Package ‘rpart.plot’

November 24, 2018

Version  3.0.6
Title Plot 'rpart' Models: An Enhanced Version of 'plot.rpart'
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Depends  R (>= 3.2.0), rpart (>= 4.1-10)
Suggests earth (>= 4.4.6)
Description Plot 'rpart' models. Extends plot.rpart() and text.rpart()
in the 'rpart' package.
License  GPL-3
LazyData yes
URL http://www.milbo.org/rpart-plot
NeedsCompilation no
Repository CRAN
Date/Publication 2018-11-24 06:10:03 UTC

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Description

Plot an rpart model.

This function combines and extends plot.rpart and text.rpart in the rpart package. For an overview, please see the package vignette Plotting rpart trees with the rpart.plot package.

The function rpart.plot provides a simplified interface to this function. First-time users should use rpart.plot rather than this function.

The arguments of this function are a superset of those of rpart.plot and some of the arguments have different defaults. See the rpart.plot help page for a table showing the different defaults.

(The defaults are different for historical reasons: for backwards compatibility the defaults of prp haven’t changed, whereas the defaults of rpart.plot were changed when type="auto" and box.palette were introduced in version 2.0.0 of this package.)

Usage

```r
prp(x=stop("no 'x' arg"),
   type=0, extra=0, under=FALSE, fallen.leaves=FALSE,
   nn=FALSE, ni=FALSE, yesno=TRUE,
   branch=if(fallen.leaves) 1 else .2,
   uniform=TRUE, left=TRUE, xflip=FALSE, yflip=FALSE,
   digits=2, varlen=8, faclen=3, roundint=TRUE,
   cex=NULL, tweak=1,
   clip.facs=FALSE, clip.right.labs=TRUE,
   compress=TRUE, ycompress=uniform,
   Margin=0, space=1, gap=NULL,
   snip=FALSE, snip.fun=NULL, trace=FALSE,

   box.col=0, box.palette=0,
   pal.thresh=NULL, pal.node.fun=FALSE,
   border.col=col,
   round=NULL, leaf.round=NULL,
   shadow.col=0, prefix="", suffix="", xsep=NULL,

   under.percent=2, under.font=font, under.col=1, under.cex=.8,

   split.cex=1, split.font=2, split.family=family, split.col=1,
   split.box.col=0, split.border.col=0,
   split.lty=1, split.lwd=NULL, split.round=0,
   split.shadow.col=0,
   split.prefix="", right.split.prefix=NULL,
   split.suffix="", right.split.suffix=NULL,
   facsep="", eq=" = ", lt=" < ", ge=" >= ",
```

branch.col=if(is.zero(branch.type)) 1 else "gray",
branch.lty=1, branch.lwd=NULL,
branch.type=0, branch.tweak=1,
min.branch.width=.002, branch.fill=branch.col,

nn.cex=NULL, nn.font=3, nn.family="", nn.col=1,
nn.box.col=0, nn.border.col=nn.col,
nn.lty=1, nn.lwd=NULL, nn.round=.3,
yes.text="yes", no.text="no",

node.fun=NULL,
split.fun=NULL,
FUN="text",
nospace=branch, minbranch=.3, do.par=TRUE,
add.labs=TRUE, clip.left.labs=(type == 5), fam.main="",
yshift=0, yspace=space, shadow.offset=.4,
split.adj=NULL, split.yshift=0, split.space=space,
split.yspace=yspace, split.shadow.offset=shadow.offset,
nn.adj=.5, nn.yshift=0, nn.space=.8, nn.yspace=.5,
ygap=gap/2, under.ygap=.5, yesno.yshift=0,
xcompact=TRUE, ycompact=uniform, xcompact.ratio=.8, min.inter.height=4,
max.auto.cex=1, min.auto.cex=.15, ycompress.cex=.7, accept.cex=1.1,
shift.amounts=c(1.5, 2),
Fallen.yspace=.1, boxes.include.gap=FALSE,
legend.x=NULL, legend.y=NULL, legend.cex=1,
...)

Arguments

x          An rpart object. The only required argument.
type       Type of plot. Possible values:
           0  Default. Draw a split label at each split and a node label at each leaf.
           1  Label all nodes, not just leaves. Similar to text.rpart's all=TRUE.
           2  Like 1 but draw the split labels below the node labels. Similar to the plots in
            the CART book.
           3  Draw separate split labels for the left and right directions.
           4  Like 3 but label all nodes, not just leaves. Similar to text.rpart's fancy=TRUE.
            See also clip.right.labs.
           5  New in version 2.2.0. Show the split variable name in the interior nodes.
extra      Display extra information at the nodes. Possible values:
           "auto" (case insensitive)
           Automatically select a value based on the model type, as follows:
           extra=106 class model with a binary response
extra=104 class model with a response having more than two levels
extra=100 other models

0 Default. No extra information.
1 Display the number of observations that fall in the node (per class for class objects; prefixed by the number of events for poisson and exp models). Similar to text.rpart’s use.n=TRUE.
2 Class models: display the classification rate at the node, expressed as the number of correct classifications and the number of observations in the node. Poisson and exp models: display the number of events.
3 Class models: misclassification rate at the node, expressed as the number of incorrect classifications and the number of observations in the node.
4 Class models: probability per class of observations in the node (conditioned on the node, sum across a node is 1).
5 Class models: like 4 but don’t display the fitted class.
6 Class models: the probability of the second class only. Useful for binary responses.
7 Class models: like 6 but don’t display the fitted class.
8 Class models: the probability of the fitted class.
9 Class models: The probability relative to all observations – the sum of these probabilities across all leaves is 1. This is in contrast to the options above, which give the probability relative to observations falling in the node – the sum of the probabilities across the node is 1.
10 New in version 2.2.0. Class models: Like 9 but display the probability of the second class only. Useful for binary responses.
11 New in version 2.2.0. Class models: Like 10 but don’t display the fitted class.

+100 Add 100 to any of the above to also display the percentage of observations in the node. For example extra=101 displays the number and percentage of observations in the node. Actually, it’s a weighted percentage using the weights passed to rpart.

