R for MATLAB users

Help

R/S-Plus	MATLAB/Octave	Description
`help.start()`	`doc` `help -i % browse with Info`	Browse help interactively
`help()`	`help help` *or* `doc doc`	Help on using help
`help(plot)` *or* `?plot`	`help plot`	Help for a function
`help(package='splines')`	`help splines` *or* `doc splines`	Help for a toolbox/library package
`demo()`	`demo`	Demonstration examples
`example(plot)`		Example using a function

Searching available documentation

R/S-Plus	MATLAB/Octave	Description
`help.search('plot')`	`lookfor plot`	Search help files
`apropos('plot')`		Find objects by partial name
`library()`	`help`	List available packages
`find(plot)`	`which plot`	Locate functions
`methods(plot)`		List available methods for a function

Using interactively

R/S-Plus	MATLAB/Octave	Description
`Rgui`	`octave -q`	Start session
`source('foo.R')`	`foo(.m)`	Run code from file
`history()`	`history`	Command history
`savehistory(file=".Rhistory")`	`diary on [..] diary off`	Save command history
`q(save='no')`	`exit` *or* `quit`	End session

Operators

R/S-Plus	MATLAB/Octave	Description
`help(Syntax)`	`help -`	Help on operator syntax

Arithmetic operators

R/S-Plus	MATLAB/Octave	Description
`a<-1; b<-2`	`a=1; b=2;`	Assignment; defining a number
`a + b`	`a + b`	Addition
`a - b`	`a - b`	Subtraction
`a * b`	`a * b`	Multiplication
`a / b`	`a / b`	Division
`a ^ b`	`a .^ b`	Power, a^b
`a %% b`	`rem(a,b)`	Remainder
`a %/% b`		Integer division
`factorial(a)`	`factorial(a)`	Factorial, $n!$

Relational operators

R/S-Plus	MATLAB/Octave	Description
`a == b`	`a == b`	Equal
`a < b`	`a < b`	Less than
`a > b`	`a > b`	Greater than
`a <= b`	`a <= b`	Less than or equal
`a >= b`	`a >= b`	Greater than or equal
`a != b`	`a ~= b`	Not Equal

Logical operators

R/S-Plus	MATLAB/Octave	Description
`a && b`	`a && b`	Short-circuit logical AND

`a || b`	`a || b`	Short-circuit logical OR
`a & b`	`a & b` *or* `and(a,b)`	Element-wise logical AND
`a | b`	`a | b` *or* `or(a,b)`	Element-wise logical OR
`xor(a, b)`	`xor(a, b)`	Logical EXCLUSIVE OR
`!a`	`~a` *or* `not(a)`	Logical NOT
	`~a` *or* `!a`	
	`any(a)`	True if any element is nonzero
	`all(a)`	True if all elements are nonzero

root and logarithm

R/S-Plus	**MATLAB/Octave**	**Description**
`sqrt(a)`	`sqrt(a)`	Square root
`log(a)`	`log(a)`	Logarithm, base e (natural)
`log10(a)`	`log10(a)`	Logarithm, base 10
`log2(a)`	`log2(a)`	Logarithm, base 2 (binary)
`exp(a)`	`exp(a)`	Exponential function

Round off

R/S-Plus	**MATLAB/Octave**	**Description**
`round(a)`	`round(a)`	Round
`ceil(a)`	`ceil(a)`	Round up
`floor(a)`	`floor(a)`	Round down
	`fix(a)`	Round towards zero

Mathematical constants

R/S-Plus	**MATLAB/Octave**	**Description**
`pi`	`pi`	$\pi=3.141592$
`exp(1)`	`exp(1)`	$e=2.718281$

Missing values; IEEE-754 floating point status flags

R/S-Plus	MATLAB/Octave	Description
	`NaN`	Not a Number
	`Inf`	Infinity, ∞

Complex numbers

R/S-Plus	MATLAB/Octave	Description
`1i`	`i`	Imaginary unit
`z <- 3+4i`	`z = 3+4i`	A complex number, $3+4i$
`abs(3+4i)` *or* `Mod(3+4i)`	`abs(z)`	Absolute value (modulus)
`Re(3+4i)`	`real(z)`	Real part
`Im(3+4i)`	`imag(z)`	Imaginary part
`Arg(3+4i)`	`arg(z)`	Argument
`Conj(3+4i)`	`conj(z)`	Complex conjugate

