unicode replacement character `\ufffd` before replacement is performed.

`usubinstr("de très près","ès","es",1)` = `"de tres près"`
`usubinstr("de très pr‘es","ès","X",2)` = `"de trX prX"`

Domain s_1: Unicode strings (to be substituted into)
Domain s_2: Unicode strings (to be substituted from)
Domain s_3: Unicode strings (to be substituted with)
Domain n: integers ≤ 0 or *missing*
Range: Unicode strings

`subinword(`s_1`,`s_2`,`s_3`,`n`)`

Description: s_1, where the first n occurrences in s_1 of s_2 as a word have been replaced with s_3

A word is defined as a space-separated token. A token at the beginning or end of s_1 is considered space-separated. This is different from a Unicode word, which is a language unit based on either a set of word-boundary rules or dictionaries for several languages (Chinese, Japanese, and Thai). If n is *missing*, all occurrences are replaced.

Also see `regexm()`, `regexr()`, and `regexs()`.

```
subinword("this is the day","is","X",1) = "this X the day"
subinword("this is the hour","is","X",.) = "this X the hour"
subinword("this is this","th","X",.) = "this is this"
```

Domain s_1: strings (to be substituted for)
Domain s_2: strings (to be substituted from)
Domain s_3: strings (to be substituted with)
Domain n: integers ≥ 0 or *missing*
Range: strings

`substr(`s`,`n_1`,`n_2`)`

Description: the substring of s, starting at n_1, for a length of n_2

`substr()` is intended for use with only plain ASCII characters and for use by programmers who want to extract a subset of bytes from a string. For those with plain ASCII text, n_1 is the starting character, and n_2 is the length of the string in characters. For programmers, `substr()` is technically a byte-based function. For plain ASCII characters, the two are equivalent but you can operate on byte values beyond that range. Note that any Unicode character beyond ASCII range (code point greater than 127) takes more than 1 byte in the UTF-8 encoding; for example, `é` takes 2 bytes.

To obtain substrings of Unicode strings, see `usubstr()`.

If $n_1 < 0$, n_1 is interpreted as the distance from the end of the string; if $n_2 = .$ (*missing*), the remaining portion of the string is returned.

```
substr("abcdef",2,3) = "bcd"
substr("abcdef",-3,2) = "de"
substr("abcdef",2,.) = "bcdef"
substr("abcdef",-3,.) = "def"
substr("abcdef",2,0) = ""
substr("abcdef",15,2) = ""
```

Domain s: strings
Domain n_1: integers ≥ 1 and ≤ -1
Domain n_2: integers ≥ 1
Range: strings

`usubstr(`s`,`n_1`,`n_2`)`

Description: the Unicode substring of s, starting at n_1, for a length of n_2

If $n_1 < 0$, n_1 is interpreted as the distance from the last character of the s; if $n_2 =$ `.` (*missing*), the remaining portion of the Unicode string is returned.

`usubstr("médiane",2,3)` = `"édi"`
`usubstr("médiane",-3,2)` = `"an"`
`usubstr("médiane",2,.)` = `"édiane"`

Domain s: Unicode strings
Domain n_1: integers ≥ 1 and ≤ -1
Domain n_2: integers ≥ 1
Range: Unicode strings

`udsubstr(`s`,`n_1`,`n_2`)`

Description: the Unicode substring of s, starting at character n_1, for n_2 display columns

If $n_2 =$ `.` (*missing*), the remaining portion of the Unicode string is returned. If n_2 display columns from n_1 is in the middle of a Unicode character, the substring stops at the previous Unicode character.

`udsubstr("médiane",2,3)` = `"édi"`
`udsubstr("中值",1,1) = ""`
`udsubstr("中值",1,2) = "中"`

Domain s: Unicode strings
Domain n_1: integers $\geq$ 1
Domain n_2: integers $\geq$ 1
Range: Unicode strings

`tobytes(`s[`,`n]`)`

Description: escaped decimal or hex digit strings of up to 200 bytes of s

The escaped decimal digit string is in the form of `\dDDD`. The escaped hex digit string is in the form of `\xhh`. If n is not specified or is 0, the decimal form is produced. Otherwise, the hex form is produced.

