R for MATLAB users

Help

R/S-Plus	MATLAB/Octave	Description
help.start()	doc	Browse help interactively
	help -i % browse with Info	
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
<pre>savehistory(file=".Rhistory")</pre>	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	Addition
a - b	Subtraction
a * b	Multiplication
a / b	Division
a .^ b	Power, \$a^b\$
rem(a,b)	Remainder
	Integer division
factorial(a)	Factorial, \$n!\$
	<pre>a - b a * b a / b a .^ b rem(a,b)</pre>

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 <i>OT</i> not(a)	Logical NOT
	~a <i>Or</i> !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, \$\infty\$

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) <i>Or</i> 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
<pre>runif(10, min=2, max=7)</pre>	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		
a <- c(2,3,4,5)		
adash <- $t(c(2,3,4,5))$		

MATLAB/Octave							
a=[2	3	4	5] ;			
adash	1=	2	3	4	5]'	;	

Description Row vector, \$1 \times n\$-matrix Column vector, \$m \times 1\$-matrix

Sequences

R/S-Plus	MATLAB/Octave	Description
seq(10) <i>OT</i> 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) <i>Or</i> 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)				<pre>max([a b])</pre>
v <- max(a)	;	i	<- which.max(a)	[v,i] = max(a)

max of all values in two vectors

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))	a = [2 3;4 5]	Define a matrix
array(c(2,3,4,5), dim=c(2,2))		

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) <i>Or</i> 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) <i>Or</i> 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
<pre>matrix(1:6,nrow=3,byrow=T)</pre>	reshape(1:6,3,2)';	Reshaping (rows first)
matrix(1:6,nrow=2)	reshape(1:6,2,3);	Reshaping (columns first)
array(1:6,c(2,3))		
as.vector(t(a))	a'(:)	Flatten to vector (by rows, like comics)
as.vector(a)	a(:)	Flatten to vector (by columns)

 $a[row(a) \le col(a)]$

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),	a = [11 12 13 14	Input is a 3,4 array
c(21, 22, 23, 24),	21 22 23 24	
c(31, 32, 33, 34))	31 32 33 34]	
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.' <i>OT</i> 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)	<pre>max(max(a))</pre>	max in array
<pre>i <- apply(a,1,which.max)</pre>	[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
<pre>kronecker(matrix(1,2,3),a)</pre>	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
a[apper.err(a/] <- 0	CIII (a)	Transalar, 10 Wei

Equivalents to "size"

R/S-Plus	MATLAB/Octave	Description
dim(a)	size(a)	Matrix dimensions
ncol(a)	size(a,2) <i>Or</i> length(a)	Number of columns
<pre>prod(dim(a))</pre>	<pre>length(a(:))</pre>	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 %0% b		Outer product
crossprod(a,b) OTt(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
<pre>ij <- which(a != 0, arr.ind=T); v <- a[ij]</pre>	<pre>[i j v] = find(a)</pre>	Vector of non-zero values
which(a>5.5)	find(a>5.5)	Condition, indices
<pre>ij <- which(a>5.5, arr.ind=T); v <- a[ij]</pre>		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	Define a 3-way array	
	4]);		
	a(1,:,:)		

File input and output

R/S-Plus	MATLAB/Octave	Description
f <- read.table("data.txt")	<pre>f = load('data.txt')</pre>	Reading from a file (2d)
f <- read.table("data.txt")	f = load('data.txt')	Reading from 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)	plot(x1,y1)	Overplotting: Add new plots to
<pre>matplot(x2,y2,add=T)</pre>	hold on	current
	plot(x2,y2)	
	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	1:1 aspect ratio
	axis('equal')	
	replot	
plot(x,y, xlim=c(0,10), ylim=c(0,5))	axis([0 10 0 5])	Set axes manually
plot(1:10, main="title",	title('title')	Axis labels and titles
<pre>xlab="x-axis", ylab="y-axis")</pre>	<pre>xlabel('x-axis')</pre>	
	<pre>ylabel('y-axis')</pre>	

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="",	fill(t,s,'b', t,c,'g')	Filled plot
ylab="")	% fill has a bug?	
<pre>polygon(t,s, col="lightblue")</pre>		
<pre>polygon(t,c, col="lightgreen")</pre>		

stem(x[,3])

Stem-and-Leaf plot

Functions

R/S-Plus	MATLAB/Octave	Description
$f \leftarrow function(x) sin(x/3) -$	f = inline('sin(x/3) - cos(x/5)')	Defining functions
cos(x/5)		
<pre>plot(f, xlim=c(0,40), type='p')</pre>	ezplot(f,[0,40])	Plot a function for given range
	fplot('sin(x/3) -	
	cos(x/5)',[0,40])	
	% no explot	

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)		
<pre>plot(apply(a,1,sort),type="l")</pre>	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,	<pre>contourf(z); colormap(gray)</pre>	Filled contour plot
<pre>nlevels=7, color=gray.colors)</pre>		
<pre>image(z, col=gray.colors(256))</pre>	<pre>image(z) colormap(gray)</pre>	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)</pre>
                                 n=-2:.1:2;
x*exp(-x^2-y^2)
                                  [x,y] = meshgrid(n,n);
n \leftarrow seq(-2,2, length=40)
                                  z=x.*exp(-x.^2-y.^2);
z <- outer(n,n,f)</pre>
                                                                       Mesh plot
persp(x,y,z,
                                   mesh(z)
theta=30, phi=30, expand=0.6,
ticktype='detailed')
                                                                       Surface plot
                                   surf(x,y,z) Or surfl(x,y,z)
persp(x,y,z,
theta=30, phi=30, expand=0.6,
                                 % no surfl()
col='lightblue', shade=0.75,
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
<pre>postscript(file="foo.eps")</pre>	plot(1:10)	PostScript
plot(1:10)	print -depsc2 foo.eps	
<pre>dev.off()</pre>	gset output "foo.eps"	
	gset terminal postscript eps	
	plot(1:10)	
pdf(file='foo.pdf')		PDF
<pre>devSVG(file='foo.svg')</pre>		SVG (vector graphics for www)
<pre>png(filename = "Rplot%03d.png"</pre>	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)	a = [1 2 2 5 2];	Create sets
b <- c(2,3,4)	b = [2 3 4];	
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) <i>Or</i> 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)	<pre>z = polyval(polyfit(x,y,1),x)</pre>	Straight line fit
plot(x,y)	plot(x,y,'o', x,z ,'-')	
abline(z)		
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)')	Find a zero near $x = 1$
	fzero(f,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	MA 1 LAB/Octave	Description
	factor()	Factorization

Programming

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

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) {	for i=1:5	Multiline for statements
<pre>print(i)</pre>	disp(i)	
print(i*2)	disp(i*2)	
}	end	

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() $or dir()$	$\dim \mathit{or}$ 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
<pre>system("notepad")</pre>	<pre>!notepad system("notepad")</pre>	Invoke a System Command

Time-stamp: "2007-06-15T17:27:54 vidar"

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