

## exp() — Exponentiation and logarithms

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## Description

`exp(Z)` returns the elementwise exponentiation of  $Z$ . `exp()` returns real if  $Z$  is real and complex if  $Z$  is complex.

`ln(Z)` and `log(Z)` return the elementwise natural logarithm of  $Z$ . The functions are synonyms. `ln()` and `log()` return real if  $Z$  is real and complex if  $Z$  is complex.

`ln(x)`,  $x$  real, returns the natural logarithm of  $x$  or returns missing (.) if  $x \leq 0$ .

`ln(z)`,  $z$  complex, returns the complex natural logarithm of  $z$ . `Im(ln())` is chosen to be in the interval  $[-\pi, \pi]$ .

`log10(Z)` returns the elementwise log base 10 of  $Z$ . `log10()` returns real if  $Z$  is real and complex if  $Z$  is complex. `log10(Z)` is defined mathematically and operationally as `ln(Z)/ln(10)`.

## Syntax

*numeric matrix* `exp(numeric matrix Z)`

*numeric matrix* `ln(numeric matrix Z)`

*numeric matrix* `log(numeric matrix Z)`

*numeric matrix* `log10(numeric matrix Z)`

## Conformability

`exp(Z)`, `ln(Z)`, `log(Z)`, `log10(Z)`:

<i>Z</i> :	$r \times c$
<i>result</i> :	$r \times c$

## Diagnostics

`exp(Z)` returns missing when  $\text{Re}(Z) > 709$ .

`ln(Z)`, `log(Z)`, and `log10(Z)` return missing when  $Z$  is real and  $Z \leq 0$ . In addition, the functions return missing (.) for real arguments when the result would be complex. For instance, `ln(-1) = .`, whereas `ln(-1+0i) = 3.14159265i`.

## Also see

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