Note: Unlike text.rpart, by default prp uses its own routine for generating node labels (not the function attached to the object). See the node.fun argument.

under Applies only if extra > 0. Default FALSE, meaning put the extra text in the box. Use TRUE to put the text under the box. See also under.cex.
fallen.leaves Default FALSE. If TRUE, position the leaf nodes at the bottom of the graph.
nn Display the node numbers. Default FALSE. (In the current implementation some overplotting may occur with nn=TRUE.)
ni Display the node indices, i.e. the row numbers of the nodes in the object’s frame. Default FALSE.
yesno

One of

0 don’t write yes and no on the tree
1 (default) write yes and no at the top split
2 write yes and no at all splits. Seems to work best with fallen.leaves=TRUE, split.border.col=1.
(The yesno argument is ignored if type=3 or 4. Use nn.col and the other nn parameters to change the color etc. of the yes and no text. Use yes.text and no.text to change the actual text displayed.)

branch

Controls the shape of the branch lines. Specify a value between 0 (V shaped branches) and 1 (square shouldered branches).
Default is if(fallen.leaves) 1 else .2.

uniform

If TRUE (the default), the vertical spacing of the nodes is uniform. If FALSE, the nodes are spaced proportionally to the fit (more precisely, to the difference between a node’s deviance and the sum of its two children’s deviances). Very small vertical spaces are automatically artificially expanded to make room for the labels, see minbranch. Note: uniform=FALSE with cex=NULL (the default) can sometimes cause very small text.

left

Default TRUE, meaning the left side of a split is the path taken if the split condition is true. With left=FALSE the split labels are changed so the right side is true.

xflip

Default FALSE. If TRUE, flip the tree horizontally.
yflip

Default FALSE. If TRUE, flip the tree vertically, so the root is at the bottom.
digits

The number of significant digits in displayed numbers. Default 2.
If 0, use getOption("digits"). If negative, use the standard format function (with the absolute value of digits).

When digits is positive, the following details apply:
Numbers from 0,001 to 9999 are printed without an exponent (and the number of digits is actually only a suggestion, see format for details). Numbers out that range are printed with an “engineering” exponent (a multiple of 3).

varlen

Length of variable names in text at the splits (and, for class responses, the class in the node label). Default ~8, meaning truncate to eight characters. Possible values:

0 use full names.

greater than 0 call abbreviate with the given varlen.

less than 0 truncate variable names to the shortest length where they are still unique, but never truncate to shorter than abs(varlen).

faclen

Length of factor level names in splits. Default 3, meaning abbreviate to three characters. Possible values are as varlen above, except that for back-compatibility with text.rpart the special value 1 means represent the factor levels with alphabetic characters (a for the first level, b for the second, etc.).

roundint

New in version 3.0.0. If roundint=TRUE (default) and all values of a predictor in the training data are integers, then splits for that predictor are rounded to
integer. For example, display nsiblings < 3 instead of nsiblings < 2.5.
If roundint=TRUE and the data used to build the model is no longer available, a
warning will be issued.
Using roundint=FALSE is advised if non-integer values are in fact possible for
a predictor, even though all values in the training data for that predictor are
integral.

cex Default NULL, meaning calculate the text size automatically.
Since font sizes are discrete, the cex you ask for may not be exactly the cex you
get.

tweak Adjust the (possibly automatically calculated) cex. Using tweak is often easier
than specifying cex.
The default tweak is 1, meaning no adjustment.
Use say tweak=1.2 to make the text 20% larger.
Since font sizes are discrete, a small change to tweak may not actually change
the type size, or change it more than you want.

clip.facs New in version 3.0.0. Default FALSE. If TRUE, print splits on factors as female
instead of sex = female: the variable name and equals is dropped.
Another example: print survived or died rather than survived = survived
or survived = died.

clip.right.labs Applies only if type=3 or 4.
Default is TRUE meaning “clip” the right-hand split labels, i.e., don’t print variable=.
See also clip.left.labs.

compress If TRUE (the default), make more space by shifting nodes horizontally where
space is available. This often allows larger text. (This is the same as plot.rpart’s
argument of the same name, except that here the default is TRUE.)

ycompress If TRUE (the default unless uniform=FALSE), make more space by shifting labels
vertically where space is available. Actually, this only kicks in if the initial
automatically calculated cex is less than 0.7. Use ycompress=FALSE if you feel
the resulting display is too messy. In the current implementation, the shifting
algorithm works a little better (allowing larger text) with type=1, 2, or 3.

Margin Extra white space around the tree, as a fraction of the graph width. Default 0,
meaning no extra space. To add say 10% space around the tree use Margin=0.1.
(This is the margin argument of plot.rpart. The name was changed to prevent
partial matching with mar, which can be passed in as a ...argument.)

space Horizontal space to the box border on each side of the node label text, in char-
acter widths. Default 1. Use this (and yspace) for bigger boxes. Since this
affects the size of the (possibly invisible) boxes, it also affects the graph layout
and hence also the automatic calculation of cex.

gap Minimum horizontal gap between the (possibly invisible) boxes, in character
widths. Default NULL, meaning automatically choose a suitable value (normally
1, but if the graph is very crowded will be set to 0, permitting boxes to touch to
allow a bigger cex). See also space.

snip Default FALSE. Set TRUE to interactively trim the tree with the mouse. See the
package vignette (or just try it).
snip.fun Function invoked after each mouse click when snip=TRUE. Default NULL, meaning no function. Otherwise set snip.fun to your own function with the prototype function(tree), where tree is the snipped tree. See the package vignette for an example.

The following control the node labels.

trace Default FALSE. Use TRUE to print the automatically calculated cex, xlim, and ylim. Use integer values greater than 1 for more detailed tracing.

box.col Color of the boxes around the text. Default 0, meaning use the background color. If this argument is used, the box.palette argument is ignored.

box.palette Palette for coloring the node boxes based on the fitted value. This is a vector of colors, for example box.palette=c("green", "green2", "green4"). Small fitted values are displayed with colors at the start of the vector; large values with colors at the end. Quantiles are used to partition the fitted values. The special value box.palette=0 (default for prp) uses the background color (typically white).