Trigonometry

R/S-Plus	MATLAB/Octave	Description
`atan2(b,a)`	`atan(a,b)`	Arctangent, $\arctan(b/a)$

Generate random numbers

R/S-Plus	MATLAB/Octave	Description
`runif(10)`	`rand(1,10)`	Uniform distribution
`runif(10, min=2, max=7)`	`2+5*rand(1,10)`	Uniform: Numbers between 2 and 7
`matrix(runif(36),6)`	`rand(6)`	Uniform: 6,6 array
`rnorm(10)`	`randn(1,10)`	Normal distribution

Vectors

R/S-Plus	MATLAB/Octave	Description
`a <- c(2,3,4,5)`	`a=[2 3 4 5];`	Row vector, $1 \times n$-matrix
`adash <- t(c(2,3,4,5))`	`adash=[2 3 4 5]';`	Column vector, $m \times 1$-matrix

Sequences

R/S-Plus	MATLAB/Octave	Description
`seq(10)` *or* `1:10`	`1:10`	1,2,3, ... ,10
`seq(0,length=10)`	`0:9`	0.0,1.0,2.0, ... ,9.0
`seq(1,10,by=3)`	`1:3:10`	1,4,7,10
`seq(10,1)` *or* `10:1`	`10:-1:1`	10,9,8, ... ,1
`seq(from=10,to=1,by=-3)`	`10:-3:1`	10,7,4,1
`seq(1,10,length=7)`	`linspace(1,10,7)`	Linearly spaced vector of n=7 points
`rev(a)`	`reverse(a)`	Reverse
	`a(:) = 3`	Set all values to same scalar value

Concatenation (vectors)

R/S-Plus	MATLAB/Octave	Description
`c(a,a)`	`[a a]`	Concatenate two vectors
`c(1:4,a)`	`[1:4 a]`	

Repeating

R/S-Plus	MATLAB/Octave	Description
`rep(a,times=2)`	`[a a]`	1 2 3, 1 2 3
`rep(a,each=3)`		1 1 1, 2 2 2, 3 3 3
`rep(a,a)`		1, 2 2, 3 3 3

Miss those elements out

R/S-Plus	MATLAB/Octave	Description
`a[-1]`	`a(2:end)`	miss the first element
`a[-10]`	`a([1:9])`	miss the tenth element
`a[-seq(1,50,3)]`		miss 1,4,7, ...
	`a(end)`	last element
	`a(end-1:end)`	last two elements

Maximum and minimum

R/S-Plus	MATLAB/Octave	Description
`pmax(a,b)`	`max(a,b)`	pairwise max
`max(a,b)`	`max([a b])`	max of all values in two vectors
`v <- max(a) ; i <- which.max(a)`	`[v,i] = max(a)`	

Vector multiplication

R/S-Plus	MATLAB/Octave	Description
`a*a`	`a.*a`	Multiply two vectors
	`dot(u,v)`	Vector dot product, $u \cdot v$

Matrices

R/S-Plus	MATLAB/Octave	Description
`rbind(c(2,3),c(4,5))` `array(c(2,3,4,5), dim=c(2,2))`	`a = [2 3;4 5]`	Define a matrix

Concatenation (matrices); rbind and cbind

R/S-Plus	MATLAB/Octave	Description
`rbind(a,b)`	`[a ; b]`	Bind rows
`cbind(a,b)`	`[a , b]`	Bind columns
	`[a(:), b(:)]`	Concatenate matrices into one vector
`rbind(1:4,1:4)`	`[1:4 ; 1:4]`	Bind rows (from vectors)
`cbind(1:4,1:4)`	`[1:4 ; 1:4]'`	Bind columns (from vectors)

Array creation

R/S-Plus	MATLAB/Octave	Description
`matrix(0,3,5)` *or* `array(0,c(3,5))`	`zeros(3,5)`	0 filled array
`matrix(1,3,5)` *or* `array(1,c(3,5))`	`ones(3,5)`	1 filled array

