Package ‘RevGadgets’

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Type Package

Title Visualization and Post-Processing of ‘RevBayes’ Analyses

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Description Processes and visualizes the output of complex phylogenetic analyses from the ‘RevBayes’ phylogenetic graphical modeling software.


BugReports https://github.com/revbayes/RevGadgets/issues

License GPL-3

Encoding UTF-8

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biocViews

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Suggests testthat, knitr, rmarkdown, phangorn

NeedsCompilation no

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**calculateShiftBayesFactor**

Bayes Factors in support of a shift in diversification rates over a given time interval.

---

**Description**

This function computes the Bayes Factor in favor of a rate-shift between time t1 and t2 (t1 < t2). The default assumption (suitable to standard HSMRF and GMRF models) is that the prior probability of a shift is 0.5.

**Usage**

```r
calculateShiftBayesFactor(
  rate_trace,
  time_trace,
  rate_name,
  time_name,
  t1,
  t2,
  prior_prob = 0.5,
  decrease = TRUE,
  return_2lnBF = TRUE
)
```

**Arguments**

- `rate_trace` (list; no default) The processed Rev output of the rate of interest through time for computation (output of readTrace()).
- `time_trace` (list; no default) The processed Rev output of the change/interval times of the rate of interest through time for computation (output of readTrace()).
- `rate_name` (character; no default) The name of the parameter (e.g. "speciation") for which Bayes Factor is to be calculated.
- `time_name` (character; no default) The name of the interval times (e.g. "interval_times") for the rate change times.
- `t1` (numeric; no default) Support will be assessed for a shift between time t1 and time t2 (t1 < t2).
- `t2` (numeric; no default) Support will be assessed for a shift between time t1 and time t2 (t1 < t2).
- `prior_prob` (numeric; 0.5) The prior probability of a shift over this interval (default of 0.5 applies to standard HSMRF- and GMRF-based models).
- `decrease` (logical; default TRUE) Should support be assessed for a decrease in the parameter (if TRUE) or an increase (if FALSE) between t1 and t2?
- `return_2lnBF` (logical; TRUE) Should the 2ln(BF) be returned (if TRUE) or simply the BF (if FALSE)?
Value

The Bayes Factor.

References


Examples

```r
#' # download the example datasets to working directory
url_times <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_speciation_times.log"
dest_path_times <- "primates_EBD_speciation_times.log"
download.file(url_times, dest_path_times)

url_rates <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_speciation_rates.log"
dest_path_rates <- "primates_EBD_speciation_rates.log"
download.file(url_rates, dest_path_rates)

# to run on your own data, change this to the path to your data file
speciation_time_file <- dest_path_times
speciation_rate_file <- dest_path_rates

speciation_times <- readTrace(speciation_time_file, burnin = 0.25)
speciation_rate <- readTrace(speciation_rate_file, burnin = 0.25)

calculateShiftBayesFactor(speciation_rate,
  speciation_times,
  "speciation",
  "interval_times",
  0.0, 40.0,
  decrease=FALSE)

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_times, dest_path_rates)
```

<table>
<thead>
<tr>
<th>colFun</th>
<th>Color Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Produce default RevGadgets colors</td>
</tr>
</tbody>
</table>
**colFun(n)**

**Arguments**
- **n** (integer; no default) Number of colors to return. Maximum of 12.

**Details**
- Produces a vector of colors from the default RevGadgets colors of length given by n, maximum of 12 colors.

**Value**
- Character vector of color hex codes.

**Examples**
```
my_colors <- colFun(2)
```

---

**combineTraces**

**Description**
- Combine traces into one trace file

**Usage**
```
combineTraces(traces, burnin = 0)
```

**Arguments**
- **traces** (list of data frames; no default) Name of a list of data frames, such as produced by readTrace().
- **burnin** (single numeric value; default = 0.0) Fraction of generations to discard (if value provided is between 0 and 1) or number of generations to discard (if value provided is greater than 1) before combining the samples.

**Details**
- Combines multiple traces from independent MCMC replicates into one trace file.

**Value**
- combineTraces() returns a list of data frames of length 1, corresponding to the combination of the provided samples.
Examples

```r
# download the example dataset to working directory
url_1 <-  
"https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR_run_1.log"
dest_path_1 <- "primates_cytb_GTR_run_1.log"
download.file(url_1, dest_path_1)

url_2 <-  
"https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR_run_2.log"
dest_path_2 <- "primates_cytb_GTR_run_2.log"
download.file(url_2, dest_path_2)

# to run on your own data, change this to the path to your data file
file_1 <- dest_path_1
file_2 <- dest_path_2

# read in the multiple trace files
multi_trace <- readTrace(path = c(file_1, file_2), burnin = 0.0)

# combine samples after discarding 10% burnin
combined_trace <- combineTraces(trace = multi_trace, 
   burnin = 0.1)

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_1, dest_path_2)
```

densiTreeWithBranchData

*DensiTree-style plot with branch-specific data*

Description

This function plots a distribution of trees (e.g. obtained from an MCMC inference) with branch-specific rates or other data. The plot is similar to those produced by DensiTree, i.e. all the trees are overlapped with each other. The data is expected to be given per node, and will be associated with the branch above its corresponding node. Its values are plotted as a color gradient.