The special value box.palette="auto" (default for rpart.plot, case insensitive) automatically selects a predefined palette based on the type of model. Otherwise specify a predefined palette e.g. box.palette="Grays" for the predefined gray palette (a range of grays). The predefined palettes are (see the show.prp.palettes function):

- Grays: Greys Greens Blues Browns Oranges Reds Purples
- Gy Gn Bu Bn Or Rd Pu (alternative names for the above palettes)
- BuGn GnRd BuOr etc. (two-color diverging palettes: any combination of two of the above palettes)
- RdYlGn GnY1Rd B1GnY1 Y1GnBl (three color palettes)

Prefix the palette name with "-" to reverse the order of the colors e.g. box.palette="-auto" or box.palette="-Grays".

The box.palette argument is ignored if the box.col palette argument is specified.

pal.thresh Applies when box.palette is a two-color diverging palette (such as BuGn). Specifies the response threshold to split the two sub-palettes (such as Bu and Gr).

For example, to display fitted values less than 90 in shades of blue and values greater than 90 in shades of green, use pal.thresh=90 with box.palette="BuGn". By default pal.thresh is calculated automatically. (For a two-class response the default threshold is 0.5; for a continuous response the default is the median fitted value.)

Node boxes for fitted values less than the threshold are displayed using colors from the first sub-palette; boxes for fitted values greater than the threshold are displayed using colors from the second sub-palette. This argument is ignored if box.palette isn’t a two-color diverging palette, and is ignored for models with multiple-class responses (more than two classes).

pal.node.fun Specifies how the box.palette argument is handled when the node.fun argument is specified.
Default is FALSE, meaning ignore node.fun and use the fitted value to select the
node color from box.palette as usual.
If TRUE, use the label returned by the node function (instead of the fitted value)
to select the color. The first number in each label returned by the node function
is used, skipping over any non-numeric initial text in the label. An error mes-
 sage will be issued if a label doesn't include a number.
This argument is ignored if node.fun isn't specified, and is ignored for models
with multiple-class responses (more than two classes).

border.col
Color of the box border around the text. Default col, the color of the text in
the box. Use 0 for no border. (Note: par settings like col can be passed in as
...arguments. If not passed in, par("col") is used.)

round
Controls the rounding of the corners of the node boxes. Default NULL, meaning
calculate automatically. Else specify 0 for sharp edges, and values greater than
0 for rounded edges. Bigger is more round. Values too big for the size of the
box get silently reduced.

leaf.round
Controls the rounding of the corners of the leaf node boxes. Default NULL, mean-
ing use round. Else specify a value greater than or equal to 0.

shadow.col
Color of the shadow under the boxes. Default 0, no shadow. Try "gray" or
"darkgray". (Note: overlapping shadows look better on devices that support
alpha channels. If you get the message "Warning: semi-transparency is not
supported" please let me know – it means that a fix is needed to the code that
determines if the device supports alpha channels.)

prefix
Default ".". Prepend this string to the node labels. So could be the name of the
fitted response, for instance.

suffix
Default ".". Append this string to the node labels. Text after a double newline
"\n\n" (if any) will be plotted under the box. (Actually, double newlines can
be used in any of the prefix or suffix arguments for this purpose.)

xsep
String which separates the individual counts and probabilities in node labels
when extra>0. Default NULL meaning automatically select: usually
" " (two spaces), but "/" for rates. Use xsep="/" for compatibility with
text.rpart. See also facsep, which separates the factor levels in split labels.

under.percent
Control whitespace before the percentage (when 100 is used with the extra argu-
ment). One of
0 put a space before the percentage
1 put a newline before the percentage
2 (default) automatically choose a space or newline before the percentage.

The following control the text under the boxes (apply only if under=TRUE or
there is a double newline \n\n in prefix or suffix).

under.font
Font of the text under the box. Default font (which can be passed in as a
...argument).

under.col
Color of the text under the box. Default 1.

under.cex
Size of the text under the box relative to the text in the box. Default .8, smaller
than the text in the box.
The following control the split labels.

- **split.cex** Size of the split text relative to cex (which by default is calculated automatically). Default 1.
- **split.font** Font for the split labels. Default 2, bold. (Note: use font to change the node label text.)
- **split.family** Font family for the split labels. Default "", or use something like split.family="serif". (Note: use family to change the node label text.)
- **split.col** Color of the split label text. Default 1. (Note: use col to change the node label text.)
- **split.box.col** Color of the split boxes. Default 0, meaning use the background color.
- **split.border.col** Color of the split box borders. Default 0, invisible.
- **split.lty** Line type for the split box borders. The default is 1, but the border will be invisible unless you change the default split.border.col. (Note: use lty to change the node box borders.)
- **split.lwd** Line width of the split box border relative to cex (which by default is calculated automatically). The border is by default invisible, see codesplit.border.col.
- **split.round** Controls the rounding of the corners of the split boxes. Default 0, meaning sharp corners. Else specify a value greater than or equal to 0. The split boxes are by default invisible, see split.box.col and split.border.col.
- **split.shadow.col** Color of the shadow under the split boxes. Default 0, no shadow.
- **split.prefix** Default "". Prepend this string to the split labels.
- **right.split.prefix** Default split.prefix. Prepend this string to the right split labels. Applies only when type=3 or 4.
- **split.suffix** Default "". Append this string to the split labels.
- **right.split.suffix** Default "". Append this string to the right split labels. Applies only when type=3 or 4.
- **facsep** Default ",". String which separates the factor levels in split labels. See also xsep, which separates the individual counts when extra is used.
- **eq** Default " = ". String which separates the factor name from the levels in split labels. The idea is that you can add or remove spaces around the =, or use words if that suits you.
- **lt** Default " < ". String which represents “less than” in split labels.
- **ge** Default " >= ". String which represents “greater than or equal” in split labels.

The following control the branches.

