R Basic Reference Card

`?topic` documentation on `topic`

`help.search("topic")` search the help system

`apropos("topic")` all objects matching the reg. exp. ”topic”

`ls()` list all objects; `pat="pat"` to search on a pattern

Input and output

`source("my.R")` includes and executes my.R in this place

`data(f)` loads specified data sets

`install.package()`

`library(s)` load add-on packages

`read.table(f)` reads a file into data frame; `sep=""` for value separator; `header=TRUE` names on the first line; `as.is=TRUE` prevent string to factor conversion

`read.csv(f,header=TRUE)` same, for comma-delimited files

`read.delim(f",header=TRUE)` same, for tab-delimited files

`read.fwf(f,widths,header=FALSE,sep=""",as.is=FALSE)` for *f*ixed *w*idth *f*ormatted data

`save(f,...)` saves the specified objects (...) in the XDR format

`save.image(f)` saves all objects

`load(f)` load the datasets written with `save`

`print(a, ...)` prints its arguments; *generic* function

`format(x,...)` format an R object for pretty printing

`write.table(x, file=f,row.names=TRUE, col.names=TRUE, sep=" ")` convert `x` to data frame and output to `f`; see params: `quote`, `sep`, `eol`, `na`, `col.names=NA`

`sink(f)` output to `f`, until `sink()`

Exchange tables with other apps. (Excel) via clipboard:

```
df <- read.table("clipboard")
write.table(df,"clipboard",sep="\t",col.names=NA)
```

Data creation

`c(...)` combine arguments to vector, *generic*, see param `recursive`

`from:to` generates a sequence;`2:5` returns `[1] 2 3 4 5`

`seq(from,to)` generates a sequence, `by=` set step; `length=` set length

`seq(along=x)` generates `1, 2, ..., length(x)`; useful for loops

`rep(x,n)` replicate `x` `n`-times (abcabc); `each=` to get (aabbcc)

`data.frame(...)` data frame from the list of vector parameters; `data.frame(v=1:6,ch=c("a","B"))`; recycle shorter vectors

`list(...)` create a list of the named or unnamed arguments; `list(a=c(1,2),b="hi",c=3i)`;

`array(x,dim=)` array with data `x`; specify dimensions like `dim=c(3,4,2)`; elements of `x` recycle if `x` is not long enough

`matrix(x,nrow=,ncol=)` matrix; elements of `x` recycle

`outer(x,y, FUN(x,y) )` create matrix by tensor product

`factor(x,levels=)` encodes a vector `x` as a factor

`gl(n,k,length=n*k,labels=1:n)` factor with `n` labels *k*-times each

`expand.grid()` data frame of all combinations of given lists

`cbind(df1, df2)`, `rbind(df1,df2)` combine arguments by columns/rows for matrix-like objects

Object operations

`rm(myvar)` removes object `myvar` from memory

`rm(list = ls(all = TRUE))` removes all objects from memory

`class(X)` class of object `X` (get type of data)

`as.array(x), as.data.frame(x), as.numeric(x), ...` convert type; `methods(as)` shows a complete list

`is.na(x), is.null(x), is.array(x), is.numeric(x), ...` test for type; `methods(is)`

`summary(a)` gives a “summary” of `a`, *generic* function

`length(x)` number of elements in `x`

`dim(x)` get or set the dimension of an object; `dim(x) <- c(3,2)`

`dimnames(x)` get or set the dimension names of an object

`nrow(x)`, `ncol(x)` number of rows/cols of matrix (cf. `NROW`, `NCOL`)

addressing vectors

`v[n]`	`n`th element
`v[-n]`	all *but* the `n`th element
`v[1:n]`	first `n` elements
`v[-(1:n)]`	elements from `n+1` to the end
`v[c(1,4,2)]`	specific elements
`v["name"]`	element named `"name"`
`v[v > 3 & v < 5]`	all elements between 3 and 5
`v[v %in% set]`	elements in vector `set`

addressing lists

`x[n]` or `x[[n]]`	`n`th element of the list
`x[["name"]]` or `x$name`	element of the list named `"name"`

addressing matrices and dataframes

`x[i,j]`	element at row `i`, column `j`
`x[i,]`	row `i`
`x[,j]`	column `j`
`x[,c(1,3)]`	columns 1 and 3
`x["name",]`	row named `"name"`
only for dataframes:	
`df[["name"]]` or `df$name`	column named `"name"`