Usage

densiTreeWithBranchData(
   tree_files = NULL,
densiTreeWithBranchData

burnin = 0.1,  
trees = NULL,  
data = NULL,  
data_name = NULL,  
type = "cladogram",  
consensus = NULL,  
direction = "rightwards",  
scaleX = FALSE,  
width = 1,  
lty = 1,  
cex = 0.8,  
font = 3,  
tip.color = 1,  
adj = 0,  
srt = 0,  
keep_underscores = FALSE,  
label_offset = 0.01,  
scale_bar = TRUE,  
jitter = list(amount = 0, random = TRUE),  
color_gradient = c("red", "yellow", "green"),  
alpha = NULL,  
bias = 1,  
data_intervals = NULL, ...}

Arguments

- **tree_files**: vector of tree files in NEXUS format with data attached to the branches/nodes of the tree. All trees should have the same tip labels (the order can change). Either tree_files or both trees and data have to be specified.

- **burnin**: fraction of samples to discard from the tree files as burn-in. Default 0.1.

- **trees**: multiPhylo object or list of trees in phylo format. All trees should have the same tip labels (the order can change). Either tree_files or both trees and data have to be specified.

- **data**: data to be plotted on the tree - expected to be a list of vectors in the same order as the trees, each vector in the order of the tips and nodes of the corresponding tree

- **data_name**: Only used when reading from tree_files. Name of the data to be plotted, if multiple are present.

- **type**: character string specifying the type of phylogeny. Options are "cladogram" (default) or "phylogram".

- **consensus**: A tree or character vector which is used to define the order of the tip labels. If NULL will be calculated from the trees.

- **direction**: a character string specifying the direction of the tree. Options are "rightwards" (default), "leftwards", "upwards" and "downwards".
scaleX  whether to scale trees to have identical heights. Default FALSE.
width   width of the tree edges.
lty     line type of the tree edges.
cex     a numeric value giving the factor scaling of the tip labels.
font    an integer specifying the type of font for the labels: 1 (plain text), 2 (bold), 3 (italic, the default), or 4 (bold italic).
tip.color color of the tip labels.
adj     a numeric specifying the justification of the text strings of the tip labels: 0 (left-justification), 0.5 (centering), or 1 (right-justification).
srt     a numeric giving how much the labels are rotated in degrees.
keep_underscores whether the underscores in tip labels should be written as spaces (the default) or left as they are (if TRUE).
label_offset a numeric giving the space between the nodes and the tips of the phylogeny and their corresponding labels.
scale_bar whether to add a scale bar to the plot. Default TRUE.
jitter   controls whether to shift trees. a list with two arguments: the amount of jitter and random or equally spaced (see details below)
color_gradient range of colors to be used for the data, in order of increasing values. Defaults to red to yellow to green.
alpha    transparency parameter for tree colors. If NULL will be set based on the number of trees.
bias     bias applied to the color gradient. See colorRampPalette for more details.
data_intervals value intervals used for the color gradient. Can be given as a vector of interval boundaries or min and max values. If NULL will be set based on the data.
...      further arguments to be passed to plot.

Details
If no consensus tree is provided, a consensus tree will be computed. This should avoid too many unnecessary crossings of edges. Trees should be rooted, other wise the output may not be visually pleasing. The jitter parameter controls whether to shift trees so that they are not exactly on top of each other. If amount = 0, no jitter is applied. If random = TRUE, the applied jitter is calculated as runif(n, -amount, amount), otherwise seq(-amount, amount, length=n), where n is the number of trees.

Value
No return value, produces plot in base R

References
This code is adapted from the densiTree function by Klaus Schliep <klaus.schliep@gmail.com>. densiTree is inspired from the DensiTree program by Remco Bouckaert.
Examples

# generate random trees & data
trees <- lapply(1:5, function(x) ape::rcoal(5))
data <- lapply(1:5, function(x) stats::runif(9, 1, 10))

# densiTree plot
densiTreeWithBranchData(trees = trees, data = data, width = 2)

# densiTree plot with different colors
densiTreeWithBranchData(trees = trees, data = data,
color_gradient = c("green", "blue"), width = 2)

Description

Drop one or multiple tips from your tree

Usage

dropTip(tree, tips)

Arguments

  tree          (list of lists of treedata objects; no default) Name of a list of lists of treedata objects, such as produced by readTrees().
  tips          (character or numeric, no default) The tips(s) to drop. Either a single taxon name or node number or vector of such.

Details

Modifies a tree object (in RevGadget’s format) by dropping one or more tips from the tree and from any associated data. Wrapper for treeio::drop.tip().

Value

returns a list of list of treedata objects, with the modified tips.

