

Mathematical functions

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Contents

<code>abs(<i>x</i>)</code>	the absolute value of <i>x</i>
<code>ceil(<i>x</i>)</code>	the unique integer <i>n</i> such that $n - 1 < x \leq n$; <i>x</i> (not “.”) if <i>x</i> is missing, meaning that <code>ceil(.a) = .a</code>
<code>cloglog(<i>x</i>)</code>	the complementary log-log of <i>x</i>
<code>comb(<i>n</i>,<i>k</i>)</code>	the combinatorial function $n!/\{k!(n-k)!\}$
<code>digamma(<i>x</i>)</code>	the <code>digamma()</code> function, $d \ln \Gamma(x)/dx$
<code>exp(<i>x</i>)</code>	the exponential function e^x
<code>expm1(<i>x</i>)</code>	$e^x - 1$ with higher precision than <code>exp(<i>x</i>) - 1</code> for small values of $ x $
<code>floor(<i>x</i>)</code>	the unique integer <i>n</i> such that $n \leq x < n + 1$; <i>x</i> (not “.”) if <i>x</i> is missing, meaning that <code>floor(.a) = .a</code>
<code>int(<i>x</i>)</code>	the integer obtained by truncating <i>x</i> toward 0 (thus, <code>int(5.2) = 5</code> and <code>int(-5.8) = -5</code>); <i>x</i> (not “.”) if <i>x</i> is missing, meaning that <code>int(.a) = .a</code>
<code>invcloglog(<i>x</i>)</code>	the inverse of the complementary log-log function of <i>x</i>
<code>invlogit(<i>x</i>)</code>	the inverse of the logit function of <i>x</i>
<code>ln(<i>x</i>)</code>	the natural logarithm, $\ln(x)$
<code>ln1m(<i>x</i>)</code>	the natural logarithm of $1 - x$ with higher precision than <code>ln(1 - <i>x</i>)</code> for small values of $ x $
<code>ln1p(<i>x</i>)</code>	the natural logarithm of $1 + x$ with higher precision than <code>ln(1 + <i>x</i>)</code> for small values of $ x $
<code>lnfactorial(<i>n</i>)</code>	the natural log of <i>n</i> factorial = $\ln(n!)$
<code>lngamma(<i>x</i>)</code>	$\ln\{\Gamma(x)\}$
<code>log(<i>x</i>)</code>	a synonym for <code>ln(<i>x</i>)</code>
<code>log10(<i>x</i>)</code>	the base-10 logarithm of <i>x</i>
<code>log1m(<i>x</i>)</code>	a synonym for <code>ln1m(<i>x</i>)</code>
<code>log1p(<i>x</i>)</code>	a synonym for <code>ln1p(<i>x</i>)</code>
<code>logit(<i>x</i>)</code>	the log of the odds ratio of <i>x</i> , $\text{logit}(x) = \ln\{x/(1-x)\}$
<code>max(<i>x</i>₁,<i>x</i>₂,...,<i>x</i>_{<i>n</i>})</code>	the maximum value of <i>x</i> ₁ , <i>x</i> ₂ , ..., <i>x</i> _{<i>n</i>}
<code>min(<i>x</i>₁,<i>x</i>₂,...,<i>x</i>_{<i>n</i>})</code>	the minimum value of <i>x</i> ₁ , <i>x</i> ₂ , ..., <i>x</i> _{<i>n</i>}
<code>mod(<i>x</i>,<i>y</i>)</code>	the modulus of <i>x</i> with respect to <i>y</i>
<code>reldif(<i>x</i>,<i>y</i>)</code>	the “relative” difference $ x - y /(y + 1)$; 0 if both arguments are the same type of extended missing value; <i>missing</i> if only one argument is missing or if the two arguments are two different types of <i>missing</i>

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<code>round(x,y)</code> or <code>round(x)</code>	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 <code>round(.a) = .a</code> and that <code>round(.a,y) = .a</code> if y is not missing) and if y is missing, then “.” is returned
<code>sign(x)</code>	the sign of x : -1 if $x < 0$, 0 if $x = 0$, 1 if $x > 0$, or <i>missing</i> if x is missing
<code>sqrt(x)</code>	the square root of x
<code>sum(x)</code>	the running sum of x , treating missing values as zero
<code>trigamma(x)</code>	the second derivative of <code>lngamma(x) = d² lnΓ(x)/dx²</code>
<code>trunc(x)</code>	a synonym for <code>int(x)</code>

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
$$\text{cloglog}(x) = \ln\{-\ln(1-x)\}$$

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 $8e+307$

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 [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, $\text{int}(5.2) = 5$ 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 [round\(\)](#) function is preferred. Also see [round\(\$x\$ \)](#), [ceil\(\$x\$ \)](#), and [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 *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 *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.

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: $-8e+307$ to $1 - \text{c}(\text{epsdouble})$

Range: -37 to 709

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`ln1p(x)`

Description: the natural logarithm of $1 + x$ with higher precision than `ln(1 + x)` for small values of $|x|$

Domain: $-1 + \text{c(epsdoub)}le$ to $8e+307$

Range: -37 to 709

`lnfactorial(n)`

Description: the natural log of n 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: a synonym for `ln(x)`

`log10(x)`

Description: the base-10 logarithm of x

Domain: $1e-323$ to $8e+307$

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 , $\text{logit}(x) = \ln\{x/(1 - x)\}$

Domain: 0 to 1 (exclusive)

Range: $-8e+307$ to $8e+307$ or *missing*

$\max(x_1, x_2, \dots, x_n)$

Description: the maximum value of x_1, x_2, \dots, 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*

$\min(x_1, x_2, \dots, x_n)$

Description: the minimum value of x_1, x_2, \dots, 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*

$\text{mod}(x, y)$

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 $8e+307$

$\text{reldif}(x, y)$

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 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 $\text{lngamma}(x) = d^2 \ln\Gamma(x)/dx^2$

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)`

Video example

[How to round a continuous variable](#)

References

- Abramowitz, M., and I. A. Stegun, ed. 1964. *Handbook of Mathematical Functions with Formulas, Graphs, and Mathematical Tables*. 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

- [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](#)