

Package ‘greport’

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Title Graphical Reporting for Clinical Trials

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Depends Hmisc (>= 3.14-2), data.table

Imports rms (>= 4.1-3), lattice, latticeExtra, Formula, survival

Description The greport package contains many functions useful for monitoring and reporting the results of clinical trials and other experiments in which treatments are compared. LaTeX is used to typeset the resulting reports, recommended to be in the context of knitr. The Hmisc and lattice packages are used by greport for high-level graphics.

License GPL (>= 2)

URL <http://biostat.mc.vanderbilt.edu/Greport>, <https://github.com/harrelfe/greport>

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accrualReport	<i>Accrual Report</i>
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Description

Generate graphics and LaTeX to analyze subject accrual

Usage

```
accrualReport(formula, data = NULL, subset = NULL, na.action = na.retain,
  dateRange = NULL, zoom = NULL, targetN = NULL, targetDate = NULL,
  closeDate = NULL, enrollmax = NULL, minrand = 10, panel = "accrual",
  h = 2.5, w = 3.75, hb = 5, wb = 5, hdot = 3.5)
```

Arguments

formula	formula object, with time variables on the left (separated by +) and grouping variables on the right. Enrollment date, randomization date, region, country, and site when present must have the variables in parenthesis preceeded by the key words enrollment, randomize, region, country, site.
data	data frame.
subset	a subsetting expression for the entire analysis.
na.action	a NA handling function for data frames, default is na.retain.
dateRange	Date or character 2-vector formatted as yyyy-mm-dd. Provides the range on the x-axis (before any zooming).
zoom	Date or character 2-vector for an option zoomed-in look at accrual.
targetN	integer vector with target sample sizes over time, same length as targetDate
targetDate	Date or character vector corresponding to targetN
closeDate	Date or characterstring. Used for randomizations per month and per site-month - contains the dataset closing date to be able to compute the number of dates that a group (country, site, etc.) has been online since randomizing its first subject.
enrollmax	numeric specifying the upper y-axis limit for cumulative enrollment when not zoomed

minrand	integer. Minimum number of randomized subjects a country must have before a box plot of time to randomization is included.
panel	character string. Name of panel, which goes into file base names and figure labels for cross-referencing.
h	numeric. Height of ordinary plots, in inches.
w	numeric. Width of ordinary plots.
hb	numeric. Height of extended box plots.
wb	numeric. Weight of extended box plots.
hdot	numeric. Height of dot charts in inches.

Details

Typically the left-hand-side variables of the formula, in order, are date of enrollment and date of randomization, with subjects enrolled but not randomized having missing date of randomization. Given such date variables, this function generates cumulative frequencies optionally with target enrollment/randomization numbers and with time-zooming. Makes a variety of dot charts by right-hand-side variables: number of subjects, number of sites, number of subjects per site, fraction of enrolled subjects randomized, number per month, number per site-month.

Examples

```
## Not run:
# See test.Rnw in tests directory

## End(Not run)
```

dNeedle	<i>Draw Needles</i>
---------	---------------------

Description

Create a LaTeX picture to draw needles for current sample sizes. Uses colors set by call to `setgreportOptions`.

Usage

```
dNeedle(sf, name, file = "", append = TRUE)
```

Arguments

sf	output of <code>sampleFrac</code>
name	character string name of LaTeX variable to create
file	output file name (character string)
append	set to FALSE to start a new file

Description

Generate graphics and LaTeX with descriptive statistics

Usage

```
dReport(formula, groups = NULL, what = c("box", "proportions", "xy", "byx"),
  byx.type = c("violin", "quantiles"), violinbox = TRUE,
  violinbox.opts = list(col = adjustcolor("blue", alpha.f = 0.25), border =
  FALSE), fun = NULL, data = NULL, subset = NULL, na.action = na.retain,
  panel = "desc", subpanel = NULL, head = NULL, tail = NULL,
  continuous = 10, h = 5.5, w = 5.5, outerlabels = TRUE,
  append = FALSE, sopts = NULL, popts = NULL)
```

