Mathematical functions

Contents

abs(x) the absolute value of x
ceil(x) the unique integer n such that n − 1 < x ≤ 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 lnΓ(x)/dx
exp(x) the exponential function e^x
expm1(x) e^x − 1 with higher precision than exp(x) − 1 for small values of |x|
floor(x) the unique integer n such that n ≤ 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)
ln1m(x) the natural logarithm of 1 − x with higher precision than ln(1 − x) for small values of |x|
ln1p(x) the natural logarithm of 1 + x with higher precision than ln(1 + x) for small values of |x|
lnfactorial(n) the natural log of n factorial = ln(n!)
lngamma(x) ln{Γ(x)}
log(x) a synonym for ln(x)
log10(x) the base-10 logarithm of x
log1m(x) a synonym for ln1m(x)
log1p(x) a synonym for ln1p(x)
logit(x) the log of the odds ratio of x, logit(x) = ln {x/(1 − x)}
max(x1,x2,...,xn) the maximum value of x1,x2,...,xn
min(x1,x2,...,xn) the minimum value of x1,x2,...,xn
mod(x,y) the modulus of x with respect to y
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
**Mathematical functions**

- \( \text{round}(x,y) \) or \( \text{round}(x) \)
  - \( x \) 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 \( \text{round}(.a) = .a \) and that \( \text{round}(.a,y) = .a \) if \( y \) is not missing) and if \( y \) is missing, then ‘.’ is returned.

- \( \text{sign}(x) \)
  - The sign of \( x \): \(-1\) if \( x < 0 \), \(0\) if \( x = 0 \), \(1\) if \( x > 0 \), or ‘missing’ if \( x \) is missing.

- \( \text{sqrt}(x) \)
  - The square root of \( x \)

- \( \text{sum}(x) \)
  - The running sum of \( x \), treating missing values as zero.

- \( \text{trigamma}(x) \)
  - The second derivative of \( \text{lngamma}(x) = d^2 \ln \Gamma(x)/dx^2 \)

- \( \text{trunc}(x) \)
  - A synonym for \( \text{int}(x) \)

### Functions

- \( \text{abs}(x) \)
  - **Description:** the absolute value of \( x \)
  - **Domain:** \(-8e+307\) to \(8e+307\)
  - **Range:** \(0\) to \(8e+307\)

- \( \text{ceil}(x) \)
  - **Description:** the unique integer \( n \) such that \( n - 1 < x \leq n \); \( x \) (not ‘.’) if \( x \) is missing, meaning that \( \text{ceil}(.a) = .a \)
  - **Also see:** \( \text{floor}(x) \), \( \text{int}(x) \), and \( \text{round}(x) \).
  - **Domain:** \(-8e+307\) to \(8e+307\)
  - **Range:** integers in \(-8e+307\) to \(8e+307\)

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

- \( \text{comb}(n,k) \)
  - **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’

- \( \text{digamma}(x) \)
  - **Description:** the digamma() function, \( d\ln \Gamma(x)/dx \)
  - This is the derivative of \( \text{lngamma}(x) \). The \( \text{digamma}(x) \) function is sometimes called the psi function, \( \psi(x) \).
  - **Domain:** \(-1e+15\) to \(8e+307\)
  - **Range:** \(-8e+307\) to \(8e+307\) or ‘missing’

- \( \text{exp}(x) \)
  - **Description:** the exponential function \( e^x \)
  - This function is the inverse of \( \ln(x) \). To compute \( e^x - 1 \) with high precision for small values of \(|x|\), use \( \text{expm1}(x) \).
  - **Domain:** \(-8e+307\) to \(709\)
  - **Range:** \(0\) to \(8e+307\)
**expm1(x)**

Description: $e^x - 1$ with higher precision than $\exp(x) - 1$ for small values of $|x|$

Domain: $-8e+307$ to $709$
Range: $-1$ 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 $\text{floor}(a) = a$

Also see $\text{ceil}(x)$, $\text{int}(x)$, and $\text{round}(x)$.