`tobytes("abc")` = `"\d097\d098\d099"`
`tobytes("abc", 1)` = `"\x61\x62\x63"`
`tobytes("café")` = `"\d099\d097\d102\d195\d169"`

Domain s: Unicode strings
Domain n: integers
Range: strings

`uisdigit(`s`)`

Description: `1` if the first Unicode character in s is a Unicode decimal digit; otherwise, `0`

A Unicode decimal digit is a Unicode character with the character property `Nd` according to the Unicode standard. The function returns `-1` if the string starts with an invalid UTF-8 sequence.

Domain s: Unicode strings
Range: integers

`uisletter(`s`)`

Description: `1` if the first Unicode character in s is a Unicode letter; otherwise, `0`

A Unicode letter is a Unicode character with the character property `L` according to the Unicode standard. The function returns `-1` if the string starts with an invalid UTF-8 sequence.

Domain s: Unicode strings

Range: integers

`ustrcompare(`s_1`,`s_2[`,`loc]`)`

Description: compares two Unicode strings

The function returns `-1`, `1`, or `0` if s_1 is less than, greater than, or equal to s_2. The function may return a negative number other than -1 if an error happens. The comparison is locale dependent. For example, z < ö in Swedish but ö < z in German. If *loc* is not specified, the default locale is used. The comparison is diacritic and case sensitive. If you need different behavior, for example, case-insensitive comparison, you should use the extended comparison function `ustrcompareex()`. Unicode string comparison compares Unicode strings in a language-sensitive manner. On the other hand, the `sort` command compares strings in code-point (binary) order. For example, uppercase “Z” (code-point value 90) comes before lowercase “a” (code-point value 97) in code-point order but comes after “a” in any English dictionary.

`ustrcompare("z", "ö", "sv")` = `-1`

`ustrcompare("z", "ö", "de")` = `1`

Domain s_1: Unicode strings

Domain s_2: Unicode strings

Domain *loc*: Unicode strings

Range: integers

`ustrcompareex(`s_1`,`s_2`,`*loc*`,`*st*`,`*case*`,`*cslv*`,`*norm*`,`*num*`,`*alt*`,`*fr*`)`

Description: compares two Unicode strings

The function returns `-1`, `1`, or `0` if s_1 is less than, greater than, or equal to s_2. The function may return a negative number other than `-1` if an error occurs. The comparison is locale dependent. For example, z < ö in Swedish but ö < z in German. If *loc* is not specified, the default locale is used.

st controls the strength of the comparison. Possible values are `1` (primary), `2` (secondary), `3` (tertiary), `4` (quaternary), or `5` (identical). `-1` means to use the default value for the locale. Any other numbers are treated as tertiary. The primary difference represents base letter differences; for example, letter “a” and letter “b” have primary differences. The secondary difference represents diacritical differences on the same base letter; for example, letters “a” and “ä” have secondary differences. The tertiary difference represents case differences of the same base letter; for example, letters “a” and “A” have tertiary differences. Quaternary strength is useful to distinguish between Katakana and Hiragana for the JIS 4061 collation standard. Identical strength is essentially the code-point order of the string, hence, is rarely useful.

`ustrcompareex("café","cafe","fr", 1, -1, -1, -1, -1, -1, -1)` = `0`

`ustrcompareex("café","cafe","fr", 2, -1, -1, -1, -1, -1, -1)` = `1`

`ustrcompareex("Café","café","fr", 3, -1, -1, -1, -1, -1, -1)` = `1` *case* controls the uppercase and lowercase letter order. Possible values are `0` (use order specified in tertiary strength), `1` (uppercase first), or `2` (lowercase first). `-1` means to use the default value for the locale. Any other values are treated as `0`.