- **branch.col** Color of the branch lines. Default 1, but set to "gray" if branch.type is nonzero.
- **branch.lty** Branch line type. Default 1.
prp

branch.lwd

Line width of the branch lines relative to cex (which by default is calculated automatically). (Note: branch.lwd does not control the width of the “wide branches” drawn when branch.type is nonzero.)

branch.type

Default 0. If nonzero draw “wide branches”, with branch widths proportional to the parameter selected by branch.type as follows:

0 The default. The branch lines are drawn conventionally.
1 deviance
2 sqrt(deviance)
3 deviance / nobs
4 sqrt(deviance / nobs) (the standard deviation when method="anova")
5 weight (frame$wt). This is the number of observations at the node, unless rpart’s weight argument was used.
6 complexity
7 abs(predicted value)
8 predicted value - min(predicted value)
9 constant (for checking visual perception of the relative width of branches).

Otherwise set branch.type to your own function. The function should take a single argument x (the rpart object) and return a numeric vector of non-negative widths corresponding to rows in frame. See get.branch.widths in the source code.

Note: with a nonzero branch.type, in the current implementation the branch argument will be silently changed to 1 (if branch > .5) or 0 (if branch < .5)

branch.tweak

Default 1. Applies only if branch.type is nonzero. Use this argument to scale the widths of the branches, for example, branch.tweak=.5 to halve the width of the branches. (By default, prp normalizes the widths so the widest branch is one-fifth the plot width.)

min.branch.width

Default 0.002. Applies only if branch.type is nonzero. The minimum width of a branch, as a fraction of the page width. The width of branches that would be thinner than min.branch.width is clamped. Increase min.branch.width if the thinnest branches are too skinny on your display device.

branch.fill

Color used to fill the wide branch lines. Applies only if branch.type is nonzero. Default branch.col.

The following control the node numbers (with nn=TRUE).

nn.cex

Default NULL, meaning calculate the cex of the node numbers automatically. This and the following arguments apply only when nn=TRUE.

nn.font

Font for the node numbers. Default 3, italic.

nn.family

Font family for the node numbers. Default "".

nn.col

Color of the node number text. Default 1.

nn.box.col

Color of the boxes around the node numbers. Default 0, meaning use the background color.

nn.border.col

Color of the box border around the node numbers. Default nn.col.
Line type of the node number box border. Default 1.

Line width of the node box border relative to cex (which by default is calculated automatically). Default NULL, meaning use lwd (which can be passed in as a ...argument).

Controls the rounding of the corners of the node number boxes. Default .3, meaning small corners. Else specify a value greater than or equal to 0.

Text displayed when yesno=TRUE. Default yes.text="yes" and no.text="no".

The following are user definable functions.

The function that generates the text at the node labels. The default is NULL, which means use a default function internal to prp. (This is necessary for full support of extra as described in the section on extra above.) Otherwise set node.fun to your own function with the prototype

See the package vignette for details. See also the pal.node.fun argument.

The function that generates the text at the splits. The default is NULL, which means use a default function internal to prp. Otherwise set split.fun to your own function with the prototype function(x, labs, digits, varlen, faclen)

The function that displays the text on the screen. Default text.

The following are esoteric parameters, mostly for the graph layout engine.

Applies only when compress=TRUE. Default nspace=branch. The size of the space between a split and a leaf, relative to the space between leaves.

Applies only when uniform=FALSE. Default .3. The minimum height between levels is clamped at minbranch times the mean interlevel distance. Needed because sometimes a split gives little or no improvement in deviance, and an interlevel distance strictly proportional to the improvement would leave no room for the label.

Default TRUE, meaning adjust the mar parameter so the tree fills the figure region. This also sets xpd=NA. These graphic parameters are restored to their original state before prp exits. If you explicitly set mar or xpd, prp will use your setting regardless of the setting of do.par.

Default TRUE, meaning display the labels. If FALSE, gives a bare bones display similar to plot.rpart.

Like clip.rightlabs but for the left labels. Default is FALSE. Note that clip.leftlabs and clip.rightlabs can be vectors, indexed on the split number.

Font family for the main text. Default ".". The (inconsistent) name was chosen to minimize partial matching with main and family which can be passed in as in as ...arguments.

Vertical position of the labels, in character heights relative to their default position. Default 0. Negative values move the text down; positive up (the box around the text will follow along).
yspace
Vertical space to the box border above and below the node label text, in character heights. Default space. See the comments for space.

shadow.offset
Offset of the shadow from the boxes, in character widths. Default .4 (but the shadow will be invisible unless the default shadow.col is changed).

split.adj
Horizontal position of the split text. In string width units, as is the convention for adj arguments. Default NULL, meaning use adj (which defaults to 0.5 but can be passed in as a . . . argument). Use values less/more than .5 to shift the text left/right (the box around the text will follow along).

split.yshift
Vertical position of the split labels, in character heights relative to their default positions. Default 0. Negative values move the text down; positive up (the box around the text will follow along). This adjusts the positions of the split labels relative to the node labels. (Use yshift if you want to shift both the split and node labels.)

split.space
Horizontal space between the split label text and the box, in character widths. Default space. Affects the size of the box drawn around the text. The split boxes are by default invisible (see split.box.col and split.border.col), but nevertheless affect the graph layout used in the automatic calculation of cex.

split.yspace
Vertical space between the split label text and the box, in character heights. Default yspace.

split.shadow.offset
Offset of the shadow from the split boxes, in character widths. Default shadow.offset. (but the shadow will be invisible unless the default shadow.col is changed).

nn.adj
Horizontal position of the node label text. Default .5.

nn.yshift
Vertical position of the node numbers, in character heights relative to their default positions. Default 0.

nn.space
Horizontal space to the box border on each side of the node number text, in character widths. Default .8.

nn.yspace
Vertical space to the box border above and below the node number text, in character heights. Default .5.

under.ygap
Applies if text is plotted under the box (i.e. if under=TRUE or there is a double newline in prefix or suffix). Vertical gap (in char heights) between the lower edge of the box and the top of the text under the box.

yesno.yshift
Vertical position of "yes" and "no" in character heights relative to their default position. Default 0. Applies only when yesno=TRUE.

