

Operators

In this table:

- **A** and **B** represent arrays, either vector or matrix.
- **u** and **v** represent vectors with real or complex elements.
- **M** represents a square matrix.
- *z* and *w* represent real or complex numbers.
- *x* and *y* represent real numbers.
- *m* and *n* represent integers.
- *i* represents a range variable.
- *S* and any names beginning with *S* represent string expressions.
- *t* represents any variable name.
- *f* represents a function.
- *X* and *Y* represent variables or expressions of any type.

For information about programming operators in Mathcad Professional, see Chapter 15, “Programming.” For information about symbolic operators and keywords, see Chapter 14, “Symbolic Calculation.”

Operation	Appearance	Keystroke	Description
Parentheses	(X)	,	Grouping operator.
Vector Subscript	\mathbf{v}_n	[Returns indicated element of a vector.
Matrix Subscript	$\mathbf{A}_{m,n}$	[Returns indicated element of a matrix.
Superscript	$\mathbf{A}^{(n)}$	[Ctrl]6	Extracts column <i>n</i> from array A . Returns a vector.
Vectorize	\vec{X}	[Ctrl]–	Forces operations in expression <i>X</i> to take place element by element. All vectors or matrices in <i>X</i> must be the same size.
Factorial	$n!$!	Returns $n \cdot (n - 1) \cdot (n - 2) \dots$. The integer <i>n</i> cannot be negative.
Complex conjugate	\overline{X}	"	Inverts the sign of the imaginary part of <i>X</i> . This keystroke creates a string expression in a blank placeholder.
Transpose	\mathbf{A}^T	[Ctrl]1	Returns a matrix whose rows are the columns of A and whose columns are the rows of A . A can be a vector or a matrix.

Power	z^w	^	Raises z to the power w .
Powers of matrix, matrix inverse	\mathbf{M}^n	^	n th power of square matrix \mathbf{M} (using matrix multiplication). n must be a whole number. \mathbf{M}^{-1} is the inverse of \mathbf{M} . Other negative powers are powers of the inverse. Returns a square matrix.
Negation	$-X$	-	Multiplies X by -1 .
Vector sum	$\Sigma \mathbf{v}$	[Ctrl]4	Sums elements of vector \mathbf{v} ; returns a scalar.
Square root	\sqrt{z}	\	Returns positive square root for positive z ; principal value for negative or complex z .
nth root	$\sqrt[n]{z}$	[Ctrl]\	Returns n th root of z ; returns a real valued root whenever possible.
Magnitude, Absolute value	$ z $	 	Returns $\sqrt{\text{Re}(z)^2 + \text{Im}(z)^2}$.
Magnitude of vector	$ \mathbf{v} $	 	Returns the magnitude of the vector \mathbf{v} : $\sqrt{\mathbf{v} \cdot \mathbf{v}}$ if all elements in \mathbf{v} are real. Returns $\sqrt{\mathbf{v} \cdot \overline{\mathbf{v}}}$ if any element in \mathbf{v} is complex.
Determinant	$ \mathbf{M} $	 	Returns the determinant of the square matrix \mathbf{M} . Result is a scalar.
Division	$\frac{X}{z}$	/	Divides the expression X by the non-zero scalar z . If X is an array, divides each element by z .
Multiplication	$X \cdot Y$	*	Returns the product of X and Y if both X and Y are scalars. Multiplies each element of Y by X if Y is an array and X is a scalar. Returns the dot product (inner product) if X and Y are vectors of the same size. Performs matrix multiplication if X and Y are conformable matrices.
Cross product	$\mathbf{u} \times \mathbf{v}$	[Ctrl]8	Returns cross-product (vector product) for the three-element vectors \mathbf{u} and \mathbf{v} .
Summation	$\sum_{i=m}^n X$	[Ctrl] [Shift]4	Performs summation of X over $i = m, m+1, \dots, n$. X can be any expression. It need not involve i but it usually does. m and n must be integers.
Product	$\prod_{i=m}^n X$	[Ctrl] [Shift]3	Performs iterated product of X for $i = m, m+1, \dots, n$. X can be any expression. It need not involve i but it usually does. m and n must be integers.
Range sum	$\sum_i X$	\$	Returns a summation of X over the range variable i . X can be any expression.
Range product	$\prod_i X$	#	Returns the iterated product of X over the range variable i . X can be any expression.

Integral	$\int_a^b f(t) dt$	&	Returns the definite integral of $f(t)$ over the interval $[a, b]$. a and b must be real scalars. All variables in the expression $f(t)$, except the variable of integration t , must be defined. The integrand, $f(t)$, cannot return an array.
Derivative	$\frac{d}{dt}f(t)$?	Returns the derivative of $f(t)$ evaluated at t . All variables in the expression $f(t)$ must be defined. The variable t must be a scalar value. The function $f(t)$ must return a scalar.
nth Derivative	$\frac{d^n}{dt^n}f(t)$	[Ctrl]?	Returns the n th derivative of $f(t)$ evaluated at t . All variables in $f(t)$ must be defined. The variable t must be a scalar value. The function $f(t)$ must return a scalar. n must be an integer between 0 and 5 for numerical evaluation or a positive integer for symbolic evaluation.
Addition	$X + Y$	+	Scalar addition if X , Y , or both are scalars. Element by element addition if X and Y are vectors or matrices of the same size. If X is an array and Y is a scalar, adds Y to each element of X .
Subtraction	$X - Y$	-	Performs scalar subtraction if X , Y , or both are scalars. Performs element by element subtraction if X and Y are vectors or matrices of the same size. If X is an array and Y is a scalar, subtracts Y from each element of X .
Addition with line break	$X \dots$ $+ Y$	[Ctrl] [-]	Same as addition. Line break is purely cosmetic.
Greater than	$x > y$, $S1 > S2$	>	For real scalars x and y , returns 1 if $x > y$, 0 otherwise. For string expressions $S1$ and $S2$, returns 1 if $S1$ strictly follows $S2$ in ASCII order, 0 otherwise.
Less than	$x < y$, $S1 < S2$	<	For real scalars x and y , returns 1 if $x < y$, 0 otherwise. For string expressions $S1$ and $S2$, returns 1 if $S1$ strictly precedes $S2$ in ASCII order, 0 otherwise.
Greater than or equal	$x \geq y$, $S1 \geq S2$	[Ctrl] 0	For real scalars x and y , returns 1 if $x \geq y$, 0 otherwise. For string expressions $S1$ and $S2$, returns 1 if $S1$ follows $S2$ in ASCII order, 0 otherwise.
Less than or equal	$x \leq y$, $S1 \leq S2$	[Ctrl] 9	For real scalars x and y , returns 1 if $x \leq y$, 0 otherwise. For string expressions $S1$ and $S2$, returns 1 if $S1$ precedes $S2$ in ASCII order, 0 otherwise.
Not equal to	$z \neq w$, $S1 \neq S2$	[Ctrl] 3	For scalars z and w , returns 1 if $z \neq w$, 0 otherwise. For string expressions $S1$ and $S2$, returns 1 if $S1$ is not character by character identical to $S2$.
Equal to	$X = Y$	[Ctrl] =	Returns 1 if $X = Y$, 0 otherwise. Appears as a bold = on the screen.