`ustrcompareex("Café","café","fr", -1, 1, -1, -1, -1, -1, -1)` = `-1`
`ustrcompareex("Café","café","fr", -1, 2, -1, -1, -1, -1, -1)` = `1`

cslv controls whether an extra case level between the secondary level and the tertiary level is generated. Possible values are `0` (off) or `1` (on). `-1` means to use the default value for the locale. Any other values are treated as `0`. Combining this setting to be "on" and the strength setting to be primary can achieve the effect of ignoring the diacritical differences but preserving the case differences. If the setting is "on", the result is also affected by the *case* setting.

`ustrcompareex("café","Cafe","fr", 1, -1, 1, -1, -1, -1, -1)` = `-1`
`ustrcompareex("café","Cafe","fr", 1, 1, 1, -1, -1, -1, -1)` = `1`

norm controls whether the normalization check and normalizations are performed. Possible values are `0` (off) or `1` (on). `-1` means to use the default value for the locale. Any other values are treated as `0`. Most languages do not require normalization for comparison. Normalization is needed in languages that use multiple combining characters such as Arabic, ancient Greek, or Hebrew.

num controls how contiguous digit substrings are sorted. Possible values are `0` (off) or `1` (on). `-1` means to use the default value for the locale. Any other values are treated as `0`. If the setting is "on", substrings consisting of digits are sorted based on the numeric value. For example, "100" is after value "20" instead of before it. Note that the digit substring is limited to 254 digits, and plus/minus signs, decimals, or exponents are not supported.

`ustrcompareex("100", "20","en", -1, -1, -1, -1, 0, -1, -1)` = `-1`
`ustrcompareex("100", "20","en", -1, -1, -1, -1, 1, -1, -1)` = `1`

alt controls how spaces and punctuation characters are handled. Possible values are `0` (use primary strength) or `1` (alternative handling). Any other values are treated as `0`. If the setting is `1` (alternative handling), "onsite", "on-site", and "on site" are considered equals.

```
ustrcompareex("onsite", "on-site","en",
        -1, -1, -1, -1, -1, 1, -1) = 0
ustrcompareex("onsite", "on site","en",
        -1, -1, -1, -1, -1, 1, -1) = 0
ustrcompareex("onsite", "on-site","en",
        -1, -1, -1, -1, -1, 0, -1) = 1
```

fr controls the direction of the secondary strength. Possible values are `0` (off) or `1` (on). `-1` means to use the default value for the locale. All other values are treated as "off". If the setting is "on", the diacritical letters are sorted backward. Note that the setting is "on" by default only for Canadian French (locale `fr_CA`).

```
ustrcompareex("coté", "côte","fr_CA",-1,-1,-1,-1,-1,-1,0) = -1
ustrcompareex("coté", "côte","fr_CA",-1,-1,-1,-1,-1,-1,1) = 1
ustrcompareex("coté", "côte","fr_CA",-1,-1,-1,-1,-1,-1,-1) = 1
ustrcompareex("coté", "côte","fr",-1,-1,-1,-1,-1,-1,-1) = 1
```

Domain s_1: Unicode strings
Domain s_2: Unicode strings
Domain *loc*: Unicode strings
Domain *st*: integers
Domain *case*: integers
Domain *cslv*: integers
Domain *norm*: integers
Domain *num*: integers
Domain *alt*: integers
Domain *fr*: integers
Range: integers

`ustrfix(`*s*[`,`*rep*]`)`

Description: replaces each invalid UTF-8 sequence with a Unicode character

In the one-argument case, the Unicode replacement character `\ufffd` is used. In the two-argument case, the first Unicode character of *rep* is used. If *rep* starts with an invalid UTF-8 sequence, then Unicode replacement character `\ufffd` is used. Note that an invalid UTF-8 sequence can contain one byte or multiple bytes.

```
ustrfix(char(200)) = ustrunescape("\ufffd")
ustrfix("ab"+char(200)+"cdé", "") = "abcdé"
ustrfix("ab"+char(229)+char(174)+"cdé", "é") = "abécdé"
```