See Also

treeio: drop.tip and ape: drop.tip.
Examples

```r
file <- system.file("extdata",
                   "sub_models/primates_cytb_GTR_MAP.tre",
                   package="RevGadgets")
tree <- readTrees(paths = file)
tree_dropped <- dropTip(tree, "Otolemur_crassicaudatus")
```

Description

Modified from RmcdrPlugin.KMggplot2 step ribbon plots.

Usage

```r
geom_stepribbon(
mapping = NULL,
data = NULL,
stat = "identity",
position = "identity",
na.rm = FALSE,
show.legend = NA,
inherit.aes = TRUE,
...
)
```

Arguments

- **mapping**: Set of aesthetic mappings created by `aes()`. If specified and `inherit.aes = TRUE` (the default), it is combined with the default mapping at the top level of the plot. You must supply `mapping` if there is no plot mapping.
- **data**: The data to be displayed in this layer. There are three options:
  - If NULL, the default, the data is inherited from the plot data as specified in the call to `ggplot()`.
  - A data.frame, or other object, will override the plot data. All objects will be fortified to produce a data frame. See `fortify()` for which variables will be created.
  - A function will be called with a single argument, the plot data. The return value must be a data.frame, and will be used as the layer data. A function can be created from a formula (e.g. `~ head(.x, 10)`).
- **stat**: The statistical transformation to use on the data for this layer, either as a ggproto Geom subclass or as a string naming the stat stripped of the `stat_` prefix (e.g. "count" rather than "stat_count")
Position adjustment, either as a string naming the adjustment (e.g. "jitter" to use `position_jitter`), or the result of a call to a position adjustment function. Use the latter if you need to change the settings of the adjustment.

**na.rm**
If `FALSE`, the default, missing values are removed with a warning. If `TRUE`, missing values are silently removed.

**show.legend**
Logical. Should this layer be included in the legends? `NA`, the default, includes if any aesthetics are mapped. `FALSE` never includes, and `TRUE` always includes. It can also be a named logical vector to finely select the aesthetics to display.

**inherit.aes**
If `FALSE`, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn’t inherit behaviour from the default plot specification, e.g. `borders()`.

**...**
Other arguments passed on to `layer()`. These are often aesthetics, used to set an aesthetic to a fixed value, like `colour = "red"` or `size = 3`. They may also be parameters to the paired geom/stat.

Details

`geom_stepribbon` is an extension of the `geom.ribbon`, and is optimized for Kaplan-Meier plots with pointwise confidence intervals or a confidence band.

See Also

- `geom.ribbon` `geom_stepribbon` inherits from `geom.ribbon`. `geom_stepribbon` is modified from RcmdrPlugin.KMggplot2::geom_stepribbon.

Examples

```r
huron <- data.frame(year = 1875:1972, level = as.vector(LakeHuron))

h <- ggplot2::ggplot(huron, ggplot2::aes(year))

h + geom_stepribbon(ggplot2::aes(ymin = level - 1, ymax = level + 1),
                      fill = "grey70") +
     ggplot2::geom_step(ggplot2::aes(y = level))

# contrast ggplot2::geom.ribbon with geom_stepribbon:
# contrast ggplot2::geom.ribbon with geom_stepribbon:
# h + ggplot2::geom.ribbon(ggplot2::aes(ymin = level - 1, ymax = level + 1),
#                          fill = "grey70") +
#     ggplot2::geom.line(ggplot2::aes(y = level))
```

Description

Calculates the Maximum a Posteriori estimate for the trace of a quantitative variable
getMAP

Usage

getMAP(var)

Arguments

var (numeric vector; no default) Vector of the samples from the trace of a quantitative variable

Details

Uses the SANN method of the optim() function to approximate the MAP estimate

Value

the MAP estimate

See Also

optim

Examples

# download the example dataset to working directory
url <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR.log"
dest_path <- "primates_cytb_GTR.log"
download.file(url, dest_path)

# to run on your own data, change this to the path to your data file
file <- dest_path

trace <- readTrace(paths = file)
MAP <- getMAP(trace[[1]]"pi[1"])

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path)
matchNodes

Description
match Nodes

Usage
matchNodes(phy)

Arguments
phy (tree in ape format; no default) Tree on which to match nodes

Value
a data frame that translates ape node numbers to RevBayes node numbers

Examples

treefile <- system.file("extdata", "bds/primates.tre", package="RevGadgets")
tree <- readTrees(treefile)
map <- matchNodes(tree[[1]][[1]]@phylo)

plotAncStatesMAP

Description
Plots the MAP estimates of ancestral states. Can accommodate cladogenetic reconstructions by plotting on shoulders. Defaults to varying the symbols by color to indicate estimated ancestral state and varying the size of the symbol to indicate the posterior probability of that estimate, but symbol shape may also vary to accommodate black and white figures. For more details on the aesthetics options, see parameter details below. For data with many character states (such as chromosome counts), vary the size of the symbol by estimated ancestral state, and vary the posterior probability of that estimate by a color gradient. Text labels at nodes and tips are also available.
plotAncStatesMAP