Arguments

formula	a formula accepted by the <code>bpplotM</code> or <code>summaryP</code> functions. formula must have an <code>id(subjectidvariable)</code> term if there are repeated measures, in order to get correct subject counts as <code>nobs</code> .
groups	a superpositioning variable, usually treatment, for categorical charts. For continuous analysis variables, groups becomes the y-axis stratification variable. This is a single character string.
what	"box" (the default) or "xy" for continuous analysis variables, or "proportions" (or shorter) for categorical ones. Instead, specifying <code>what="byx"</code> results in an array of quantile intervals for continuous y, Wilson confidence intervals for proportions when y is binary, or means and parametric confidence limits when y is not continuous but is not binary. If what is omitted or <code>what="byx"</code> , actions will be inferred from the most continuous variable listed in formula. When fun is given, different behavior results (see below).
byx.type	set to "quantiles" to show vertical quantile intervals of y at each x for when <code>what="byx"</code> and the y variable is continuous numeric, or set <code>byx.type="violin"</code> (the default) to plot half-violin plots at each x.
violinbox	set to TRUE to add violin plots to box plots
violinbox.opts	a list to pass to <code>panel.violin</code>
fun	a function that takes individual response variables (which may be matrices, as in Surv objects) and creates one or more summary statistics that will be computed while the resulting data frame is being collapsed to one row per condition. Dot charts are drawn when fun is given.
data	data frame
subset	a subsetting expression for the entire analysis
na.action	a NA handling function for data frames, default is <code>na.retain</code>

panel	character string. Name of panel, which goes into file base names and figure labels for cross-referencing
subpanel	If calling dReport more than once for the same type of chart (by different values of what), specify subpanel to distinguish the multiple calls. In that case, -subpanel will be appended to panel when creating figure labels and cross-references.
head	character string. Specifies initial text in the figure caption, otherwise a default is used
tail	optional character string. Specifies final text in the figure caption, e.g., what might have been put in a footnote in an ordinary text page. This appears just before any needles.
continuous	the minimum number of numeric values a variable must have in order to be considered continuous
h	numeric. Height of plot, in inches
w	numeric. Width of plot
outerlabels	logical that if TRUE, pass lattice graphics through the latticeExtra package's useOuterStripsfunction if there are two conditioning (paneling) variables, to put panel labels in outer margins.
....	Passed to summaryP or bplotM
append	logical. Set to FALSE to start a new panel
sopts	list specifying extra arguments to pass to bplotM, summaryP, or summaryS
popts	list specifying extra arguments to pass to a plot method. One example is text.at to specify some number beyond xlim[2] to leave extra space for numerators and denominators when using summaryP for categorical analysis variables. Another common use is for example popts=list(layout=c(columns,rows)) to be used in rendering lattice plots. key and panel are also frequently used.

Details

dReport generates multi-panel charts, separately for categorical analysis variables and continuous ones. The Hmisc summaryP function and its plot method are used for categorical variables, and bplotM is used to make extended box plots for continuous ones unless what='byx'. Stratification is by treatment or other variables. The user must have defined a LaTeX macro \eboxpopup (which may be defined to do nothing) with one argument. This macro is called with argument extended box plot whenever that phrase appears in the legend, so that a PDF popup may be generated to show the prototype. See the example in report.Rnw in the tests directory. Similarly a popup macro \qintpopup must be defined, which generates a tooltip for the phrase quantile intervals.

Examples

```
# See test.Rnw in tests directory
```

eReport

Event Report

Description

Generates graphics for binary event proportions

Usage

```
eReport(formula, data = NULL, subset = NULL, na.action = na.retain,
        minincidence = 0, conf.int = 0.95, etype = "adverse events",
        panel = "events", subpanel = NULL, head = NULL, tail = NULL, h = 6,
        w = 7, append = FALSE, popts = NULL)
```

Arguments

formula	a formula with one or two left hand variables (the first representing major categorization and the second minor), and 1-2 right hand variables. One of these may be enclosed in <code>id()</code> to indicate the presence of a unique subject ID, and the other is treatment.
data	input data frame
subset	subsetting criteria
na.action	function for handling NAs when creating analysis frame
minincidence	a number between 0 and 1 specifying the minimum incidence in any stratum that must hold before an event is included in the summary
conf.int	confidence level for difference in proportions
etype	a character string describing the nature of the events, for example "adverse events", "serious adverse events". Used in figure captions.
panel	panel string
subpanel	a subpanel designation to add to panel
head	character string. Specifies initial text in the figure caption, otherwise a default is used.
tail	a character string to add to end of automatic caption
h	height of graph
w	width of graph
append	set to TRUE if adding to an existing sub-report
popts	a list of options to pass to graphing functions