Domain *s*: Unicode strings
Domain *rep*: Unicode character
Range: Unicode strings

`ustrfrom(`*s*`,`*enc*`,`*mode*`)`

Description: converts the string *s* in encoding *enc* to a UTF-8 encoded Unicode string

mode controls how invalid byte sequences in *s* are handled. The possible values are `1`, which substitutes an invalid byte sequence with a Unicode replacement character `\ufffd`; `2`, which skips any invalid byte sequences; `3`, which stops at the first invalid byte sequence and returns an empty string; or `4`, which replaces any byte in an invalid sequence with an escaped hex digit sequence `%Xhh`. Any other values are treated as `1`. A good use of value `4` is to check what invalid bytes a Unicode string *ust* contains by examining the result of `ustrfrom(ust, "utf-8", 4)`.

Also see `ustrto()`.

```
ustrfrom("caf"+char(233), "latin1", 1) = "café"
ustrfrom("caf"+char(233), "utf-8", 1) =
        "caf"+ustrunescape("\ufffd")
ustrfrom("caf"+char(233), "utf-8", 2) = "caf"
ustrfrom("caf"+char(233), "utf-8", 3) = ""
ustrfrom("caf"+char(233), "utf-8", 4) = "caf%XE9"
```

Domain *s*: strings in encoding *enc*
Domain *enc*: Unicode strings
Domain *mode*: integers
Range: Unicode strings

`ustrinvalidcnt(`*s*`)`

Description: the number of invalid UTF-8 sequences in *s*

An invalid UTF-8 sequence may contain one byte or multiple bytes.

`ustrinvalidcnt("médiane")` = `0`
`ustrinvalidcnt("médiane"+char(229))` = `1`
`ustrinvalidcnt("médiane"+char(229)+char(174))` = `1`
`ustrinvalidcnt("médiane"+char(174)+char(158))` = `2`

Domain *s*: Unicode strings
Range: integers

`ustrleft(`*s*`,`*n*`)`

Description: the first *n* Unicode characters of the Unicode string *s*

An invalid UTF-8 sequence is replaced with a Unicode replacement character `\ufffd`.

`ustrleft("Экспериментальные",3) = "Экс"`
`ustrleft("Экспериментальные",5) = "Экспе"`

Domain *s*: Unicode strings
Domain *n*: integers
Range: Unicode strings

`ustrnormalize(`*s*`,`*norm*`)`

Description: normalizes Unicode string *s* to one of the five normalization forms specified by *norm*

The normalization forms are `nfc`, `nfd`, `nfkc`, `nfkd`, or `nfkcc`. The function returns an empty string for any other value of *norm*. Unicode normalization removes the Unicode string differences caused by Unicode character equivalence. `nfc` specifies `Normalization Form C`, which normalizes decomposed Unicode code points to a composited form. `nfd` specifies `Normalization Form D`, which normalizes composited Unicode code points to a decomposed form. `nfc` and `nfd` produce canonical equivalent form. `nfkc` and `nfkd` are similar to `nfc` and `nfd` but produce compatibility equivalent forms. `nfkcc` specifies `nfkc` with casefolding. This normalization and casefolding implement the Unicode Character Database.

In the Unicode standard, both "i" (`\u0069` followed by a diaeresis `\u0308`) and the composite character `\u00ef` represent "ï" with 2 dots as in "naïve". Hence, the code-point sequence `\u0069\u0308` and the code point `\u00ef` are considered Unicode equivalent. According to the Unicode standard, they should be treated as the same single character in Unicode string operations, such as in display, comparison, and selection. However, Stata does not support multiple code-point characters; each code point is considered a separate Unicode character. Hence, `\u0069\u0308` is displayed as two characters in the Results window. `ustrnormalize()` can be used with `"nfc"` to normalize `\u0069\u0308` to the canonical equivalent composited code point `\u00ef`.

