

## Quick Reference

GENERAL	
<code>help</code>	help facility
<code>demo</code>	run demonstrations
<code>who</code>	list variables in memory
<code>what</code>	list M-files on disk
<code>size</code>	row and column dimensions
<code>length</code>	vector length
<code>clear</code>	clear workspace
<code>computer</code>	type of computer
<code>^C</code>	local abort
<code>exit</code>	exit MATLAB
<code>quit</code>	same as exit

MATRIX OPERATORS	ARRAY OPERATORS
<code>+</code> addition	<code>+</code> addition
<code>-</code> subtraction	<code>-</code> subtraction
<code>*</code> multiplication	<code>.*</code> multiplication
<code>/</code> right division	<code>./</code> right division
<code>\</code> left division	<code>.\</code> left division
<code>^</code> power	<code>.^</code> power
<code>'</code> conjugate transpose	<code>.'</code> transpose

RELATIONAL AND LOGICAL OPERATORS	
<code>&lt;</code> less than	<code>&amp;</code> and
<code>&lt;=</code> less than or equal	<code> </code> or
<code>&gt;</code> greater than	<code>~</code> not
<code>&gt;=</code> greater than or equal	
<code>==</code> equal	
<code>~=</code> not equal	

SPECIAL CHARACTERS	
=	assignment statement
[	used to form vectors and matrices
]	see [
(	arithmetic expression precedence
)	see (
.	decimal point
...	continue statement to next line
,	separate subscripts and function arguments
;	end rows, suppress printing
%	comments
:	subscripting, vector generation
!	execute operating system command

SPECIAL VALUES	
<b>ans</b>	answer when expression not assigned
<b>eps</b>	floating point precision
<b>pi</b>	$\pi$
<b>i, j</b>	$\sqrt{-1}$
<b>inf</b>	$\infty$
<b>NaN</b>	Not-a-Number
<b>clock</b>	wall clock
<b>date</b>	date
<b>flops</b>	floating point operation count
<b>nargin</b>	number of function input arguments
<b>nargout</b>	number of function output arguments

DISK FILES	
<b>chdir</b>	change current directory
<b>delete</b>	delete file
<b>diary</b>	diary of the session
<b>dir</b>	directory of files on disk
<b>load</b>	load variables from file
<b>save</b>	save variables to file
<b>type</b>	list function or file
<b>what</b>	show M-files on disk
<b>fprintf</b>	write to a file
<b>pack</b>	compact memory via <b>save</b>

SPECIAL MATRICES	
<code>compan</code>	companion
<code>diag</code>	diagonal
<code>eye</code>	identity
<code>gallery</code>	esoteric
<code>hadamard</code>	Hadamard
<code>hankel</code>	Hankel
<code>hilb</code>	Hilbert
<code>invhilb</code>	inverse Hilbert
<code>linspace</code>	linearly spaced vectors
<code>logspace</code>	logarithmically spaced vectors
<code>magic</code>	magic square
<code>meshdom</code>	domain for mesh points
<code>ones</code>	constant
<code>pascal</code>	Pascal
<code>rand</code>	random elements
<code>toeplitz</code>	Toeplitz
<code>vander</code>	Vandermonde
<code>zeros</code>	zero

MATRIX MANIPULATION	
<code>rot90</code>	rotation
<code>fliplr</code>	flip matrix left-to-right
<code>flipud</code>	flip matrix up-to-down
<code>diag</code>	diagonal matrices
<code>tril</code>	lower triangular part
<code>triu</code>	upper triangular part
<code>reshape</code>	reshape
<code>.'</code>	transpose
<code>:</code>	convert matrix to single column; <code>A(:)</code>

RELATIONAL AND LOGICAL FUNCTIONS	
<code>any</code>	logical conditions
<code>all</code>	logical conditions
<code>find</code>	find array indices of logical values
<code>isnan</code>	detect NaNs
<code>finite</code>	detect infinities
<code>isempty</code>	detect empty matrices
<code>isstr</code>	detect string variables
<code>strcmp</code>	compare string variables

CONTROL FLOW	
<code>if</code>	conditionally execute statements
<code>elseif</code>	used with <code>if</code>
<code>else</code>	used with <code>if</code>
<code>end</code>	terminate <code>if</code> , <code>for</code> , <code>while</code>
<code>for</code>	repeat statements a number of times
<code>while</code>	do while
<code>break</code>	break out of <code>for</code> and <code>while</code> loops
<code>return</code>	return from functions
<code>pause</code>	pause until key pressed