Usage

plotAncStatesMAP(
  t,
  cladogenetic = FALSE,
  tip_labels = TRUE,
  tip_labels_size = 2,
  tip_labels_offset = 1,
  tip_labels_italics = FALSE,
  tip_labels_formatted = FALSE,
  tip_labels_remove_underscore = TRUE,
  tip_labels_states = FALSE,
  tip_labels_states_size = 2,
  tip_labels_states_offset = 0.1,
  node_labels_as = NULL,
  node_labels_size = 2,
  node_labels_offset = 0.1,
  node_labels_centered = FALSE,
  node_size_as = "state_posterior",
  node_color_as = "state",
  node_shape_as = NULL,
  node_shape = 19,
  node_color = "default",
  node_size = c(2, 6),
  tip_states = TRUE,
  tip_states_size = node_size,
  tip_states_shape = node_shape,
  state_transparency = 0.75,
  tree_layout = "rectangular",
  timeline = FALSE,
  geo = timeline,
  geo_units = list("epochs", "periods"),
  time_bars = timeline,
  ...
)

Arguments

t (treedata object; none) Output of processAncStates() function containing tree and ancestral states.
cladogenetic (logical; FALSE) Plot shoulder states of cladogenetic analyses?
tip_labels (logical; TRUE) Label taxa labels at tips?
tip_labels_size (numeric; 2) Size of tip labels.
tip_labels_offset (numeric; 1) Horizontal offset of tip labels from tree.
tip_labels_italics (logical; FALSE) Italicize tip labels?
Do the tip labels contain manually added formatting information? Will set parse = TRUE in geom_text() and associated functions to interpret formatting. See ?plotmath for more. Cannot be TRUE if tip_labels_italics = TRUE.

Remove underscores from tip labels?

Optional plotting of text at tips in addition to taxa labels.

Size of state labels at tips. Ignored if tip_labels_states is FALSE.

Horizontal offset of tip state labels. Ignored if tip_labels_states = NULL.

Optional plotting of text at nodes. Possible values are "state" for the ancestral states, "state_posterior" for posterior probabilities of the estimated ancestral state, "node_posterior" or the posterior probability of the node on the tree, or NULL for not plotting any text at the nodes (default).

Size of node labels text. Ignored if node_labels_as = NULL.

Horizontal offset of node labels from nodes. Ignored if node_labels_as = NULL.

Should node labels be centered over the nodes? Defaults to FALSE: adjusting node labels to the right of nodes and left of shoulders.

How to vary size of node symbols. Options are "state_posterior" (default) for posterior probabilities of the estimated ancestral state, "node_posterior" or the posterior probability of the node on the tree, "state" for vary size by the ancestral state itself in cases where there are many character states (e.g. chromosome numbers; we do not recommend this option for characters with few states), or NULL for fixed symbol size.

How to vary to color of node symbols. Options are "state" (default) to vary by estimated ancestral states, "state_posterior" for posterior probabilities of the estimated ancestral state, "node_posterior" or the posterior probability of the node on the tree, or NULL to set all as one color.

Option to vary node symbol by shape. Options are NULL to keep shape constant or "state" to vary shape by ancestral state.

Shape type for nodes. If node_shape_as = "state", provide a vector with length of the number of states. See ggplot2 documentation for details: https://ggplot2.tidyverse.org/articles/ggplot2-specs.html#point

Colors for node symbols. Defaults to default RevGadgets colors. If node_color_as = "state", provide a vector of length of the character states. If your color vector is labeled with state labels, the legend will be displayed in the order of the labels. If node_color_as = "posterior", provide a vector of length 2 to generate a color gradient.
node_size (numeric; c(2, 6)) Range of sizes, or fixed size, for node symbols. If node_size_as = "state_posterior", "node_posterior", or "state", numeric vector of length two. If node_size_as = NULL, numeric vector of length one. Size regulates the area of the symbol, following ggplot2 best practices: https://ggplot2.tidyverse.org/reference/scale_size.html

tip_states (logical; TRUE) Plot states of taxa at tips?
tip_states_size (numeric; node_size) Size for tip symbols. Defaults to the same size as node symbols.
tip_states_shape (integer; node_shape) Shape for tip symbols. Defaults to the same as node symbols.
state_transparency (integer; 0.75) Alpha (transparency) of state symbols- varies from 0 to 1.
tree_layout (character; "rectangular") Tree shape layout, passed to ggtree(). Options are 'rectangular', 'slanted', 'ellipse', 'roundrect', 'fan', 'circular', 'inward_circular', 'radial', 'equal_angle', 'daylight' or 'ape'. When cladogenetic = TRUE, only "rectangular" and 'circular' are available.
timeline (logical; FALSE) Plot time tree with labeled x-axis with timescale in MYA.
geo (logical; timeline) Add a geological timeline? Defaults to the same as timeline.
geo_units (list; list("epochs", "periods")) Which geological units to include in the geo timescale. May be "periods", "epochs", "stages", "eons", "eras", or a list of two of those units.
time_bars (logical; timeline) Add vertical gray bars to indicate geological timeline units if geo == TRUE or regular time intervals (in MYA) if geo == FALSE.
...
(Various) Additional arguments passed to ggtree::ggtree().