Details

Generates dot charts showing proportions on left and risk difference with confidence intervals on the right, if there is only one level of event categorization. Input data must contain one record per event, with this record containing the event name. If there is more than one event of a given type per subject, unique subject ID must be provided. Denominators come from greport options and it is assumed that only randomized subjects have records. Some of the graphics functions are modifications of those found in the HH package. The data are expected to have one record per event, and non-events are inferred from setgreportOption('denom'). It is also assumed that only randomized subjects are included in the dataset.

Author(s)

Frank Harrell

Examples

```
# See test.Rnw in tests directory
```

exReport

Exclusion Report

Description

Generates graphics for sequential exclusion criteria

Usage

```
exReport(formula, data = NULL, subset = NULL, na.action = na.retain,
  ignoreExcl = NULL, ignoreRand = NULL, autoother = FALSE, sort = TRUE,
  whenapp = NULL, erdata = NULL, panel = "excl", subpanel = NULL,
  head = NULL, tail = NULL, h = 5.5, w = 6.5, hc = 4.5, wc = 5,
  adjustwidth = "-0.75in", append = FALSE, popts = NULL, app = TRUE)
```

Arguments

formula	a formula with only a right-hand side, possibly containing a term of the form <code>pending(x)</code> to inform the function of which subjects have incomplete randomization ("randomization pending"). The pending variable is ignored if a subject has an exclusion marked. A randomized variable is an optional logical vector specifying which subjects are considered to have been randomized. The presence of this variable causes consistency checking against exclusions. One or more <code>cond</code> variables provide binary/logical vectors used to define subsets of subjects for which denominators are used to compute additional fractions of exclusions that are reported in a detailed table. The arguments of the <code>cond</code> function are the name of the original variable (assumed to be provided as a regular variable in <code>formula</code> , a single character string giving the label for the condition, and the vector of essentially binary values that specify the condition.
---------	--

data	input data frame
subset	subsetting criteria
na.action	function for handling NAs when creating analysis frame
ignoreExcl	a formula with only a right-hand side, specifying the names of exclusion variable names that are to be ignored when counting exclusions (screen failures)
ignoreRand	a formula with only a right-hand side, specifying the names of exclusion variable names that are to be ignored when counting randomized subjects marked as exclusions
autoother	set to TRUE to add another exclusion Unspecified that is set to TRUE for non-pending subjects that have no other exclusions
sort	set to FALSE to not sort variables by descending exclusion frequency
whenapp	a named character vector (with names equal to names of variables in formula). For each variable that is only assessed (i.e., is not NA) under certain conditions, add an element to this vector naming the condition
erdata	a data frame that is subsetted on the combination of id variables when randomized is present, to print auxiliary information about randomized subjects who have exclusion criteria
panel	panel string
subpanel	If calling exReport more than once (e.g., for different values of sort), specify subpanel to distinguish the multiple calls. In that case, -subpanel will be appended to panel when creating figure labels and cross-references.
head	character string. Specifies initial text in the figure caption, otherwise a default is used.
tail	a character string to add to end of automatic caption
h	height of 2-panel graph
w	width of 2-panel graph
hc	height of cumulative exclusion 1-panel graph
wc	width of this 1-panel graph
adjustwidth	used to allow wide detailed exclusion table to go into left margin in order to be centered on the physical page. The default is '-0.75in', which works well when using article document class with default page width. To use the geometry package in LaTeX with margin=.45in specify adjustwidth='+.90in'.
append	set to TRUE if adding to an existing sub-report
popts	a list of options to pass to graphing functions
app	set to FALSE to prevent writing appendix information

Details

With input being a series of essentially binary variables with positive indicating that a subject is excluded for a specific reason, orders the reasons so that the first excludes the highest number of subjects, the second excludes the highest number of remaining subjects, and so on. First draws a single vertical axis graph showing cumulative exclusions, then creates a 2-panel dot chart with

the first panel showing that information, along with the marginal frequencies of exclusions and the second showing the number of subjects remaining in the study after the sequential exclusions. A pop-up table is created showing those quantities plus fractions. There is an option to not sort by descending exclusion frequencies but instead to use the original variable order. Assumes that any factor variable exclusions that have only one level and that level indicates a positive finding, that variable has a denominator equal to the overall number of subjects.