ygap

xcompact
If TRUE (the default) and there is too much white space, automatically change xlim to compact the entire tree horizontally. This usually only activates for small trees. (The xcompact and ycompact arguments compact the tree as a whole, whereas the compress and ycompress arguments move parts of the tree into available space.)

ycompact
If TRUE (the default) and there is too much vertical space, automatically change ylim to compact the entire tree vertically.

xcompact.ratio
Default .8. Applies only when xcompact=TRUE. The maximum possible without overplotting is 1, but compacting by .8 usually gives more pleasing spacing (it gives more space).
min.inter.height
Default 4. Applies only when ycompact=TRUE. Minimum height (in units of character height) between the lowest label in a layer and the highest label in the layer below it.

max.auto.cex
Clamp the maximum automatically calculated cex at this value Default 1, meaning never expand cex, only contract when necessary.

min.auto.cex
Default .15. Never downscale to less than this when automatically calculating cex, even if overplotted labels result. (The graph layout algorithm is unstable with cex's below 0.15 – meaning that the automatic type size may be smaller than necessary.)

ycompress.cex
Default .7. Applies only when ycompress=TRUE. Apply the ycompress algorithm if the initial automatically calculated cex is less than this. The idea is that we don’t want to shift if we get an acceptable cex without shifting. Make Inf to always attempt shifting.

accept.cex
Accept shifting only if it causes at least this much improvement in cex (because we don’t want to shift if it gives only a small improvement in cex). Default 1.1 i.e. require at least a 10% improvement. Use 0 to always accept shifts and Inf to never accept (or use ycompress=FALSE).

shift.amounts
Default c(1.5, 2, 3). For ycompress, choose the best cex yielded by shifting nodes by these amounts, in multiples of the box heights (after initial scaling).

Fallen.yspace
Extra space for fallen leaves. Default .1, meaning allow 10% of the vertical space for the fallen leaves. (The name Fallen.yspace uses upper case to avoid partial matching with fallen.leaves.)

boxes.include.gap
Default FALSE. Include gap and ygap when drawing the boxes, for debugging purposes. (To draw the boxes, see box.col, border.col, split.box.col, and split.border.col.) This argument only affects the way the boxes are drawn, not the graph layout algorithm in any way. With the optimum cex at least one pair of boxes displayed in this manner will just touch (but none will overlap).

legend.x
Applies only to models with a multilevel class response (not binary or anova models, for which no legend is drawn). Horizontal position of the legend. Typically a value between 0 and 1, although values beyond those limits are often useful. Default is NULL meaning automatically position the legend (assuming there is enough space). Use NA for no legend. Use trace=TRUE to see the automatically calculated legend position.

legend.y
Like legend.x but for the vertical position of the legend.

legend.cex
Like legend.x but for the relative size of the legend text. Default is 1.

Value
A list with the following components. With the default args most of these are calculated automatically.
obj  The rpart object. Identical to the x argument passed in unless snip was used.
snipped.nodes  The snipped nodes, NULL unless snip was used.
xlim, ylim  The graph limits.
x, y  The node coords.
branch.x, branch.y  The branch line coords.
labs  The node labels.
cex  The node label cex.
boxes  The coords of the boxes around the nodes.
split.labs  The split labels.
split.cex  The split label cex.
split.boxes  The coords of the boxes around the splits.

See Also

The package vignette Plotting rpart trees with the rpart.plot package

rpart.plot

Functions in the rpart package: plot.rpart text.rpart rpart

Examples

data(ptitanic)
tree <- rpart(survived ~ ., data = ptitanic, cp = .02)
    # cp = .02 because want small tree for demo

old.par <- par(mfrow = c(2,2))
    # put 4 figures on one page

prp(tree, main = "default prp\n(type = 0, extra = 0)"

prp(tree, main = "type = 4, extra = 6\nbox.palette = \"auto\",
type = 4, extra = 6,  # label all nodes, show prob of second class
box.palette = "auto",  # auto color the nodes based on the model type
faclen = 0)  # faclen = 0 to print full factor names

cols <- ifelse(tree$frame$yval == 1, "darkred", "green")
    # green if survived

prp(tree, main = "assorted arguments",
extra = 106,  # display prob of survival and percent of obs
nn = TRUE,  # display the node numbers
fallen.leaves = TRUE,  # put the leaves on the bottom of the page
shadow.col = "gray",  # shadows under the leaves
branch.lty = 3,  # draw branches using dotted lines
branch = .5,  # change angle of branch lines
faclen = 0,  # faclen = 0 to print full factor names
trace = 1, # print the auto calculated cex, xlim, ylim
split.cex = 1.2, # make the split text larger than the node text
split.prefix = "is ", # put "is " before split text
split.suffix = "?", # put "?" after split text
col = cols, border.col = cols, # green if survived
split.box.col = "lightgray", # lightgray split boxes (default is white)
split.border.col = "darkgray", # darkgray border on split boxes
split.round = .5) # round the split box corners a tad

# compare to the plotting functions in the rpart package
plot(tree, uniform = TRUE, compress = TRUE, branch = .2)
text(tree, use.n = TRUE, cex = .8, xpd = NA) # cex is a guess, depends on your window size

par(old.par)

---

**ptitanic**

*Titanic data with passenger names and other details removed.*

**Description**

Titanic data with passenger names and other details removed.

**Format**

A data frame with 1046 observations on 6 variables.

- **pclass**: passenger class, unordered factor: 1st 2nd 3rd
- **survived**: factor: died or survived
- **sex**: unordered factor: male female
- **age**: age in years, min 0.167 max 80.0
- **sibsp**: number of siblings or spouses aboard, integer: 0...8
- **parch**: number of parents or children aboard, integer: 0...6

**Source**

The dataset was compiled by Frank Harrell and Robert Dawson:


See also:

http://biostat.mc.vanderbilt.edu/twiki/pub/Main/DataSets/titanic3info.txt.

For this version of the Titanic data, passenger details were deleted, survived was cast as a factor, and the name changed to `ptitanic` to minimize confusion with other versions.