Value
A ggplot object

Examples

# Standard ancestral state reconstruction example with various aesthetics
# process file
file <- system.file("extdata", "comp_method_disc/ase_freeK.tree", package="RevGadgets")
example <- processAncStates(file, state_labels = c("1" = "Awesome", "2" = "Beautiful", "3" = "Cool!")

# have states vary by color and indicate state pp with size (default)
plotAncStatesMAP(t = example)
# have states vary by color and indicate state pp with size, 
# and add a timeline
plotAncStatesMAP(t = example, timeline = TRUE)

# have states vary by color and symbol, label nodes with pp of states
plotAncStatesMAP(t = example, node_shape_as = "state",  
        node_size = 4, node_shape = c(15, 17, 20),  
        node_size_as = NULL, node_labels_as = "state_posterior")

# black and white figure - state as symbols and state pp with text
plotAncStatesMAP(t = example, node_color_as = NULL,  
        node_shape_as = "state", node_shape = c(15, 17, 20),  
        node_size_as = NULL, node_size = 4,  
        node_labels_as = "state_posterior",  
        node_color = "grey", state_transparency = 1)

# default with circular tree
plotAncStatesMAP(t = example, tree_layout = "circular")

# Chromosome evolution example

# process file
file <- system.file("extdata",  
    "chromo/ChromEvol_simple_final.tree",  
    package="RevGadgets")
chromo_example <- processAncStates(file, labels_as_numbers = TRUE)

# plot
plotAncStatesMAP(t = chromo_example, node_color_as = "state_posterior",  
        node_size_as = "state", node_color = colFun(2),  
        tip_labels_offset = 0.005, node_labels_as = "state",  
        node_labels_offset = 0, tip_labels_states = TRUE,  
        tip_labels_states_offset = 0, tip_states = FALSE)

# DEC example (cladogenetic)

# process file
file <- system.file("extdata", "dec/simple.ase.tre", package="RevGadgets")
labs <- c("1" = "K", "2" = "O", "3" = "M", "4" = "H", "5" = "KO",  
     "6" = "KM", "7" = "OM", "8" = "KH", "9" = "OH", "10" = "MH", "11" = "KOM",  
     "12" = "KOH", "13" = "KOMH", "14" = "OMH", "15" = "KOMM")
dec_example <- processAncStates(file, state_labels = labs)

# plot
plotAncStatesMAP(t = dec_example,  
        cladogenetic = TRUE,  
        tip_labels_offset = 0.5)
plotAncStatesPie  plot Ancestral States Pie

Description
Plot character states and posterior probabilities as pies on nodes.

Usage

plotAncStatesPie(
  t,
  cladogenetic = FALSE,
  tip_labels = TRUE,
  tip_labels_size = 2,
  tip_labels_offset = 1,
  tip_labels_italics = FALSE,
  tip_labels_formatted = FALSE,
  tip_labels_remove_underscore = TRUE,
  tip_labels_states = FALSE,
  tip_labels_states_size = 2,
  tip_labels_states_offset = 0.1,
  node_labels_as = NULL,
  node_labels_size = 2,
  node_labels_offset = 0.1,
  pie_colors = "default",
  node_pie_size = 1,
  shoulder_pie_size = node_pie_size,
  tip_pies = TRUE,
  tip_pie_size = 0.5,
  node_pie_nudge_x = 0,
  node_pie_nudge_y = 0,
  tip_pie_nudge_x = node_pie_nudge_x,
  tip_pie_nudge_y = node_pie_nudge_y,
  shoulder_pie_nudge_x = node_pie_nudge_x,
  shoulder_pie_nudge_y = node_pie_nudge_y,
  state_transparency = 0.75,
  timeline = FALSE,
  geo = timeline,
  geo_units = list("epochs", "periods"),
  time_bars = timeline,
  ...
)