`matrix(9,3,5)` *or* `array(9,c(3,5))`	`ones(3,5)*9`	Any number filled array
`diag(1,3)`	`eye(3)`	Identity matrix
`diag(c(4,5,6))`	`diag([4 5 6])`	Diagonal
	`magic(3)`	Magic squares; Lo Shu

Reshape and flatten matrices

R/S-Plus	MATLAB/Octave	Description
`matrix(1:6,nrow=3,byrow=T)`	`reshape(1:6,3,2)';`	Reshaping (rows first)
`matrix(1:6,nrow=2)` `array(1:6,c(2,3))`	`reshape(1:6,2,3);`	Reshaping (columns first)
`as.vector(t(a))`	`a'(:)`	Flatten to vector (by rows, like comics)
`as.vector(a)`	`a(:)`	Flatten to vector (by columns)
`a[row(a) <= col(a)]`	`vech(a)`	Flatten upper triangle (by columns)

Shared data (slicing)

R/S-Plus	MATLAB/Octave	Description
`b = a`	`b = a`	Copy of a

Indexing and accessing elements (Python: slicing)

R/S-Plus	MATLAB/Octave	Description

`a <- rbind(c(11, 12, 13, 14),`
`c(21, 22, 23, 24),`
`c(31, 32, 33, 34))`
	`a = [ 11 12 13 14 ...`
	`21 22 23 24 ...`
	`31 32 33 34 ]`
		Input is a 3,4 array

`a[2,3]`	`a(2,3)`	Element 2,3 (row,col)
`a[1,]`	`a(1,:)`	First row
`a[,1]`	`a(:,1)`	First column
	`a([1 3],[1 4]);`	Array as indices
`a[-1,]`	`a(2:end,:)`	All, except first row
	`a(end-1:end,:)`	Last two rows
	`a(1:2:end,:)`	Strides: Every other row

`a[-2,-3]`		All, except row,column (2,3)
`a[,-2]`	`a(:,[1 3 4])`	Remove one column

Assignment

R/S-Plus	MATLAB/Octave	Description
`a[,1] <- 99`	`a(:,1) = 99`	
`a[,1] <- c(99,98,97)`	`a(:,1) = [99 98 97]'`	
`a[a>90] <- 90`	`a(a>90) = 90;`	Clipping: Replace all elements over 90

Transpose and inverse

R/S-Plus	MATLAB/Octave	Description
`t(a)`	`a'`	Transpose
	`a.'` *or* `transpose(a)`	Non-conjugate transpose
`det(a)`	`det(a)`	Determinant
`solve(a)`	`inv(a)`	Inverse
`ginv(a)`	`pinv(a)`	Pseudo-inverse
	`norm(a)`	Norms
`eigen(a)$values`	`eig(a)`	Eigenvalues
`svd(a)$d`	`svd(a)`	Singular values
	`chol(a)`	Cholesky factorization
`eigen(a)$vectors`	`[v,l] = eig(a)`	Eigenvectors
`rank(a)`	`rank(a)`	Rank

Sum

R/S-Plus	MATLAB/Octave	Description
`apply(a,2,sum)`	`sum(a)`	Sum of each column
`apply(a,1,sum)`	`sum(a')`	Sum of each row
`sum(a)`	`sum(sum(a))`	Sum of all elements
`apply(a,2,cumsum)`	`cumsum(a)`	Cumulative sum (columns)

Sorting

R/S-Plus	MATLAB/Octave	Description
	`a = [ 4 3 2 ; 2 8 6 ; 1 4 7 ]`	Example data
`t(sort(a))`	`sort(a(:))`	Flat and sorted
`apply(a,2,sort)`	`sort(a)`	Sort each column
`t(apply(a,1,sort))`	`sort(a')'`	Sort each row
	`sortrows(a,1)`	Sort rows (by first row)
`order(a)`		Sort, return indices

Maximum and minimum

R/S-Plus	MATLAB/Octave	Description
`apply(a,2,max)`	`max(a)`	max in each column
`apply(a,1,max)`	`max(a')`	max in each row
`max(a)`	`max(max(a))`	max in array
`i <- apply(a,1,which.max)`	`[v i] = max(a)`	return indices, i
`pmax(b,c)`	`max(b,c)`	pairwise max
`apply(a,2,cummax)`	`cummax(a)`	