`ustrnormalize(ustrunescape("\u0069\u0308"), "nfc")` = `"ï"`

The decomposed form `nfd` can be used to removed diacritical marks from base letters. First, normalize the Unicode string to canonical decomposed form, and then call `ustrto()` with mode `skip` to skip all non-ASCII characters.

Also see `ustrfrom()`.

`ustrto(ustrnormalize("café", "nfd"), "ascii", 2)` = `"cafe"`

Domain *s*: Unicode strings
Domain *norm*: Unicode strings
Range: Unicode strings

`ustrright(`*s*`,`*n*`)`

Description: the last *n* Unicode characters of the Unicode string *s*

An invalid UTF-8 sequence is replaced with a Unicode replacement character `\ufffd`.

`ustrright("Экспериментальные",3) = "ные"`
`ustrright("Экспериментальные",5) = "льные"`

Domain *s*: Unicode strings
Domain *n*: integers
Range: Unicode strings

`ustrsortkey(`*s*[`,`*loc*]`)`

Description: generates a null-terminated byte array that can be used by the `sort` command to produce the same order as `ustrcompare()`

The function may return an empty array if an error occurs. The result is locale dependent. If *loc* is not specified, the default locale is used. The result is also diacritic and case sensitive. If you need different behavior, for example, case-insensitive results, you should use the extended function `ustrsortkeyex()`. See **[U] 12.4.2.5 Sorting strings containing Unicode characters** for details and examples.

Domain *s*: Unicode strings
Domain *loc*: Unicode strings
Range: null-terminated byte array

`ustrsortkeyex(`*s*`,`*loc*`,`*case*`,`*cslv*`,`*norm*`,`*num*`,`*alt*`,`*fr*`)`

Description: generates a null-terminated byte array that can be used by the `sort` command to produce the same order as `ustrcompare()`

The function may return an empty array if an error occurs. The result is locale dependent. If *loc* is not specified, the default locale is used. See **[U] 12.4.2.5 Sorting strings containing Unicode characters** for details and examples.

st controls the strength of the comparison. Possible values are `1` (primary), `2` (secondary), `3` (tertiary), `4` (quaternary), or `5` (identical). `-1` means to use the default value for the locale. Any other numbers are treated as tertiary. The primary difference represents base letter differences; for example, letter "a" and letter "b" have primary differences. The secondary difference represents diacritical differences on the same base letter; for example, letters "a" and "ä" have secondary differences. The tertiary difference represents case differences of the same base letters; for example, letters "a" and "A" have tertiary differences. Quaternary strength is useful to distinguish between Katakana and Hiragana for the JIS 4061 collation standard. Identical strength is essentially the code-point order of the string and, hence, is rarely useful.

case controls the uppercase and lowercase letter order. Possible values are `0` (use order specified in tertiary strength), `1` (uppercase first), or `2` (lowercase first). `-1` means to use the default value for the locale. Any other values are treated as `0`.

cslv controls if an extra case level between the secondary level and the tertiary level is generated. Possible values are `0` (off) or `1` (on). `-1` means to use the default value for the locale. Any other values are treated as `0`. Combining this setting to be "on" and the strength setting to be primary can achieve the effect of ignoring the diacritical differences but preserving the case differences. If the setting is "on", the result is also affected by the *case* setting.

norm controls whether the normalization check and normalizations are performed. Possible values are `0` (off) or `1` (on). `-1` means to use the default value for the locale. Any other values are treated as `0`. Most languages do not require normalization for comparison. Normalization is needed in languages that use multiple combining characters such as Arabic, ancient Greek, or Hebrew.

num controls how contiguous digit substrings are sorted. Possible values are `0` (off) or `1` (on). `-1` means to use the default value for the locale. Any other values are treated as `0`. If the setting is "on", substrings consisting of digits are sorted based on the numeric value. For example, "100" is after "20" instead of before it. Note that the digit substring is limited to 254 digits, and plus/minus signs, decimals, or exponents are not supported.

alt controls how spaces and punctuation characters are handled. Possible values are `0` (use primary strength) or `1` (alternative handling). Any other values are treated as `0`. If the setting is `1` (alternative handling), "onsite", "on-site", and "on site" are considered equals.

fr controls the direction of the secondary strength. Possible values are `0` (off) or `1` (on). `-1` means to use the default value for the locale. All other values are treated as "off". If the setting is "on", the diacritical letters are sorted backward. Note that the setting is "on" by default only for Canadian French (locale `fr_CA`).