Author(s)

Frank Harrell

Examples

```
# See test.Rnw in tests directory
```

getgreportOption	<i>Get greport Options</i>
------------------	----------------------------

Description

Get greport options, assigning default values of unspecified options.

Usage

```
getgreportOption(opts = NULL)
```

Arguments

opts	character vector containing list of option names to retrieve. If only one element, the result is a scalar, otherwise a list. If opts is not specified, a list with all current option settings is returned.
------	---

greport	<i>Graphical Reporting for Clinical Trials</i>
---------	--

Description

Graphical Reporting for Clinical Trials

Usage

```
.noGenerics
```

Format

```
logi TRUE
```

Author(s)

Frank E Harrell Jr <f.harrell@vanderbilt.edu>

latticeInit	<i>Setup lattice plots using greport options</i>
-------------	--

Description

Initializes colors and other graphical attributes based on what is stored in system option greport.

Usage

```
latticeInit()
```

Merge	<i>Merge Multiple Data Frames or Data Tables</i>
-------	--

Description

Merges an arbitrarily large series of data frames or data tables containing common id variables (keys for data tables). Information about number of observations and number of unique ids in individual and final merged datasets is printed. The first data frame has special meaning in that all of its observations are kept whether they match ids in other data frames or not. For all other data frames, by default non-matching observations are dropped. The first data frame is also the one against which counts of unique ids are compared. Sometimes merge drops variable attributes such as labels and units. These are restored by Merge. If all objects are of class `data.table`, faster merging will be done using the `data.table` package's join operation. This assumes that all objects have identical key variables and those of the variables on which to merge.

Usage

```
Merge(..., id, all = TRUE, verbose = TRUE)
```

Arguments

...	two or more dataframes or data tables
id	a formula containing all the identification variables such that the combination of these variables uniquely identifies subjects or records of interest. May be omitted for data tables; in that case the key function retrieves the id variables.
all	set to FALSE to drop observations not found in second and later data frames (only applies if not using <code>data.table</code>)
verbose	set to FALSE to not print information about observations

Examples

```

a <- data.frame(sid=1:3, age=c(20,30,40))
b <- data.frame(sid=c(1,2,2), bp=c(120,130,140))
d <- data.frame(sid=c(1,3,4), wt=c(170,180,190))
all <- Merge(a, b, d, id = ~ sid)
# For data.table, first file must be the master file and must
# contain all ids that ever occur. ids not in the master will
# not be merged from other datasets.
a <- data.table(a); setkey(a, sid)
# data.table also does not allow duplicates without allow.cartesian=TRUE
b <- data.table(sid=1:2, bp=c(120,130)); setkey(b, sid)
d <- data.table(d); setkey(d, sid)
all <- Merge(a, b, d)

```

mfrowSuggest

*Compute mfrow Parameter***Description**

Compute a good par("mfrow") given the number of figures to plot.

Usage

```
mfrowSuggest(n, small = FALSE)
```

Arguments

n numeric. Total number of figures to place in layout.
small logical. Set to 'TRUE' if the plot area should be smaller to accomodate many plots.

Value

return numeric vector. oldmfrow <- mfrowSet(8)

nriskReport

*Number at Risk Report***Description**

Graph number of subjects at risk

Usage

```

nriskReport(formula, groups = NULL, data = NULL, subset = NULL,
na.action = na.retain, ylab = "Number Followed", panel = "nrisk",
head = NULL, tail = NULL, h = 5.5, w = 5.5, outerlabels = TRUE,
append = FALSE, popts = NULL)