Matrix manipulation

R/S-Plus	MATLAB/Octave	Description
`a[,4:1]`	`fliplr(a)`	Flip left-right
`a[3:1,]`	`flipud(a)`	Flip up-down
	`rot90(a)`	Rotate 90 degrees
`kronecker(matrix(1,2,3),a)`	`repmat(a,2,3)` `kron(ones(2,3),a)`	Repeat matrix: [a a a ; a a a]
`a[lower.tri(a)] <- 0`	`triu(a)`	Triangular, upper
`a[upper.tri(a)] <- 0`	`tril(a)`	Triangular, lower

Equivalents to "size"

R/S-Plus	MATLAB/Octave	Description
`dim(a)`	`size(a)`	Matrix dimensions
`ncol(a)`	`size(a,2)` *or* `length(a)`	Number of columns
`prod(dim(a))`	`length(a(:))`	Number of elements
	`ndims(a)`	Number of dimensions
`object.size(a)`		Number of bytes used in memory

Matrix- and elementwise- multiplication

R/S-Plus	MATLAB/Octave	Description
`a * b`	`a .* b`	Elementwise operations
`a %*% b`	`a * b`	Matrix product (dot product)
`outer(a,b)` *or* `a %o% b`		Outer product
`crossprod(a,b)` *or* `t(a) %*% b`		Cross product
`kronecker(a,b)`	`kron(a,b)`	Kronecker product
	`a / b`	Matrix division, $b{\cdot}a^{-1}$
`solve(a,b)`	`a \ b`	Left matrix division, $b^{-1}{\cdot}a$ \newline (solve linear equations)

Find; conditional indexing

R/S-Plus	MATLAB/Octave	Description
`which(a != 0)`	`find(a)`	Non-zero elements, indices
`which(a != 0, arr.ind=T)`	`[i j] = find(a)`	Non-zero elements, array indices
`ij <- which(a != 0, arr.ind=T); v <- a[ij]`	`[i j v] = find(a)`	Vector of non-zero values
`which(a>5.5)`	`find(a>5.5)`	Condition, indices
`ij <- which(a>5.5, arr.ind=T); v <- a[ij]`		Return values
	`a .* (a>5.5)`	Zero out elements above 5.5

Multi-way arrays

R/S-Plus	MATLAB/Octave	Description
	`a = cat(3, [1 2; 1 2],[3 4; 3 4]);` `a(1,:,:)`	Define a 3-way array

File input and output

R/S-Plus	MATLAB/Octave	Description
`f <- read.table("data.txt")`	`f = load('data.txt')`	Reading from a file (2d)
`f <- read.table("data.txt")`	`f = load('data.txt')`	Reading from a file (2d)
`f <- read.table(file="data.csv", sep=";")`	`x = dlmread('data.csv', ';')`	Reading fram a CSV file (2d)
`write(f,file="data.txt")`	`save -ascii data.txt f`	Writing to a file (2d)

Plotting

Basic x-y plots

R/S-Plus	MATLAB/Octave	Description
`plot(a, type="l")`	`plot(a)`	1d line plot
`plot(x[,1],x[,2])`	`plot(x(:,1),x(:,2),'o')`	2d scatter plot
	`plot(x1,y1, x2,y2)`	Two graphs in one plot

`plot(x1,y1)`
`matplot(x2,y2,add=T)`
	`plot(x1,y1)`
	`hold on`
	`plot(x2,y2)`
		Overplotting: Add new plots to current

	`subplot(211)`	subplots
`plot(x,y,type="b",col="red")`	`plot(x,y,'ro-')`	Plotting symbols and color

Axes and titles

R/S-Plus	MATLAB/Octave	Description
`grid()`	`grid on`	Turn on grid lines

`plot(c(1:10,10:1), asp=1)`	`axis equal`
	`axis('equal')`
	`replot`
		1:1 aspect ratio