Data selection and manipulation

`which.max(v), which.min(v)` index of the max/min element of `v`

`rev(v)` reverses the elements of `v`

`sort(v)` sorts `v` (increasing); use `rev(sort(x))` for decreasing

`cut(x,breaks)` divides `x` into intervals (laels of resulting factor) `breaks` is number of intervals or vector of cut points

`match(x, y)` for every `x[i]` index of same value in `y`, `NA` otherwise

`which(x)` indices of TRUE in logical vector `x`; e.g. `which(x>7)`

`na.omit(x)` suppress `NA` values (or lines of matrix or data frame)

`na.fail(x)` returns an error message if `x` contains at least one `NA`

`unique(x)` suppress duplicate values (or lines of matrix or DF)

`table(x)` freqency/**contingency table** for vector/data frame

`subset(df, x)` lines where `x` is TRUE; e.g. `subset(df, V1 < 5)`

`sample(x, N)` random sample of size `N` from vector `x`;`replace=FALSE`

`prop.table(x,margin=)` table entries as fraction of marginal table

Math

`sin,cos,tan,asin,acos,atan,atan2,log,log10,exp`

`range(x)` shortcut for `c(min(x), max(x))`

`sum(x)` sum of the elements of `x`

`diff(x)` iterated differences of vector `x`

`prod(x)` product of the elements of `x`

`mean(x)` mean of the elements of `x`

`median(x)` median of the elements of `x`

`quantile(x,probs=)` sample quantiles; `type=` nine types of approx.

`weighted.mean(x, w)` mean of `x` with weights `w`

`rank(x)` ranks of the elements of `x`

`var(x)` variance of the elements of `x`;

`sd(x)` standard deviation of `x`

`cov(x)` covariance matrix of the matrix or data frame`x`

`cor(x)` correlation matrix of `x` see param. `method=`

`var(x, y)` or `cov(x, y)` covariance between `x` and `y`

`cor(x, y)` linear correlation between `x` and `y` (also for matrices)

`choose(n, k)` k-combinations from n elements $= n!/[(n-k)!k!]$

`round(x, n)` rounds the elements of `x` to `n` decimals

`scale(x)` normalization of vector (matrix, df) x

`pmin(x,y,...)`, `pmax(x,y,...)` parallel minimum, maximum

`cumsum(v)` vector with i^{th} element `sum(v[:i])`

`cumprod(v)`, `cummin(v)`, `cummax(v)` . . . similar

Many math functions have a logical parameter `na.rm=FALSE` to specify missing data (NA) removal.

Matrices

`t(x)` transpose

`diag(x)` diagonal

`%*%` matrix multiplication and scalar product

`solve(a,b)` solves `a %*% x = b` for `x`

`solve(a)` matrix inverse of `a`

`rowSums(x)`, `colSums(x)`, `rowMeans`, `colMeans` sum/mean of rows/cols for a matrix-like object

Advanced data processing

`function( arglist ) expr` function definition; `return(value)`

`lapply(X,FUN)` apply `FUN` to each element of the list `X`

`by(data,FACTOR,FUN,...)` split data frame `data` by `FACTOR` of same length and apply `FUN` to resulting data frames

`merge(a,b)` merge two data frames (default by common columns)

`ftable(xtabs(cols rows,data=x))` a contingency table from DF

`stack, unstack(x,...)` convert list of factor vectors to/from DF

Distributions

`rnorm(n, mean=0, sd=1)` Gaussian (normal)

`rlnorm(n, meanlog=0, sdlog=1)` lognormal

`rweibull(n, shape, scale=1)` Weibull

`rgamma(n, shape, scale=1)` gamma

`rbeta(n, shape1, shape2)` beta

`rt(n, df)` ‘Student’ (t)

`rf(n, df1, df2)` Fisher–Snedecor (F)