In this data the crew are conspicuous by their absence.

Contents of `ptitanic`:

```
 pclass survived   sex   age sibsp parch
```
1       1st survived female 29.000   0   0  
2       1st survived   male  0.917    1   2  
3       1st    died female  2.000    1   2  
4       1st    died   male 30.000    1   2  
5       1st    died female 25.000    1   2  
...  
1309   3rd    died   male 29.000    0   0  

How ptitanic was built:

load("titanic3.sav") # from Dr. Harrell's web site  
# discard name, ticket, fare, cabin, embarked, body, home.dest  
ptitanic <- titanic3[,c(1,2,4,5,6,7)]  
# change survived from integer to factor  
ptitanic$survived <- factor(ptitanic$survived, labels = c("died", "survived"))  
save(ptitanic, file = "ptitanic.rda")

This version of the data differs from etitanic in the earth package in that here survived is a factor (not an integer) and age has some NAs.

Examples

data(ptitanic)
summary(ptitanic)

# survival rate was greater for females
rpart.rules(rpart(survived ~ sex, data = ptitanic))

# survival rate was greater for higher classes
rpart.rules(rpart(survived ~ pclass, data = ptitanic))

# survival rate was greater for children
rpart.rules(rpart(survived ~ age, data = ptitanic))

# main indicator of missing data is 3rd class esp. with many children
obs.with.nas <- rowSums(is.na(ptitanic)) > 0  
rpart.rules(rpart(obs.with.nas ~ ., data = ptitanic, method = "class"))

---

rpart.plot  
Plot an rpart model. A simplified interface to the prp function.

Description

Plot an rpart model, automatically tailoring the plot for the model's response type.
For an overview, please see the package vignette Plotting rpart trees with the rpart.plot package.
This function is a simplified front-end to \texttt{prp}, with only the most useful arguments of that function, and with different defaults for some of the arguments.

The different defaults for the \texttt{extra} and \texttt{col\_palette} arguments mean that this function automatically creates a colored plot suitable for the type of model (whereas \texttt{prp} by default creates a minimal plot). In detail the different defaults are:

\begin{verbatim}
<table>
<thead>
<tr>
<th>rpart.plot</th>
<th>prp</th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>2</td>
</tr>
<tr>
<td>extra</td>
<td>&quot;auto&quot;</td>
</tr>
<tr>
<td>fallen.leaves</td>
<td>TRUE</td>
</tr>
<tr>
<td>varlen</td>
<td>0</td>
</tr>
<tr>
<td>faclen</td>
<td>0</td>
</tr>
<tr>
<td>box.palette</td>
<td>&quot;auto&quot;</td>
</tr>
</tbody>
</table>
\end{verbatim}

The function \texttt{rpart.plot.version1} is compatible with old versions of this function and has the same defaults as \texttt{prp}.

Usage

\begin{verbatim}
rpart.plot(x = stop("no 'x' arg"),
  type = 2, extra = "auto",
  under = FALSE, fallen.leaves = TRUE,
  digits = 2, varlen = 0, faclen = 0, roundint = TRUE,
  cex = NULL, tweak = 1,
  clip.facs = FALSE, clip.right.labs = TRUE,
  snip = FALSE,
  box.palette = "auto", shadow.col = 0,
  ...)
\end{verbatim}

Arguments

To start off, look at the arguments \texttt{x}, \texttt{type} and \texttt{extra}. Just those arguments will suffice for many users. If you don’t want a colored plot, use \texttt{box.palette}=0.

An \texttt{rpart} object. The only required argument.

\textbf{type}

Type of plot. Possible values:

0 Draw a split label at each split and a node label at each leaf.
1 Label all nodes, not just leaves. Similar to \texttt{text.rpart}'s \texttt{all}=TRUE.
2 Default. Like 1 but draw the split labels below the node labels. Similar to the plots in the CART book.
3 Draw separate split labels for the left and right directions.
4 Like 3 but label all nodes, not just leaves. Similar to \texttt{text.rpart}'s \texttt{fancy}=TRUE. See also \texttt{clip.right.labs}.

5 \textbf{New in version 2.2.0.} Show the split variable name in the interior nodes.
extra

Display extra information at the nodes. Possible values:
"auto" (case insensitive) Default.
Automatically select a value based on the model type, as follows:
extra=106 class model with a binary response
extra=104 class model with a response having more than two levels
extra=100 other models

0 No extra information.
1 Display the number of observations that fall in the node (per class for class
objects; prefixed by the number of events for poisson and exp models). Similar
to text.rpart's use.n=TRUE.
2 Class models: display the classification rate at the node, expressed as the
number of correct classifications and the number of observations in the node.
Poisson and exp models: display the number of events.
3 Class models: misclassification rate at the node, expressed as the number of
incorrect classifications and the number of observations in the node.
4 Class models: probability per class of observations in the node (conditioned
on the node, sum across a node is 1).
5 Class models: like 4 but don’t display the fitted class.
6 Class models: the probability of the second class only. Useful for binary
responses.
7 Class models: like 6 but don’t display the fitted class.
8 Class models: the probability of the fitted class.
9 Class models: The probability relative to all observations – the sum of these
probabilities across all leaves is 1. This is in contrast to the options above, which
give the probability relative to observations falling in the node – the sum of the
probabilities across the node is 1.
10 New in version 2.2.0. Class models: Like 9 but display the probability of
the second class only. Useful for binary responses.
11 New in version 2.2.0. Class models: Like 10 but don’t display the fitted class.

+100 Add 100 to any of the above to also display the percentage of observations
in the node. For example extra=101 displays the number and percentage of ob-
servations in the node. Actually, it’s a weighted percentage using the weights
passed to rpart.

Note: Unlike text.rpart, by default prp uses its own routine for generating
node labels (not the function attached to the object). See the node.fun argu-
ment of prp.

under

Applies only if extra > 0. Default FALSE, meaning put the extra text in the
box. Use TRUE to put the text under the box.

fallen.leaves

Default TRUE to position the leaf nodes at the bottom of the graph. It can be
helpful to use FALSE if the graph is too crowded and the text size is too small.
digits

The number of significant digits in displayed numbers. Default 2. If 0, use `getOption("digits")`. If negative, use the standard `format` function (with the absolute value of digits).