```

Arguments

formula	a formula with time and the left hand side, and with variables on the right side being possible stratification variables. If no stratification put 1 as the right hand side. Specify unique subject IDs by including a term <code>id()</code> if subjects have more than one observation.
groups	a character string naming a superpositioning variable. Must also be included in formula.
data	data frame
subset	a subsetting expression for the entire analysis
na.action	a NA handling function for data frames, default is <code>na. retain</code>
ylab	character string if you want to override "Number Followed"
panel	character string. Name of panel, which goes into file base names and figure labels for cross-referencing. The default is 'nrisk'.
head	character string. Specifies initial text in the figure caption, otherwise a default is used
tail	optional character string. Specifies final text in the figure caption, e.g., what might have been put in a footnote in an ordinary text page. This appears just before any needles.
h	numeric. Height of plot, in inches
w	numeric. Width of plot
outerlabels	logical that if TRUE, pass lattice graphics through the <code>latticeExtra</code> package's <code>useOuterStrips</code> function if there are two conditioning (paneling) variables, to put panel labels in outer margins.
append	logical. Set to FALSE to start a new panel
popts	list specifying extra arguments to pass to <code>Ecdf</code> . A common use is for example <code>popts=list(layout=c(columns,rows))</code> to be used in rendering lattice plots. <code>key</code> and <code>panel</code> are also frequently used.

Details

`nriskReport` generates multi-panel charts, separately for categorical analysis variables. Each panel depicts the number at risk as a function of follow-up time. The `Hmisc Ecdf` function is used. Stratification is by treatment or other variables. It is assumed that this function is only run on randomized subjects.

Examples

```
# See test.Rnw in tests directory
```

putFig	<i>Put Figure</i>
--------	-------------------

Description

Included a generated figure within LaTeX document. tcaption and tlongcaption only apply if setgreportOption(tablelink="hyperref").

Usage

```
putFig(panel, name, caption = NULL, longcaption = NULL,
       tcaption = caption, tlongcaption = NULL, poptable = NULL,
       popfull = FALSE, sidecap = FALSE, append = TRUE)
```

Arguments

panel	character. Panel name.
name	character. Name for figure.
caption	character. Short caption for figure.
longcaption	character. Long caption for figure.
tcaption	character. Short caption for supporting table.
tlongcaption	character. Long caption for supporting table.
poptable	an optional character string containing LaTeX code that will be used as a pop-up tool tip for the figure (typically a tabular)
popfull	set to TRUE to make the pop-up be full-page
sidecap	set to TRUE (only applies if greportOption(figenv="SCfigure")) to assume the figure is narrow and to use side captions
append	logical. If 'TRUE' output will be appended instead of overwritten.

sampleFrac	<i>Compute Sample Fractions</i>
------------	---------------------------------

Description

Uses denominators stored with setgreportOption along with counts specified to SampleFrac to compute fractions of subjects in current analysis

Usage

```
sampleFrac(n, nobsY = NULL, table = TRUE)
```

Arguments

n	integer vector, named with "enrolled", "randomized" and optionally also including treatment levels.
nobsY	a result of the the nobsY Hmisc function
table	set to TRUE to return as an attribute "table" a character string containing a LaTeX tabular showing the pertinent frequencies created from n and the denom option, and if nobsY is present, adding another table with response variable-specific counts.

setgreportOption *Set greport Options*

Description

Set greport Options

Usage

```
setgreportOption(...)
```

Arguments

- ... a series of options for which non-default values are desired:
- tx.pch:symbols corresponding to treatments
 - tx.col:colors corresponding to treatments
 - tx.linecol:colors for lines in line plots
 - tx.lty:line types corresponding to treatments
 - tx.lwd:line widths corresponding to treatments
 - tx.var:character string name of treatment variable
 - er.col:2-vector with names "enrolled", "randomized" containing colors to use for enrolled and randomized in needle displays
 - denom:named vector with overall sample sizes
 - tablelink:a character string, either "tooltip" or "hyperref" (the default); use the latter to make supporting data tables be hyperlinked to tables in the appendix rather than using a pop-up tooltip
 - figenv:LaTeX figure environment to use, default is "figure". Use figenv="SCfigure" if using the LaTeX sidecap package. SCfigure is only used for narrow images, by calling putFig with sidecap=TRUE.
 - codefigpos:LaTeX figure environment position; default is "htb!"
 - gtype:graphics type, "pdf" or "interactive"
 - pdfdir:name of subdirectory in which to write pdf graphics
 - texdir:name of subdirectory in which to write LaTeX code
 - texwhere:default is "texdir" to use location specified by texdir. Set to "" to write generated non-appendix LaTeX code to the console as expected by knitr

startPlot	<i>Plot Initialization</i>
-----------	----------------------------

Description

Toggle plotting. Sets options by examining `setgreportOption(gtype=)`.