Domain *s*: Unicode strings
Domain *loc*: Unicode strings
Domain *st*: integers
Domain *case*: integers
Domain *cslv*: integers
Domain *norm*: integers
Domain *num*: integers
Domain *alt*: integers
Domain *fr*: integers
Range: null-terminated byte array

`ustrto(`*s*`,`*enc*`,`*mode*`)`

Description: converts the Unicode string *s* in UTF-8 encoding to a string in encoding *enc*

See [D] **unicode encoding** for details on available encodings. Any invalid sequence in *s* is replaced with a Unicode replacement character `\ufffd`. *mode* controls how unsupported Unicode characters in the encoding *enc* are handled. The possible values are `1`, which substitutes any unsupported characters with the *enc*'s substitution strings (the substitution character for both `ascii` and `latin1` is `char(26)`); `2`, which skips any unsupported characters; `3`, which stops at the first unsupported character and returns an empty string; or `4`, which replaces any unsupported character with an escaped hex digit sequence `\uhhhh` or `\Uhhhhhhhh`. The hex digit sequence contains either 4 or 8 hex digits, depending if the Unicode character's code-point value is less than or greater than `\uffff`. Any other values are treated as `1`.

`ustrto("café", "ascii", 1)` = `"caf"+char(26)`
`ustrto("café", "ascii", 2)` = `"caf"`
`ustrto("café", "ascii", 3)` = `""`
`ustrto("café", "ascii", 4)` = `"caf\u00E9"`

`ustrto()` can be used to removed diacritical marks from base letters. First, normalize the Unicode string to `NFD` form using `ustrnormalize()`, and then call `ustrto()` with value `2` to skip all non-ASCII characters.

`ustrto(ustrnormalize("café", "nfd"), "ascii", 2)` = `"cafe"`

Domain *s*: Unicode strings
Domain *enc*: Unicode strings
Domain *mode*: integers
Range: strings in encoding *enc*

`ustrtohex(`s[,n]`)`

Description: escaped hex digit string of s up to 200 Unicode characters

The escaped hex digit string is in the form of `\uhhhh` for code points less than `\uffff` or `\Uhhhhhhhh` for code points greater than `\uffff`. The function starts at the nth Unicode character of s if n is specified and larger than 0. Any invalid UTF-8 sequence is replaced with a Unicode replacement character `\ufffd`. Note that the null terminator `char(0)` is a valid Unicode character. Function `ustrunescape()` can be applied on the result to get back the original Unicode string s if s does not contain any invalid UTF-8 sequences.

Also see `ustrunescape()`.

`ustrtohex("нулю") = "\u043d\u0443\u043b\u044e"`
`ustrtohex("нулю", 2) = "\u0443\u043b\u044e"`
`ustrtohex("i"+char(200)+char(0)+"s") =`
`"\u0069\ufffd\u0000\u0073"`

Domain s: Unicode strings
Domain n: integers ≥ 1
Range: strings

`ustrunescape(`s`)`

Description: the Unicode string corresponding to the escaped sequences of s

The following escape sequences are recognized: 4 hex digit form `\uhhhh`; 8 hex digit form `\Uhhhhhhhh`; 1–2 hex digit form `\xhh`; and 1–3 octal digit form `\ooo`, where `h` is `[0-9A-Fa-f]` and `o` is `[0-7]`. The standard ANSI C escapes `\a`, `\b`, `\t`, `\n`, `\v`, `\f`, `\r`, `\e`, `\"`, `\'`, `\?`, `\\` are recognized as well. The function returns an empty string if an escape sequence is badly formed. Note that the 8 hex digit form `\Uhhhhhhhh` begins with a capital letter "U".

