

norm() — Matrix and vector norms

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Description

`norm(A)` returns `norm(A, 2)`.

`norm(A, p)` returns the value of the norm of *A* for the specified *p*. The possible values and the meaning of *p* depend on whether *A* is a vector or a matrix.

When *A* is a vector, `norm(A, p)` returns

$$\text{sum}(\text{abs}(A) : ^p)^{1/p} \quad \text{if } 1 \leq p < \infty$$
$$\max(\text{abs}(A)) \quad \text{if } p \geq \infty$$

When *A* is a matrix, returned is

<i>p</i>	<code>norm(A, p)</code>
0	<code>sqrt(trace(conj(A)'A))</code>
1	<code>max(colsum(abs(A)))</code>
2	<code>max(svdsv(A))</code>
.	<code>max(rowsum(abs(A)))</code>

Syntax

real scalar `norm(numeric matrix A)`

real scalar `norm(numeric matrix A, real scalar p)`

Remarks and examples

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`norm(A)` and `norm(A, p)` calculate vector norms and matrix norms. *A* may be real or complex and need not be square when it is a matrix.

The formulas presented above are not the actual ones used in calculation. In the vector-norm case when $1 \leq p < \infty$, the formula is applied to `A:/max(abs(A))` and the result then multiplied by `max(abs(A))`. This prevents numerical overflow. A similar technique is used in calculating the matrix norm for $p = 0$, and that technique also avoids storage of `conj(A)'A`.

Conformability

`norm(A)`:
 A: $r \times c$
 result: 1×1

`norm(A, p)`:
 A: $r \times c$
 p: 1×1
 result: 1×1

Diagnostics

The `norm()` is defined to return 0 if *A* is void and missing if any element of *A* is missing.

`norm(A, p)` aborts with error if *p* is out of range. When *A* is a vector, *p* must be greater than or equal to 1. When *A* is a matrix, *p* must be 0, 1, 2, or . (missing).

`norm(A)` and `norm(A, p)` return missing if the 2-norm is requested and the singular value decomposition does not converge, an event not expected to occur; see [\[M-5\]](#) `svd()`.

Also see

[\[M-4\]](#) **Matrix** — Matrix functions

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