Usage

```
startPlot(file, h = 7, w = 7, lattice = TRUE, ...)
```

```
endPlot()
```

Arguments

file	character. Character string specifying file prefix.
h	numeric. Height of plot in inches, default=7.
w	numeric. Width of plot in inches, default=7.
lattice	logical. Set to FALSE to prevent <code>latticeInit</code> from being called.
...	Arguments to be passed to <code>spar</code> .

survReport	<i>Survival Report</i>
------------	------------------------

Description

Generate a Survival Report with Kaplan-Meier Estimates

Usage

```
survReport(formula, data = NULL, subset = NULL, na.action = na.retain,
  ylab = NULL, what = c("S", "1-S"), conf = c("diffbands", "bands",
  "bars", "none"), panel = "surv", subpanel = NULL, head = NULL,
  tail = NULL, h = 3, w = 4.5, multi = FALSE, mfrow = NULL,
  y.n.risk = -0.5, bot = 2, append = FALSE, ...)
```

Arguments

formula	a formula with survival (<code>Srv</code>) objects on the left hand side and an optional stratification factor on the right (or 1 if none). The survival object component variables should be labeled; these labels are used for graph annotation.
data	<code>data.frame</code>
subset	optional subsetting criteria

na.action	function for handling NAs while creating a data frame
ylab	character. Passed to <code>survplot.npsurv</code> as the <code>ylab</code> argument. Constructed by default.
what	"S" (the default) to plot survival functions or "1-S" to plot cumulative incidence functions.
conf	character. See <code>survplot.npsurv</code> .
panel	character string. Name of panel, which goes into file base names and figure labels for cross-referencing.
subpanel	character string. If calling <code>dReport</code> more than once for the same type of chart (categorical or continuous), specify <code>subpanel</code> to distinguish the multiple calls. In that case, <code>-subpanel</code> will be appended to <code>panel</code> when creating figure labels and cross-references.
head	character string. Specifies initial text in the figure caption, otherwise a default is used.
tail	optional character string. Specifies final text in the figure caption, e.g., what might have been put in a footnote in an ordinary text page. This appears just before any needles.
h	numeric. Height of plots.
w	numeric. Width of plots in inches.
multi	logical. If TRUE, multiple figures are produced, otherwise a single figure with a matrix of survival plots is made.
mfrow	numeric 2-vector, used if <code>multi=FALSE</code> . If not specified, default plot matrix layout will be figured.
y.n.risk	used if <code>what="1-S"</code> , to specify y coordinate for putting numbers at risk, typically below the x-axis label
bot	number of spaces to reserve at bottom of plot for numbers at risk, if <code>what="1-S"</code>
append	logical. If TRUE output will be appended instead of overwritten.
...	ignored

Examples

```
## See tests directory test.Rnw for a live example
## Not run:
set.seed(1)
n <- 400
dat <- data.frame(t1=runif(n, 2, 5), t2=runif(n, 2, 5),
                 e1=rbinom(n, 1, .5), e2=rbinom(n, 1, .5),
                 treat=sample(c('a','b','c'), n, TRUE))
dat <- upData(dat,
             labels=c(t1='Time to operation',
                    t2='Time to rehospitalization',
                    e1='Operation', e2='Hospitalization',
                    treat='Treatment')
             units=c(t1='year', t2='year'))
survReport(Srv(t1, e1) + Srv(t2, e2) ~ treat, data=dat)

## End(Not run)
```

`upFirst`*Change First Letters to Upper Case*

Description

Changes the first letter of each word in a string to upper case, keeping selected words in lower case

Usage

```
upFirst(txt)
```

Arguments

`txt` a character vector

References

<http://lanecc.libguides.com/content.php?pid=38483&sid=295540>, http://en.wikipedia.org/wiki/Letter_case#Headings_and_publication_titles, <http://titlecapitalization.com>

Examples

```
upFirst(c('this and that','that is Beyond question'))
```

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