Arguments

  t  (treedata object; none) Output of processAncStates() function containing tree and ancestral states.
cladogenetic  (logical; FALSE) Plot shoulder pies of cladogenetic analyses?
tip_labels   (logical; TRUE) Label taxa labels at tips?
tip_labels_size
  (numeric; 2) Size of tip labels.
tip_labels_offset
  (numeric; 1) Horizontal offset of tip labels from tree.
tip_labels_italics
  (logical; FALSE) Italicize tip labels?
tip_labels_formatted
  (logical; FALSE) Do the tip labels contain manually added formatting information? Will set parse = TRUE in geom_text() and associated functions to interpret formatting. See ?plotmath for more. Cannot be TRUE if tip_labels_italics = TRUE.
tip_labels_remove_underscore
  (logical; TRUE) Remove underscores from tip labels?
tip_labels_states
  (logical; FALSE) Optional plotting of text at tips in addition to taxa labels. Will plot the MAP state label.
tip_labels_states_size
  (numeric; 2) Size of state labels at tips. Ignored if tip_labels_states is FALSE.
tip_labels_states_offset
  (numeric; 0.1) Horizontal offset of tip state labels. Ignored if tip_labels_states = NULL.
node_labels_as
  (character; NULL) Optional plotting of text at nodes. Possible values are "state" for the MAP ancestral states, "node_posterior" for the posterior probability of the node on the tree, "state_posterior" for the posterior probability of the MAP, or NULL for not plotting any text at the nodes (default).
node_labels_size
  (numeric; 2) Size of node labels text. Ignored if node_labels_as = NULL.
node_labels_offset
  (numeric; 0.1) Horizontal offset of node labels from nodes. Ignored if node_labels_as = NULL.
pie_colors  ("character"; "default") Colors for states in pies. If "default", plots the default RevGadgets colors. Provide a character vector of hex codes or other R-readable colors the same length of the number of character states. Names of the vector should correspond to state labels.
node_pie_size
  (numeric; 1) Size (diameter) of the pies at nodes.
shoulder_pie_size
  (numeric; node_pie_size) Size (diameter) of the pies at shoulders for cladogenetic plots.
tip_pies    (logical; TRUE) Plot pies tips?
tip_pie_size
  (numeric; 0.5) Size (diameter) of the pies at tips.
node_pie_nudge_x
  (numeric; 0) If pies aren’t centered, adjust by nudging
node_pie_nudge_y
  (numeric; 0) If pies aren’t centered, adjust by nudging

tip_pie_nudge_x
  (numeric; node_pie_nudge_x) If pies aren’t centered, adjust by nudging

tip_pie_nudge_y
  (numeric; node_pie_nudge_y) If pies aren’t centered, adjust by nudging

shoulder_pie_nudge_x
  (numeric; node_pie_nudge_x) If pies aren’t centered, adjust by nudging

shoulder_pie_nudge_y
  (numeric; node_pie_nudge_y) If pies aren’t centered, adjust by nudging

state_transparency
  (integer; 0.75) Alpha (transparency) of state symbols- varies from 0 to 1.

timeline
  (logical; FALSE) Plot tree with labeled x-axis with timescale in MYA.

geo
  (logical; timeline) Add a geological timeline? Defaults to the same as timeline.

geo_units
  (list; list("epochs", "periods")) Which geological units to include in the geo timescale. May be "periods", "epochs", "stages", "eons", "eras", or a list of two of those units.

time_bars
  (logical; timeline) Add vertical gray bars to indicate geological timeline units if geo == TRUE or regular time intervals (in MYA) if geo == FALSE.

... (various) Additional arguments passed to ggtree::ggtree().

Value

A ggplot object

Examples

# Standard ancestral state reconstruction example

# process file and assign state labels
file <- system.file("extdata", 
  "comp_method_disc/ase_freeK.tree", 
  package="RevGadgets")
example <- processAncStates(file, 
  state_labels = c("1" = "Awesome", 
    "2" = "Beautiful", 
    "3" = "Cool!")
)

# plot (this may take a while)
plotAncStatesPie(t = example)

# DEC Biogeographic range evolution example (with timeline)

# process file
file <- system.file("extdata", "dec/simple.ase.tre", package="RevGadgets")
# labels that correspond to each region/ possible combination of regions
labs <- c("1" = "K", "2" = "O", "3" = "M", "4" = "H", "5" = "KO",
   "6" = "KM", "7" = "OM", "8" = "KH", "9" = "OH", "10" = "MH",
   "11" = "KOM", "12" = "KOH", "13" = "KMH", "14" = "OMH",
   "15" = "KOMH")
dec_example <- processAncStates(file, state_labels = labs)
# Use the state_labels in returned tidytree object to define color palette
# These state_labels may be a subset of the labels you provided
# (not all possible regions may be sampled in the dataset)
colors <- colorRampPalette(colFun(12))(length(dec_example@state_labels))
names(colors) <- dec_example@state_labels

# plot
plotAncStatesPie(t = dec_example, pie_colors = colors, tip_labels_size = 3,
   cladogenetic = TRUE, tip_labels_offset = 0.25, timeline = TRUE,
   geo = FALSE) +
ggplot2::theme(legend.position = c(0.1, 0.75))

---

**plotDiversityOBDP**  
*Plot Diversity Distribution from OBDP Analysis*

**Description**

Plots the probability distribution of the number of lineages through time inferred with the Occurrence Birth Death Process #'