`plot(x,y, xlim=c(0,10), ylim=c(0,5))`	`axis([ 0 10 0 5 ])`	Set axes manually

`plot(1:10, main="title", xlab="x-axis", ylab="y-axis")`	`title('title')`
	`xlabel('x-axis')`
	`ylabel('y-axis')`
		Axis labels and titles

Log plots

R/S-Plus	MATLAB/Octave	Description
`plot(x,y, log="y")`	`semilogy(a)`	logarithmic y-axis
`plot(x,y, log="x")`	`semilogx(a)`	logarithmic x-axis
`plot(x,y, log="xy")`	`loglog(a)`	logarithmic x and y axes

Filled plots and bar plots

R/S-Plus	MATLAB/Octave	Description

`plot(t,s, type="n", xlab="", ylab="")`
`polygon(t,s, col="lightblue")`
`polygon(t,c, col="lightgreen")`
	`fill(t,s,'b', t,c,'g')`
	`% fill has a bug?`
		Filled plot

`stem(x[,3])`		Stem-and-Leaf plot

Functions

R/S-Plus	MATLAB/Octave	Description
`f <- function(x) sin(x/3) - cos(x/5)`	`f = inline('sin(x/3) - cos(x/5)')`	Defining functions

`plot(f, xlim=c(0,40), type='p')`	`ezplot(f,[0,40])`
	`fplot('sin(x/3) - cos(x/5)',[0,40])`
	`% no ezplot`
		Plot a function for given range

Polar plots

R/S-Plus	MATLAB/Octave	Description

	`theta = 0:.001:2*pi;`
	`r = sin(2*theta);`
	`polar(theta, rho)`	

Histogram plots

R/S-Plus	MATLAB/Octave	Description
`hist(rnorm(1000))`	`hist(randn(1000,1))`	
`hist(rnorm(1000), breaks= -4:4)`	`hist(randn(1000,1), -4:4)`	
`hist(rnorm(1000), breaks=c(seq(-5,0,0.25), seq(0.5,5,0.5)), freq=F)`		
`plot(apply(a,1,sort),type="l")`	`plot(sort(a))`	

3d data

Contour and image plots

R/S-Plus	MATLAB/Octave	Description
`contour(z)`	`contour(z)`	Contour plot
`filled.contour(x,y,z, nlevels=7, color=gray.colors)`	`contourf(z); colormap(gray)`	Filled contour plot
`image(z, col=gray.colors(256))`	`image(z)` `colormap(gray)`	Plot image data
	`quiver()`	Direction field vectors

Perspective plots of surfaces over the x-y plane

R/S-Plus	MATLAB/Octave	Description
`f <- function(x,y) x*exp(-x^2-y^2)` `n <- seq(-2,2, length=40)` `z <- outer(n,n,f)`	`n=-2:.1:2;` `[x,y] = meshgrid(n,n);` `z=x.*exp(-x.^2-y.^2);`	
`persp(x,y,z, theta=30, phi=30, expand=0.6, ticktype='detailed')`	`mesh(z)`	Mesh plot
`persp(x,y,z, theta=30, phi=30, expand=0.6, col='lightblue', shade=0.75,`	`surf(x,y,z)` *or* `surfl(x,y,z)` `% no surfl()`	Surface plot

```
ltheta=120,
ticktype='detailed')
```

Scatter (cloud) plots

R/S-Plus	MATLAB/Octave	Description
`cloud(z~x*y)`	`plot3(x,y,z,'k+')`	3d scatter plot

Save plot to a graphics file

R/S-Plus	MATLAB/Octave	Description

`postscript(file="foo.eps")`
`plot(1:10)`
`dev.off()`
	`plot(1:10)`
	`print -depsc2 foo.eps`
	`gset output "foo.eps"`
	`gset terminal postscript eps`
	`plot(1:10)`
		PostScript

`pdf(file='foo.pdf')`		PDF
`devSVG(file='foo.svg')`		SVG (vector graphics for www)
`png(filename = "Rplot%03d.png"`	`print -dpng foo.png`	PNG (raster graphics)