`rchisq(n, df)` Pearson (χ^2)

`rexp(n, rate=1)` exponential

`rpois(n, lambda)` Poisson

`rcauchy(n, location=0, scale=1)` Cauchy

`rbinom(n, size, prob)` binomial

`rhyper(nn, m, n, k)` nn-white drown, m-white, n-black, k-drown

`rgeom(n, prob)` geometric

`rnbinom(n, size, prob)` negative binomial

`rlogis(n, location=0, scale=1)` logistic

`runif(n, min=0, max=1)` uniform

`rwilcox(nn, m, n)`, `rsignrank(nn, n)` Wilcoxon’s statistics

`d<distr>(x, ...)` density function

`p<distr>(x, ...)` distribution (CDF)

`q<distr>(p, ...)` quantile function ($0 \leq p \leq 1$)

Tests and confidence intervals

t.test() Student's test

pairwise.t.test() ...corrections for ANOVA posthoc analysis

power.t.test() power of t-test

binom.test() exact test for p

var.test() F-test for variance of normal distribution

fisher.test() exact test for independence in contingency table

ks.test() one or two sample Kolmogorov-Smirnov test

kruskal.test(x) Kruskal-Wallis ("robust" ANOVA for list x)

shapiro.test() test of normality

apropos("test") for full list

Statistics

approx(x,y=) piecewise linear or constant interpolation

spline(x,y=) cubic spline interpolation

lm(formula, data=, subset=) fit linear model; formula is typically of the form response   termA + termB + ...; use I(x*y) + I(x^2) for terms made of nonlinear components

aov(formula) analysis of variance model

formulas

x+c:d with interaction term $y = \beta_0 + \beta_x x + \beta_{cd}$;

a-1 without intercept

c*d same as c+d+c:d same as (c+d)$\hat{2}$

I(x$\hat{2}$) $y = \beta_0 + \beta_2 x^2$

work with fit

predict(fit,...) predictions from fit based on input data

df.residual(fit) number of residual degrees of freedom

coef(fit) returns the estimated coefficients

residuals(fit) returns the residuals

deviance(fit) returns the deviance

fitted(fit) returns the fitted values

anova(fit,...) ANOVA table

plot(fit)

Basic Plotting

plot(y) plot of the values of y (on the y-axis) ordered on the x-axis

plot(vx, vy) scatter plot; points (vx[i], vy[i])

matplot(x,y) i^{th} col of matrix x vs. i^{th} col of y taking i^{th} value from vector plot params (col, bg, pch,..)

stripchart(x) plot of the values of x on a line

hist(x) histogram of the frequencies of x

barplot(x) histogram of the values of x; horizontal: horiz=FALSE

pie(x) circular pie-chart

boxplot(x) "box-and-whiskers" plot

pairs(x) plot for every pair of columns in data frame x

pairs(~V1+V2+V3,data=df) only for columns 1,2,3

plot.ts(x) plot time series object x

ts.plot(x) multivariate series may have different dates

qqnorm(x) quantiles of x with respect to qnorm()

qqplot(x, y) quantiles of y with respect to the quantiles of x

contour(x, y, z) x, y - vectors; z= $z(x, y)$

filled.contour(x, y, z) same + fill between contours

image(x, y, z) plot z as colour

persp(x, y, z) 3D graph with perspective

dotchart(x) Cleveland's plot, cf. dotchart2 from package Hmisc

stars(x) draw star for every row of df x; draw.segments=

coplot(x~y | z) conditioning scatter plots for each value or interval of values of z

symbols(x, y, ...) draw parametic symbols (termometer, circle, ...) at x,y points