**Usage**

```r
plotDiversityOBDP(
  Kt_mean,
  xlab = "Time",
  ylab = "Number of lineages",
  xticks_n_breaks = 5,
  col_Hidden = "dodgerblue3",
  col_LTT = "gray25",
  col_Total = "forestgreen",
  col_Hidden_interval = "dodgerblue2",
  col_Total_interval = "darkolivegreen4",
  palette_Hidden = c("transparent", "dodgerblue2", "dodgerblue3", "dodgerblue4", "black"),
  palette_Total = c("transparent", "green4", "forestgreen", "black"),
  line_size = 0.7,
  interval_line_size = 0.5,
  show_Hidden = TRUE,
  show_LTT = TRUE,
  show_Total = TRUE,
  show_intervals = TRUE,
)```
show_densities = TRUE,
show_expectations = TRUE,
use_interpolate = TRUE
)

**Arguments**

- **Kt_mean** (data.frame; no default) The processed data.frame (output of readOBDP()).
- **xlab** (character; "Time") The label of the x-axis.
- **ylab** (character; "Number of lineages") The label of the y-axis.
- **xticks_n_breaks** (numeric; 5) An integer guiding the number of major breaks.
- **col_Hidden** (character; "dodgerblue3") The color of the hidden lineages plot line.
- **col_LTT** (character; "gray25") The color of the LTT plot line.
- **col_Total** (character; "forestgreen") The color of the total lineages plot line.
- **col_Hidden_interval** (character; "dodgerblue2") The color of the credible interval lines around the hidden lineages plot.
- **col_Total_interval** (character; "darkolivegreen4") The color of the credible interval lines around the total lineages plot.
- **palette_Hidden** (character; c("transparent", "dodgerblue2", "dodgerblue3", "dodgerblue4", "black")) The palette of the hidden lineages plot distribution.
- **palette_Total** (character; c("transparent", "green4", "forestgreen", "black")) The palette of the total lineages plot distribution.
- **line_size** (numeric; 0.7) The width of the lineage plot line.
- **interval_line_size** (numeric; 0.5) The width of the credible interval.
- **show_Hidden** (boolean; TRUE) Whether to show the plot for hidden lineages.
- **show_LTT** (boolean; TRUE) Whether to show the plot for observed lineages.
- **show_Total** (boolean; TRUE) Whether to show the plot for total lineages.
- **show_intervals** (boolean; TRUE) Whether to show the credible intervals.
- **show_densities** (boolean; TRUE) Whether to show the diversity densities.
- **show_expectations** (boolean; TRUE) Whether to show the diversity expectations.
- **use_interpolate** (boolean; TRUE) Whether to interpolate densities.

**Value**

A ggplot object
Examples

```r
## Not run:
# first run readOBDP()
start_time_trace_file <-
  system.file("extdata", "obdp/start_time_trace.p", package="RevGadgets")
popSize_distribution_matrices_file <-
  system.file("extdata", "obdp/Kt_trace.p", package="RevGadgets")
trees_trace_file <-
  system.file("extdata", "obdp/mcmc_OBDP_trees.p", package="RevGadgets")

Kt_mean <- readOBDP( start_time_trace_file=start_time_trace_file,
  popSize_distribution_matrices_file=popSize_distribution_matrices_file,
  trees_trace_file=trees_trace_file )

# then get the customized ggplot object with plotDiversityOBDP()
p <- plotDiversityOBDP( Kt_mean,
  xlab="Time (My)",
  ylab="Number of lineages",
  xticks_n_breaks=21,
  col_Hidden="dodgerblue3",
  col_LTT="gray25",
  col_Total="forestgreen",
  col_Hidden_interval="dodgerblue2",
  col_Total_interval="darkolivegreen4",
  palette_Hidden=c("transparent", "dodgerblue2", "dodgerblue3",
                  "dodgerblue4", "black"),
  palette_Total=c("transparent", "green4", "forestgreen", "black"),
  line_size=0.7,
  interval_line_size=0.5,
  show_Hidden=TRUE,
  show_LTT=TRUE,
  show_Total=TRUE,
  show_intervals=TRUE,
  show_densities=TRUE,
  show_expectations=TRUE,
  use_interpolate=TRUE )

# basic plot
p

# option: add a stratigraphic scale
library(deeptime)
library(ggplot2)
q <- gggeo_scale(p, dat="periods", height=unit(1.3, "line"), abbrv=F, size=4.5, neg=T)
r <- gggeo_scale(q, dat="epochs", height=unit(1.1, "line"), abbrv=F, size=3.5, neg=T,
                 skip=c("Paleocene", "Pliocene", "Pleistocene", "Holocene"))
s <- gggeo_scale(r, dat="stages", height=unit(1, "line"), abbrv=T, size=2.5, neg=T)
s
## End(Not run)```
plotDivRates  

**Plot Diversification Rates**

**Description**

Plots the output of an episodic diversification rate analysis

**Usage**

plotDivRates(rates, facet = TRUE)

**Arguments**

- **rates**
  - (list of dataframes; no default) A list of dataframes, such as produced by processDivRates(), containing the data on rates and interval times for each type of rate to be plotted (e.g. speciation rate, etc.).

- **facet**
  - (logical; TRUE) plot rates in separate facets.

**Details**

Plots the output of episodic diversification rate analyses. Takes as input the output of processDivRates() and plotting parameters. For now, only variable names (under "item") that contain the word "rate" are included in the plot.