Data analysis

Set membership operators

R/S-Plus	MATLAB/Octave	Description
`a <- c(1,2,2,5,2)` `b <- c(2,3,4)`	`a = [ 1 2 2 5 2 ];` `b = [ 2 3 4 ];`	Create sets
`unique(a)`	`unique(a)`	Set unique
`union(a,b)`	`union(a,b)`	Set union
`intersect(a,b)`	`intersect(a,b)`	Set intersection
`setdiff(a,b)`	`setdiff(a,b)`	Set difference
`setdiff(union(a,b),intersect(a,b))`	`setxor(a,b)`	Set exclusion
`is.element(2,a)` *or* `2 %in% a`	`ismember(2,a)`	True for set member

Statistics

R/S-Plus	MATLAB/Octave	Description
`apply(a,2,mean)`	`mean(a)`	Average
`apply(a,2,median)`	`median(a)`	Median
`apply(a,2,sd)`	`std(a)`	Standard deviation
`apply(a,2,var)`	`var(a)`	Variance
`cor(x,y)`	`corr(x,y)`	Correlation coefficient
`cov(x,y)`	`cov(x,y)`	Covariance

Interpolation and regression

R/S-Plus	MATLAB/Octave	Description

`z <- lm(y~x)`
`plot(x,y)`
`abline(z)`
	`z = polyval(polyfit(x,y,1),x)`
	`plot(x,y,'o', x,z ,'-')`
		Straight line fit

`solve(a,b)`	`a = x\y`	Linear least squares $y = ax + b$
	`polyfit(x,y,3)`	Polynomial fit

Non-linear methods

Polynomials, root finding

R/S-Plus	MATLAB/Octave	Description
`polyroot(c(1,-1,-1))`	`roots([1 -1 -1])`	Find zeros of polynomial
	`f = inline('1/x - (x-1)')` `fzero(f,1)`	Find a zero near $x = 1$
	`solve('1/x = x-1')`	Solve symbolic equations
	`polyval([1 2 1 2],1:10)`	Evaluate polynomial

Differential equations

R/S-Plus	MATLAB/Octave	Description

	`diff(a)`	Discrete difference function and approximate derivative
		Solve differential equations

Fourier analysis

R/S-Plus	MATLAB/Octave	Description
`fft(a)`	`fft(a)`	Fast fourier transform
`fft(a, inverse=TRUE)`	`ifft(a)`	Inverse fourier transform

Symbolic algebra; calculus

R/S-Plus	MATLAB/Octave	Description
	`factor()`	Factorization

Programming

R/S-Plus	MATLAB/Octave	Description
`.R`	`.m`	Script file extension
`#`	`%` `% or #`	Comment symbol (rest of line)
`library(RSvgDevice)`	`% must be in MATLABPATH` `% must be in LOADPATH`	Import library functions
`string <- "a <- 234"` `eval(parse(text=string))`	`string='a=234';` `eval(string)`	Eval

Loops

R/S-Plus	MATLAB/Octave	Description
`for(i in 1:5) print(i)`	`for i=1:5; disp(i); end`	for-statement

`for(i in 1:5) {`
`print(i)`
`print(i*2)`
`}`
	`for i=1:5`
	`disp(i)`
	`disp(i*2)`
	`end`
		Multiline for statements

Conditionals

R/S-Plus	MATLAB/Octave	Description
`if (1>0) a <- 100`	`if 1>0 a=100; end`	if-statement
	`if 1>0 a=100; else a=0; end`	if-else-statement
`ifelse(a>0,a,0)`		Ternary operator (if?true:false)

Debugging

R/S-Plus	MATLAB/Octave	Description
`.Last.value`	`ans`	Most recent evaluated expression
`objects()`	`whos` *or* `who`	List variables loaded into memory
`rm(x)`	`clear x` *or* `clear [all]`	Clear variable x from memory
`print(a)`	`disp(a)`	Print

Working directory and OS

R/S-Plus	MATLAB/Octave	Description
`list.files()` *or* `dir()`	`dir` *or* `ls`	List files in directory
`list.files(pattern="\.r$")`	`what`	List script files in directory
`getwd()`	`pwd`	Displays the current working directory
`setwd('foo')`	`cd foo`	Change working directory
`system("notepad")`	`!notepad` `system("notepad")`	Invoke a System Command