Statistic Plotting

fourfoldplot(x) plot 2 by 2 by k contingency table $x$visualizes, with quarters of circles, the association between two dichotomous variables for different populations (x must be an array with dim=c(2, 2, k), or a matrix with dim=c(2, 2) if $k = 1$)

assocplot(x) Cohen–Friendly graph showing the deviations from independence of rows and columns in a two dimensional contingency table

mosaicplot(x) 'mosaic' graph of the residuals from a log-linear regression of a contingency table

interaction.plot (f1, f2, y) plot means of y (y-axis) for factors f1 (x-axis) and f2 (line type)

termplot(mod.obj) plot (partial) effects of a regression model

Low-level plotting commands

points(x, y) adds points (the option type= can be used)

lines(x, y) id. but with lines

text(x, y, labels, ...) add text labels at points (x, y)

mtext(text, side=3, ...) add text at margin specified by side

segments(x0, y0, x1, y1) lines from (x0,y0) to (x1,y1)

arrows(x0, y0, x1, y1, angle= 30, code=2) same with arrows

abline(a,b) draws a line of slope b and intercept a

abline(h=y) draws a horizontal line at ordinate y

abline(v=x) draws a vertical line at abcissa x

abline(lm.obj) draws the regression line given by lm.obj

rect(x1, y1, x2, y2) rectangle with corners (x1, y2) (x2, y2)

polygon(x, y) polygon linking the points (x, y)

legend(x, y, legend) add legend (x,y)

title() adds a title and optionally a sub-title

axis(side, ...) add axis on side (1=below, 2=left, 3=above, 4=right)

rug(v) draws the data on the x-axis as small vertical lines

locator(N, type=‘‘n’’, ...) returns coordinates (x, y) after the user has clicked n times on the plot; also draws symbols type

common plot params

add=FALSE if TRUE superposes the plot on the previous one (if it exists)

axes=TRUE if FALSE does not draw the axes and the box

type="p" specifies the type of plot, "p": points, "l": lines, "b": points connected by lines, "o": id. but the lines are over the points, "h": vertical lines, "s": steps, the data are represented by the top of the vertical lines, "S": id. but the data are represented by the bottom of the vertical lines

xlim=, ylim= specifies the lower and upper limits of the axes, for example with xlim=c(1, 10) or xlim=range(x)

xlab=, ylab= annotates the axes, must be variables of mode character

main= main title, must be a variable of mode character

sub= sub-title (written in a smaller font)

Graphical parameters

par(...) set grapics parameters globally

adj adjustement of text (0=left, 0.5=center, 1=right)

bg background color (fill); colors() list color names

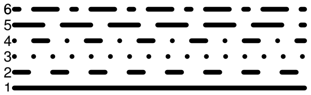
bty box type around plot, ("o", "l", "7", "c", "u", "]") or bty="n" for none

cex scale size of texts and symbols (also: cex.axis, ...)

col color of symbols and lines; use color names or "#RRGGBB"; see rgb(), hsv(), gray(), and rainbow();

font style of text (1: normal, 2: italics, 3: bold, 4: bold italics)

las orientation of axis labels
0: parallel, 1: horizontal,
2: perpendicular, 3: vertical

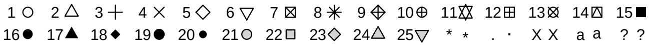


lty line type:

lwd line width

mfrow=c(nr,nc) set matrix nr × nc of subplots

pch point type (integer code) or single character and 25, or any single character within ""



ps size of texts

pty plotting region type, "s": square, "m": maximal

xpd if set to TRUE, do not clip objects poking out

Lattice (Trellis) graphics

xyplot(y~x) bivariate plots (with many functionalities)

barchart(y~x) histogram of the values of y with respect to those of x

dotplot(y~x) Cleveland dot plot (stacked plots line-by-line and column-by-column)

densityplot(~x) density functions plot

histogram(~x) histogram of the frequencies of x

bwplot(y~x) "box-and-whiskers" plot

qqmath(~x) quantiles of x with respect to the values expected under a theoretical distribution

stripplot(y~x) single dimension plot, x must be numeric, y may be a factor

qq(y~x) quantiles to compare two distributions, x must be numeric, y may be numeric, character, or factor but must have two 'levels'

splom(~x) matrix of bivariate plots

parallel(~x) parallel coordinates plot

levelplot(z~x*y|g1*g2) coloured plot of the values of z at the coordinates given by x and y (x, y and z are all of the same length)

wireframe(z~x*y|g1*g2) 3d surface plot

cloud(z~x*y|g1*g2) 3d scatter plot