Also see `ustrtohex()`.

`ustrunescape("\u043d\u0443\u043b\u044e") = "нулю"`

Domain s: strings of escaped hex values
Range: Unicode strings

`word(`s,n`)`

Description: the nth word in s; *missing* (`""`) if n is missing

Positive numbers count words from the beginning of s, and negative numbers count words from the end of s. (`1` is the first word in s, and `-1` is the last word in s.) A word is a set of characters that start and terminate with spaces. This is different from a Unicode word, which is a language unit based on either a set of word-boundary rules or dictionaries for several languages (Chinese, Japanese, and Thai).

Domain s: strings
Domain n: integers
Range: strings

`ustrword(`s`,`n[`,`loc]`)`

Description: the nth Unicode word in the Unicode string s

Positive n counts Unicode words from the beginning of s, and negative n counts Unicode words from the end of s. For examples, n equal to 1 returns the first word in s, and n equal to -1 returns the last word in s. If loc is not specified, the default locale is used. A Unicode word is different from a Stata word produced by the `word()` function. A Stata word is a space-separated token. A Unicode word is a language unit based on either a set of word-boundary rules or dictionaries for some languages (Chinese, Japanese, and Thai). The function returns *missing* (`""`) if n is greater than cnt or less than $-cnt$, where cnt is the number of words s contains. cnt can be obtained from `ustrwordcount()`. The function also returns *missing* (`""`) if an error occurs.

`ustrword("Parlez-vous français", 1, "fr")` = `"Parlez"`
`ustrword("Parlez-vous français", 2, "fr")` = `"-"`
`ustrword("Parlez-vous français",-1, "fr")` = `"français"`
`ustrword("Parlez-vous français",-2, "fr")` = `"vous"`

Domain s: Unicode strings
Domain loc: Unicode strings
Domain n: integers
Range: Unicode strings

`wordbreaklocale(`loc`,`$type$`)`

Description: the most closely related locale supported by ICU from loc if $type$ is `1`, the actual locale where the word-boundary analysis data come from if $type$ is `2`; or an empty string is returned for any other $type$

`wordbreaklocale("en_us_texas", 1)` = `en_US`
`wordbreaklocale("en_us_texas", 2)` = `root`

Domain loc: strings of locale name
Domain $type$: integers
Range: strings

`wordcount(`s`)`

Description: the number of words in s

A word is a set of characters that starts and terminates with spaces, starts with the beginning of the string, or terminates with the end of the string. This is different from a Unicode word, which is a language unit based on either a set of word-boundary rules or dictionaries for several languages (Chinese, Japanese, and Thai).

Domain s: strings
Range: nonnegative integers 0, 1, 2, ...

`ustrwordcount(`s[`,`loc]`)`

Description: the number of nonempty Unicode words in the Unicode string s

An empty Unicode word is a Unicode word consisting of only Unicode whitespace characters. If *loc* is not specified, the default locale is used. A Unicode word is different from a Stata word produced by the `word()` function. A Stata word is a space-separated token. A Unicode word is a language unit based on either a set of word-boundary rules or dictionaries for some languages (Chinese, Japanese, and Thai). The function may return a negative number if an error occurs.

`ustrwordcount("Parlez-vous français", "fr")` = 4

Domain s: Unicode strings

Domain *loc*: Unicode strings

Range: Unicode strings

References

Cox, N. J. 2004. Stata tip 6: Inserting awkward characters in the plot. *Stata Journal* 4: 95–96.

——. 2011. Stata tip 98: Counting substrings within strings. *Stata Journal* 11: 318–320.

Jeanty, P. W. 2013. Dealing with identifier variables in data management and analysis. *Stata Journal* 13: 699–718.