When `digits` is positive, the following details apply:
Numbers from 0.001 to 9999 are printed without an exponent (and the number of digits is actually only a suggestion, see `format` for details). Numbers out that range are printed with an “engineering” exponent (a multiple of 3).

varlen

Length of variable names in text at the splits (and, for class responses, the class in the node label). Default 0, meaning display the full variable names. Possible values:

0 use full names (default).

greater than 0 call `abbreviate` with the given `varlen`.

less than 0 truncate variable names to the shortest length where they are still unique, but never truncate to shorter than `abs(varlen)`.

faclen

Length of factor level names in splits. Default 0, meaning display the full factor names. Possible values are as `varlen` above, except that for back-compatibility with `text.rpart` the special value 1 means represent the factor levels with alphabetic characters (a for the first level, b for the second, etc.).

roundint

New in version 3.0.0. If `roundint=TRUE` (default) and all values of a predictor in the training data are integers, then splits for that predictor are rounded to integer. For example, display `nsiblings < 3` instead of `nsiblings < 2.5`. If `roundint=TRUE` and the data used to build the model is no longer available, a warning will be issued.
Using `roundint=FALSE` is advised if non-integer values are in fact possible for a predictor, even though all values in the training data for that predictor are integral.

cex

Default `NULL`, meaning calculate the text size automatically. Since font sizes are discrete, the `cex` you ask for may not be exactly the `cex` you get.

tweak

Adjust the (possibly automatically calculated) `cex`. Using `tweak` is often easier than specifying `cex`.
The default `tweak` is 1, meaning no adjustment.
Use say `tweak=1.2` to make the text 20% larger.
Since font sizes are discrete, a small change to `tweak` may not actually change the type size, or change it more than you want.

clip.facs

New in version 3.0.0. Default `FALSE`. If `TRUE`, print splits on factors as `female` instead of `sex = female`; the variable name and equals is dropped.
Another example: print `survived` or `died` rather than `survived = survived` or `survived = died`. 
clip.right.labs
Applies only if type=3 or 4.
Default is TRUE meaning "clip" the right-hand split labels, i.e., don't print variable=.

snip
Default FALSE. Set TRUE to interactively trim the tree with the mouse. See the package vignette (or just try it).

box.palette
Palette for coloring the node boxes based on the fitted value. This is a vector of colors, for example box.palette=c("green", "green2", "green4"). Small fitted values are displayed with colors at the start of the vector; large values with colors at the end. Quantiles are used to partition the fitted values. The special value box.palette=0 (default for prp) uses the background color (typically white).
The special value box.palette="auto" (default for rpart.plot, case insensitive) automatically selects a predefined palette based on the type of model.
Otherwise specify a predefined palette e.g. box.palette="Grays" for the predefined gray palette (a range of grays). The predefined palettes are (see the show.prp.palettes function):
Grays Greys Greens Blues Browns Oranges Reds Purples Gy Gn Bu Bn Or Rd Pu (alternative names for the above palettes)
BuGn GnRd BuOr etc. (two-color diverging palettes: any combination of two of the above palettes)
RdYlGn GnYlRd B1GnY1 Y1GnB1 (three color palettes)
Prefix the palette name with "-" to reverse the order of the colors e.g. box.palette="-auto" or box.palette="-Grays".

shadow.col
Color of the shadow under the boxes. Default 0, no shadow. Try "gray" or "darkgray".

Extra arguments passed to prp and the plotting routines. Any of prp's arguments can be used.

Value
The returned value is identical to that of prp.

Author(s)
Stephen Milborrow, borrowing heavily from the rpart package by Terry M. Therneau and Beth Atkinson, and the R port of that package by Brian Ripley.

See Also
The package vignette Plotting rpart trees with the rpart.plot package
prp
rpart.plot.version1
rpart.rules
Functions in the rpart package: plot.rpart text.rpart rpart
**Examples**

```r
old.par <- par(mfrow=c(2,2))  # put 4 figures on one page
data(titanic)

#-------------------------------

binary.model <- rpart(survived ~ ., data = ptitanic, cp = .02)
# cp = .02 for small demo tree
rpart.plot(binary.model,
  main = "titanic survived\n(binary response)"
)
rpart.plot(binary.model, type = 3, clip.right.labs = FALSE,
  branch = .4,
  box.palette = "Grays",
  main = "type = 3, clip.right.labs = FALSE, ...
"
)

#-------------------------------
anova.model <- rpart(Mileage ~ ., data = cu.summary)
rpart.plot(anova.model,
  shadow.col = "gray",  # add shadows just for kicks
  main = "miles per gallon\n(continuous response)"
)

#-------------------------------
multi.class.model <- rpart(Re liability ~ ., data = cu.summary)
rpart.plot(multi.class.model,
  main = "vehicle reliability\n(multi class response)"

par(old.par)
```

---

**Description**

This function is provided for backward compatibility with old versions of `rpart.plot` (prior to version 2.0.0, June 2016).

By default this function creates a minimal unadorned plot, whereas `rpart.plot` creates a colored plot automatically tailored to the model's type.

Actually, the only difference between the two functions is that some arguments have different defaults. This function has the same defaults as `prp`. See the `rpart.plot` help page for a table showing the different defaults.
Usage

rpart.plot.version1(x = stop("no 'x' arg"),
  type = 0, extra = 0,
  under = FALSE, fallen.leaves = FALSE,
  digits = 2, varlen = -8, faclen = 3,
  cex = NULL, tweak = 1,
  snip = FALSE,
  box.palette = 0, shadow.col = 0,
  ...
)

Arguments

x
  Same as rpart.plot.
type
  Default 0. Same as rpart.plot.
extra
  Default 0, otherwise the same as rpart.plot (which has a default of "auto").
under
  Default FALSE. Same as rpart.plot.
fallen.leaves
  Default FALSE, otherwise the same as rpart.plot (which has a default of TRUE).
digits
  Default 2. Same as rpart.plot.
varlen
  Default -8, otherwise the same as rpart.plot (which has a default of 0).
faclen
  Default 3, otherwise the same as rpart.plot (which has a default of 0).
cex
  Default NULL. Same as rpart.plot.
tweak
  Default 1. Same as rpart.plot.
snip
  Default FALSE. Same as rpart.plot.
box.palette
  Default 0, otherwise the same as rpart.plot (which has a default of "auto").
shadow.col
  Default 0. Same as rpart.plot.
...
  Same as rpart.plot.