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, $\text{int}(5.2) = 5$ and $\text{int}(-5.8) = -5$); $x$ (not ".") if $x$ is missing, meaning that $\text{int}(a) = a$

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

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 $x$

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

Domain: $-8e+307$ to $8e+307$
Range: $0$ to $1$ or $\text{missing}$

**invlogit(x)**

Description: the inverse of the logit function of $x$

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

Domain: $-8e+307$ to $8e+307$
Range: $0$ to $1$ or $\text{missing}$

**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,

$$\log_5(x) = \ln(x)/\ln(5) = \log(x)/\log(5) = \log_{10}(x)/\log_{10}(5)$$
$$\log_2(x) = \ln(x)/\ln(2) = \log(x)/\log(2) = \log_{10}(x)/\log_{10}(2)$$

You can calculate $\log_b(x)$ by using the formula that best suits your needs. To compute $\ln(1 - x)$ and $\ln(1 + x)$ with high precision for small values of $|x|$, use $\text{ln1m}(x)$ and $\text{ln1p}(x)$, respectively.

Domain: $1e-323$ to $8e+307$
Range: $-744$ to $709$
ln1m(x)
Description: the natural logarithm of \(1 - x\) with higher precision than \(\ln(1 - x)\) for small values of \(|x|\)
Domain: \(-8\times10^{307}\) to \(1 - c(\text{epsdouble})\)
Range: \(-37\) to \(709\)

ln1p(x)
Description: the natural logarithm of \(1 + x\) with higher precision than \(\ln(1 + x)\) for small values of \(|x|\)
Domain: \(-1 + c(\text{epsdouble})\) to \(8\times10^{307}\)
Range: \(-37\) to \(709\)

lnfactorial(n)
Description: the natural log of \(n\) factorial = \(\ln(n!\)\)
To calculate \(n!\), use \(\text{round}(\exp(\text{lnfactorial}(n)), 1)\) 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 \(1\times10^{305}\)
Range: 0 to \(8\times10^{307}\)

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 \(\ln((x - 1)!\).\n\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 \(1\times10^{305}\) (excluding negative integers)
Range: \(-8\times10^{307}\) to \(8\times10^{307}\)

log(x)
Description: a synonym for \(\ln(x)\)

log10(x)
Description: the base-10 logarithm of \(x\)
Domain: \(1\times10^{-323}\) to \(8\times10^{307}\)
Range: \(-323\) to \(308\)

log1m(x)
Description: a synonym for \(\ln1m(x)\)

log1p(x)
Description: a synonym for \(\ln1p(x)\)

logit(x)
Description: the log of the odds ratio of \(x\), \(\logit(x) = \ln\{x/(1 - x)\}\)
Domain: 0 to 1 (exclusive)
Range: \(-8\times10^{307}\) to \(8\times10^{307}\) or \textit{missing}
max($x_1, x_2, \ldots, x_n$)
Description: the maximum value of $x_1, x_2, \ldots, x_n$

Unless all arguments are missing, missing values are ignored.

$\max(2, 10, \ldots, 7) = 10$
$\max(\ldots, \ldots) = .$

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

Unless all arguments are missing, missing values are ignored.

$\min(2, 10, \ldots, 7) = 2$
$\min(\ldots, \ldots) = .$

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 $y$

$\text{mod}(x, y) = x - y \, \text{floor}(x/y)$
$\text{mod}(x, 0) = .$

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
**Mathematical functions**

**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* ≠ 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
- *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 *j*th observation on *y* contains the sum of the first through *j*th 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 lgamma(*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*)

---

**Video example**

How to round a continuous variable
References


Also see

[FN] **Functions by category**

[D] egen — Extensions to generate

[D] generate — Create or change contents of variable

[M-4] Intro — Categorical guide to Mata functions

[U] 13.3 Functions