PROGRAMMING AND M-FILES	
<code>input</code>	get numbers from keyboard
<code>keyboard</code>	call keyboard as M-file
<code>error</code>	display error message
<code>function</code>	define function
<code>eval</code>	interpret text in variables
<code>feval</code>	evaluate function given by string
<code>echo</code>	enable command echoing
<code>exist</code>	check if variables exist
<code>casesen</code>	set case sensitivity
<code>global</code>	define global variables
<code>startup</code>	startup M-file
<code>getenv</code>	get environment string
<code>menu</code>	select item from menu
<code>etime</code>	elapsed time

TEXT AND STRINGS	
<code>abs</code>	convert string to ASCII values
<code>eval</code>	evaluate text macro
<code>num2str</code>	convert number to string
<code>int2str</code>	convert integer to string
<code>setstr</code>	set flag indicating matrix is a string
<code>sprintf</code>	convert number to string
<code>isstr</code>	detect string variables
<code>strcmp</code>	compare string variables
<code>hex2num</code>	convert hex string to number

COMMAND WINDOW	
<code>clc</code>	clear command screen
<code>home</code>	move cursor home
<code>format</code>	set output display format
<code>disp</code>	display matrix or text
<code>fprintf</code>	print formatted number
<code>echo</code>	enable command echoing

GRAPH PAPER	
<code>plot</code>	linear X-Y plot
<code>loglog</code>	loglog X-Y plot
<code>semilogx</code>	semi-log X-Y plot
<code>semilogy</code>	semi-log X-Y plot
<code>polar</code>	polar plot
<code>mesh</code>	3-dimensional mesh surface
<code>contour</code>	contour plot
<code>meshdom</code>	domain for mesh plots
<code>bar</code>	bar charts
<code>stairs</code>	stairstep graph
<code>errorbar</code>	add error bars

GRAPH ANNOTATION	
<code>title</code>	plot title
<code>xlabel</code>	x-axis label
<code>ylabel</code>	y-axis label
<code>grid</code>	draw grid lines
<code>text</code>	arbitrarily position text
<code>gtext</code>	mouse-positioned text
<code>ginput</code>	graphics input

GRAPH WINDOW CONTROL	
<code>axis</code>	manual axis scaling
<code>hold</code>	hold plot on screen
<code>shg</code>	show graph window
<code>clg</code>	clear graph window
<code>subplot</code>	split graph window

GRAPH WINDOW HARDCOPY	
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<code>print</code>	send graph to printer
<code>prtsc</code>	screen dump
<code>meta</code>	graphics metafile

ELEMENTARY MATH FUNCTIONS	
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<code>abs</code>	absolute value or complex magnitude
<code>angle</code>	phase angle
<code>sqrt</code>	square root
<code>real</code>	real part
<code>imag</code>	imaginary part
<code>conj</code>	complex conjugate
<code>round</code>	round to nearest integer
<code>fix</code>	round toward zero
<code>floor</code>	round toward $-\infty$
<code>ceil</code>	round toward $\infty$
<code>sign</code>	signum function
<code>rem</code>	remainder
<code>exp</code>	exponential base e
<code>log</code>	natural logarithm
<code>log10</code>	log base 10

TRIGONOMETRIC FUNCTIONS	
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<code>sin</code>	sine
<code>cos</code>	cosine
<code>tan</code>	tangent
<code>asin</code>	arcsine
<code>acos</code>	arccosine
<code>atan</code>	arctangent
<code>atan2</code>	four quadrant arctangent
<code>sinh</code>	hyperbolic sine
<code>cosh</code>	hyperbolic cosine
<code>tanh</code>	hyperbolic tangent
<code>asinh</code>	hyperbolic arcsine
<code>acosh</code>	hyperbolic arccosine
<code>atanh</code>	hyperbolic arctangent

SPECIAL FUNCTIONS	
<b>bessel</b>	bessel function
<b>gamma</b>	gamma function
<b>rat</b>	rational approximation
<b>erf</b>	error function
<b>inverf</b>	inverse error function
<b>ellipk</b>	complete elliptic integral of first kind
<b>ellipj</b>	Jacobian elliptic integral

