# norm() — Matrix and vector norms

## Description


\[
\text{norm}(A) \text{ returns norm}(A, 2).
\]

\[
\text{norm}(A, p) \text{ returns the value of the norm of } A \text{ for the specified } p. \text{ The possible values and the meaning of } p \text{ depend on whether } A \text{ is a vector or a matrix.}
\]

When \( A \) is a vector, \( \text{norm}(A, p) \) returns

\[
\begin{align*}
\text{sum} (\text{abs}(A)^p)^{1/p} & \quad \text{if } 1 \leq p < . \\
\text{max} (\text{abs}(A)) & \quad \text{if } p \geq .
\end{align*}
\]

When \( A \) is a matrix, returned is

\[
\begin{array}{c|c}
 p & \text{norm}(A, p) \\
\hline
 0 & \sqrt{\text{trace}((\text{conj}(A)^\prime A))} \\
 1 & \text{max}\left(\text{colsum(\text{abs}(A))}\right) \\
 2 & \text{max}\left(\text{svdsv}(A)\right) \\
 . & \text{max}\left(\text{rowsum(\text{abs}(A))}\right)
\end{array}
\]

## Syntax

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

## Remarks and examples

\( \text{norm}(A) \) and \( \text{norm}(A, p) \) 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 \( 1 \leq p < . \), the formula is applied to \( A:/\text{max}(\text{abs}(A)) \) and the result then multiplied by \( \text{max}(\text{abs}(A)) \). This prevents numerical overflow. A similar technique is used in calculating the matrix norm for \( p = 0 \), and that technique also avoids storage of \( \text{conj}(A)^\prime A \).
Conformability

\[
\text{\texttt{norm}(A):} \quad A: \quad r \times c \\
\text{\texttt{result:} } \quad 1 \times 1
\]

\[
\text{\texttt{norm}(A, p):} \\
A: \quad r \times c \\
p: \quad 1 \times 1 \\
\text{\texttt{result:} } \quad 1 \times 1
\]

Diagnostics

The \texttt{norm()} is defined to return 0 if \( A \) is void and missing if any element of \( A \) is missing. \texttt{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).

\texttt{norm}(A) and \texttt{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 \[M-5\] \texttt{svd(\)}.  

Also see

\[M-4\] Matrix — Matrix functions