exp() — Exponentiation and logarithms

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 ≤ 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).

expm1(Z) returns exp(z) − 1 for every element z of real matrix Z. expm1(z) is more accurate than exp(z) − 1 for small values of |z|.

\ln1p(Z) and \log1p(Z) return \log(1+z) for every element z of real matrix Z. The functions are synonyms. \ln1p(z) is more accurate than \ln(1+z) for small values of |z|.

\ln1m(Z) and \log1m(Z) return \log(1−z) for every element z of real matrix Z. The functions are synonyms. \ln1m(z) is more accurate than \ln(1−z) for small values of |z|.

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)
numeric matrix expm1(numeric matrix Z)
numeric matrix ln1p(numeric matrix Z)
numeric matrix log1p(numeric matrix Z)
numeric matrix ln1m(numeric matrix Z)
numeric matrix log1m(numeric matrix Z)
```
Conformability

\[ \text{exp}(Z), \ln(Z), \log(Z), \log10(Z), \expm1(Z), \ln1p(Z), \log1p(Z), \ln1m(Z), \log1m(Z): \]
\[ Z: \quad r \times c \]
\[ \text{result:} \quad r \times c \]

Diagnostics

\( \text{exp}(Z) \) 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 \( \ln(-1+0i) = 3.14159265i. \)

\( \expm1(Z) \) returns missing when \( Z > 709. \)

\( \ln1p(z) \) and \( \log1p(z) \) return missing when \( 1 + z \leq 0. \)

\( \ln1m(z) \) and \( \log1m(z) \) return missing when \( 1 - z \leq 0. \)

Also see

[M-4] Scalar — Scalar mathematical functions