Also see

[D] **egen** — Extensions to generate

[M-4] **string** — String manipulation functions

[M-5] **intro** — Alphabetical index to functions

[U] 12.4.2 Handling Unicode strings

[U] 13.3 Functions

Title

Trigonometric functions

Contents Functions Reference Also see

Contents

Functions

acos(x)
Description: the radian value of the arccosine of x
Domain: -1 to 1
Range: 0 to π

acosh(x)
Description: the inverse hyperbolic cosine of x

$$\texttt{acosh}(x) = \ln(x + \sqrt{x^2 - 1})$$

Domain: 1 to 8.9e+307
Range: 0 to 709.77

asin(x)
Description: the radian value of the arcsine of x
Domain: -1 to 1
Range: $-\pi/2$ to $\pi/2$

asinh(x)
Description: the inverse hyperbolic sine of x

$$\texttt{asinh}(x) = \ln(x + \sqrt{x^2 + 1})$$

Domain: $-8.9\text{e}+307$ to 8.9e+307
Range: -709.77 to 709.77

`atan(`x`)`
- Description: the radian value of the arctangent of x
- Domain: $-8e+307$ to $8e+307$
- Range: $-\pi/2$ to $\pi/2$

`atan2(`y`, `x`)`
- Description: the radian value of the arctangent of y/x, where the signs of the parameters y and x are used to determine the quadrant of the answer
- Domain y: $-8e+307$ to $8e+307$
- Domain x: $-8e+307$ to $8e+307$
- Range: $-\pi$ to π

`atanh(`x`)`
- Description: the inverse hyperbolic tangent of x

  $\texttt{atanh}(x) = \frac{1}{2}\{\ln(1+x) - \ln(1-x)\}$
- Domain: -1 to 1
- Range: $-8e+307$ to $8e+307$

`cos(`x`)`
- Description: the cosine of x, where x is in radians
- Domain: $-1e+18$ to $1e+18$
- Range: -1 to 1

`cosh(`x`)`
- Description: the hyperbolic cosine of x

  $\texttt{cosh}(x) = \{\exp(x) + \exp(-x)\}/2$
- Domain: -709 to 709
- Range: 1 to $4.11e+307$

`sin(`x`)`
- Description: the sine of x, where x is in radians
- Domain: $-1e+18$ to $1e+18$
- Range: -1 to 1

`sinh(`x`)`
- Description: the hyperbolic sine of x

  $\texttt{sinh}(x) = \{\exp(x) - \exp(-x)\}/2$
- Domain: -709 to 709
- Range: $-4.11e+307$ to $4.11e+307$

`tan(`x`)`
- Description: the tangent of x, where x is in radians
- Domain: $-1e+18$ to $1e+18$
- Range: $-1e+17$ to $1e+17$ or *missing*

`tanh(`x`)`
- Description: the hyperbolic tangent of x

  $\texttt{tanh}(x) = \{\exp(x) - \exp(-x)\}/\{\exp(x) + \exp(-x)\}$
- Domain: $-8e+307$ to $8e+307$
- Range: -1 to 1 or *missing*

❑ Technical note

The trigonometric functions are defined in terms of *radians*. There are 2π radians in a circle. If you prefer to think in terms of *degrees*, because there are also 360 degrees in a circle, you may convert degrees into radians by using the formula $r = d\pi/180$, where d represents degrees and r represents radians. Stata includes the built-in constant `_pi`, equal to π to machine precision. Thus, to calculate the sine of `theta`, where `theta` is measured in degrees, you could type

```
sin(theta*_pi/180)
```

`atan()` similarly returns radians, not degrees. The arccotangent can be obtained as

acot(x) = `_pi/2 - atan(`x`)`

❑

Reference

Oldham, K. B., J. C. Myland, and J. Spanier. 2009. *An Atlas of Functions*. 2nd ed. New York: Springer.

Also see

[D] **egen** — Extensions to generate

[M-5] **intro** — Alphabetical index to functions

[M-5] **sin( )** — Trigonometric and hyperbolic functions

[U] 13.3 Functions

Subject and author index

See the combined subject index and the combined author index in the *Glossary and Index*.