Value

The returned value is identical to that of prp.

Examples

data(titanic)
tree <- rpart(survived ~ ., data = ptitanic, cp = .02)
  # cp = .02 because want small tree for demo

tree <- rpart(survived ~ ., data = ptitanic, cp = .02)
  # cp = .02 because want small tree for demo

old.par <- par(mfrow = c(2,2))
  # put 4 figures on one page

rpart.plot.version1(tree, main = "default rpart.plot.version1\n(type = 0, extra = 0)")
rpart.plot.version1(tree, main = "type = 4, extra = 6",
  type = 4, extra = 6,
  faclen = 0) # faclen = 0 to print full factor names
rpart.predict

Extended version of predict.rpart

Description

Identical to predict.rpart but optionally show the node numbers and rules for the predicted values.

Usage

rpart.predict(object, newdata, type = c("vector", "prob", "class", "matrix"), na.action = na.pass, nn=FALSE, rules=FALSE, ...)

Arguments

object, newdata, type, na.action

Identical to the same arguments for predict.rpart. If both nn and rules are FALSE, the returned value is identical to predict.rpart.

nn

If TRUE, return a data.frame with the predictions as usual but with an extra column showing the leaf node number for each prediction.

rules

If TRUE, return a data.frame with the predictions as usual but with an extra column showing the rpart rule (as a string) for each prediction. It may be helpful to use options(width=1000) before printing this data.frame.

...

Passed on to rpart.rules, for example clip.facs=TRUE.

Value

Same as predict.rpart, but with additional information if nn=TRUE and/or rules=TRUE.

See Also

predict.rpart
rpart.rules
Examples

data(ptitanic)
model <- rpart(survived ~ ., data = ptitanic, cp = .02)
head(rpart.predict(model, rules=TRUE))

rpart.rules

Print an rpart model as a set of rules.

Description

Print an rpart model as a set of rules.

Usage

rpart.rules(x = stop("no 'x' argument"),
    style = "wide", cover = FALSE, nn = FALSE,
    roundint = TRUE, clip.facs = FALSE,
    varorder = NULL, ...)

## S3 method for class 'rpart.rules'
print(x = stop("no 'x' argument"), style = attr(x, "style"), ...)

Arguments

x An rpart object. The only required argument.

style One of:
"wide" (default) One rule per line. May require a lot of horizontal space.
"tall" One split per line.
"tallw" Like "tall" but with more horizontal white space for readability.

cover Default FALSE. If TRUE, also print the percentage of cases covered by each rule.

nn Default FALSE. If TRUE, also print the leaf node number for each rule.

roundint If roundint=TRUE (default) and all values of a predictor in the training data are integers, then splits for that predictor are rounded to integer. For example, display nsiblings < 3 instead of nsiblings < 2.5. Identical to the argument of the same name in rpart.plot, see there for details.

clip.facs Default FALSE. If TRUE, print splits on factors as female instead of sex = female; the variable name and equals is dropped.

Identical to the argument of the same name in rpart.plot.

varorder By default, the variables in the rules are ordered left to right on importance, where the “importance” of a variable here is the number of rules it appears in. Use varorder to force variables to appear first in the rules. For example varorder="sex" or varorder=c("sex", "pclass") will put the specified variables first.

Partial matching of variable names is supported.

... The following can be passed as dot arguments. See prp for details on these arguments.
show.prp.palettes

<table>
<thead>
<tr>
<th>argument</th>
<th>default</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>extra</td>
<td>&quot;auto&quot;</td>
<td>a subset of the legal values for prp are supported</td>
</tr>
<tr>
<td>digits</td>
<td>2</td>
<td>default is two digits of accuracy, increase if necessary</td>
</tr>
<tr>
<td>varlen</td>
<td>0</td>
<td>default displays full variable names</td>
</tr>
<tr>
<td>faclen</td>
<td>0</td>
<td>default displays full factor names</td>
</tr>
<tr>
<td>trace</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>facsep</td>
<td>&quot; or &quot;</td>
<td></td>
</tr>
<tr>
<td>eq</td>
<td>&quot; is &quot;</td>
<td></td>
</tr>
<tr>
<td>lt</td>
<td>&quot; &lt; &quot;</td>
<td></td>
</tr>
<tr>
<td>ge</td>
<td>&quot; &gt;= &quot;</td>
<td></td>
</tr>
<tr>
<td>and</td>
<td>&quot; &amp; &quot;</td>
<td></td>
</tr>
<tr>
<td>when</td>
<td>&quot; when &quot;</td>
<td></td>
</tr>
<tr>
<td>because</td>
<td>&quot; because &quot;</td>
<td>used only by rpart.predict</td>
</tr>
<tr>
<td>null.model</td>
<td>&quot;null model&quot;</td>
<td>for root-only models (no splits)</td>
</tr>
<tr>
<td>response.name</td>
<td>NULL</td>
<td>the response name printed before the rules (NULL means automatic)</td>
</tr>
</tbody>
</table>

Value

A data.frame of class c("rpart.rules", "data.frame") with some attached attributes which are passed on to print.rpart.rules. Note that print.rpart.rules temporarily increases options(width).

See Also

rpart.plot

Examples

data(ptitanic)
model <- rpart(survived ~ ., data = ptitanic, cp = .02)
rpart.plot(model)
rpart.rules(model)

show.prp.palettes  Show the built-in prp palettes.

Description

Display a diagram showing the built-in palettes accepted by prp's box.palette argument.

Usage

show.prp.palettes()

Examples

show.prp.palettes()
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