DECOMPOSITIONS AND FACTORIZATIONS	
<b>balance</b>	balanced form
<b>backsub</b>	backsubstitution
<b>cdf2rdf</b>	convert complex-diagonal to real-diagonal
<b>chol</b>	Cholesky factorization
<b>eig</b>	eigenvalues and eigenvectors
<b>hess</b>	Hessenberg form
<b>inv</b>	inverse
<b>lu</b>	factors from Gaussian elimination
<b>npls</b>	nonnegative least squares
<b>null</b>	null space
<b>orth</b>	orthogonalization
<b>pinv</b>	pseudoinverse
<b>qr</b>	orthogonal-triangular decomposition
<b>qz</b>	QZ algorithm
<b>rref</b>	reduced row echelon form
<b>schur</b>	Schur decomposition
<b>svd</b>	singular value decomposition

MATRIX CONDITIONING	
<b>cond</b>	condition number in 2-norm
<b>norm</b>	1-norm,2-norm,F-norm, $\infty$ -norm
<b>rank</b>	rank
<b>rcond</b>	condition estimate (reciprocal)

ELEMENTARY MATRIX FUNCTIONS	
<code>expm</code>	matrix exponential
<code>logm</code>	matrix logarithm
<code>sqrtn</code>	matrix square root
<code>funm</code>	arbitrary matrix function
<code>poly</code>	characteristic polynomial
<code>det</code>	determinant
<code>trace</code>	trace
<code>kron</code>	Kronecker tensor product

POLYNOMIALS	
<code>poly</code>	characteristic polynomial
<code>roots</code>	polynomial roots—companion matrix method
<code>roots1</code>	polynomial roots—Laguerre’s method
<code>polyval</code>	polynomial evaluation
<code>polyvalm</code>	matrix polynomial evaluation
<code>conv</code>	multiplication
<code>deconv</code>	division
<code>residue</code>	partial-fraction expansion
<code>polyfit</code>	polynomial curve fitting

COLUMN-WISE DATA ANALYSIS	
<code>max</code>	maximum value
<code>min</code>	minimum value
<code>mean</code>	mean value
<code>median</code>	median value
<code>std</code>	standard deviation
<code>sort</code>	sorting
<code>sum</code>	sum of elements
<code>prod</code>	product of elements
<code>cumsum</code>	cumulative sum of elements
<code>cumprod</code>	cumulative product of elements
<code>diff</code>	approximate derivatives
<code>hist</code>	histograms
<code>corrcoef</code>	correlation coefficients
<code>cov</code>	covariance matrix
<code>cplxpair</code>	reorder into complex pairs

SIGNAL PROCESSING	
<b>abs</b>	complex magnitude
<b>angle</b>	phase angle
<b>conv</b>	convolution
<b>corrcoef</b>	correlation coefficients
<b>cov</b>	covariance
<b>dct</b>	discrete cosine transform
<b>decimate</b>	decimation
<b>deconv</b>	deconvolution
<b>fft</b>	radix-2 fast Fourier transform
<b>fft2</b>	two-dimensional FFT
<b>idct</b>	inverse DCT
<b>ifft</b>	inverse fast Fourier transform
<b>ifft2</b>	inverse 2-D FFT
<b>interp</b>	interpolation
<b>intfilt</b>	interpolation filters
<b>fftshift</b>	FFT rearrangement
<b>filter</b>	digital filtering
<b>firls</b>	least squares filter design
<b>freqz</b>	frequency response
<b>remez</b>	equiripple filter design
<b>sinc</b>	sinc function
<b>zplane</b>	pole-zero plot

NUMERICAL INTEGRATION	
<b>quad</b>	numerical function integration
<b>quad8</b>	numerical function integration

DIFFERENTIAL EQUATION SOLUTION	
<b>ode23</b>	2nd/3rd order Runge-Kutta method
<b>ode45</b>	4th/5th order Runge-Kutta-Fehlberg method

NONLINEAR EQUATIONS AND OPTIMIZATION	
<b>fmin</b>	minimum of a function of one variable
<b>fmins</b>	minimum of a multivariable function
<b>fsolve</b>	solution of a system of nonlinear equations (zeros of a multivariable function)
<b>fzero</b>	zero of a function of one variable