The return object can be manipulated. For example, you can change the axis labels, the color palette, whether the axes are to be linked, or the overall plotting style/theme, just as with any ggplot object.

**Value**

A ggplot object

**Examples**

```r
# download the example datasets to working directory

url_ex_times <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_extinction_times.log"
dest_path_ex_times <- "primates_EBD_extinction_times.log"
download.file(url_ex_times, dest_path_ex_times)

url_ex_rates <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_extinction_rates.log"
dest_path_ex_rates <- "primates_EBD_extinction_rates.log"
download.file(url_ex_rates, dest_path_ex_rates)

url_sp_times <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_speciation_times.log"
```
dest_path_sp_times <- "primates_EBD_speciation_times.log"
download.file(url_sp_times, dest_path_sp_times)

url_sp_rates <- "https://revbayes.github.io/tutorials/intro/data/primates_EBD_speciation_rates.log"
dest_path_sp_rates <- "primates_EBD_speciation_rates.log"
download.file(url_sp_rates, dest_path_sp_rates)

# to run on your own data, change this to the path to your data file
speciation_time_file <- dest_path_sp_times
speciation_rate_file <- dest_path_sp_rates
destination_time_file <- dest_path_ex_times
destination_rate_file <- dest_path_ex_rates

rates <- processDivRates(speciation_time_log = speciation_time_file,
                          speciation_rate_log = speciation_rate_file,
                          extinction_time_log = extinction_time_file,
                          extinction_rate_log = extinction_rate_file,
                          burnin = 0.25)

# then plot results:
p <- plotDivRates(rates = rates);p

# change the x-axis
p <- p + ggplot2::xlab("Thousands of years ago");p

# change the colors
p <- p + ggplot2::scale_fill_manual(values = c("red",
                                         "green",
                                         "yellow",
                                         "purple")) +
    ggplot2::scale_color_manual(values = c("red",
                                         "green",
                                         "yellow",
                                         "purple"));p

# let's say we don't want to plot relative-extinction rate,
# and use the same y-axis for all three rates
rates <- rates[!grepl("relative-extinction", rates$item),]
p2 <- plotDivRates(rates)
p2 <- p2 + ggplot2::facet_wrap(ggplot2::vars(item), scale = "fixed");p2

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_sp_times, dest_path_ex_times,
dest_path_sp_rates, dest_path_ex_rates)
plotFBDTree  

Plot FBD tree

Description

Plots a single FBD tree, such as an MCC or MAP tree.

Usage

plotFBDTree(
  tree,
  timeline = FALSE,
  geo = timeline,
  geo_units = list("epochs", "periods"),
  time_bars = timeline,
  node_age_bars = TRUE,
  tip_age_bars = TRUE,
  age_bars_color = "blue",
  age_bars_colored_by = NULL,
  node_labels = NULL,
  node_labels_color = "black",
  node_labels_size = 3,
  node_labels_offset = 0,
  tip_labels = TRUE,
  tip_labels_italics = FALSE,
  tip_labels_formatted = FALSE,
  tip_labels_remove_underscore = TRUE,
  tip_labels_color = "black",
  tip_labels_size = 3,
  tip_labels_offset = 0,
  node_pp = FALSE,
  node_pp_shape = 16,
  node_pp_color = "black",
  node_pp_size = "variable",
  branch_color = "black",
  color_branch_by = NULL,
  line_width = 1,
  label_sampled_ancs = FALSE,
  ...
)

Arguments

tree  
(list of lists of treedata objects; no default) Name of a list of lists of treedata objects, such as produced by readTrees(). This object should only contain only one summary tree from one trace file. If it contains multiple trees or multiple traces, only the first will be used.
timeline (logical; FALSE) Plot time tree with labeled x-axis with timescale in MYA. #'
geo (logical; timeline) Add a geological timeline? Defaults to the same as timeline.
geo_units (list; list("epochs", "periods");) Which geological units to include in the geo
timescale. May be "periods", "epochs", "stages", "eons", "eras", or a list of
two of those units.
time_bars (logical; timeline) Add vertical gray bars to indicate geological timeline units if
geo == TRUE or regular time intervals (in MYA) if geo == FALSE.
node_age_bars (logical; TRUE) Plot time tree with node age bars?
tip_age_bars (logical; FALSE) Plot node age bars for the tips as well? Useful for plotting
serial sampled analyses or fossilized birth-death analyses, or any cases where
some tip ages are estimated.
age_bars_color (character; "blue") Color for node/tip age bars. If age_bars_colored_by specifies
a variable (not NULL), you must provide two colors, low and high values for a
gradient. Colors must be either R valid color names or valid hex codes.
age_bars_colored_by (character; NULL) Specify column to color node/tip age bars by, such as "post-
erior". If null, all age bars plotted the same color, specified by age_bars_color
node_labels (character; NULL) Plot text labels at nodes, specified by the name of the corre-
sponding column in the tidytree object. If NULL, no text is plotted.
node_labels_color (character; "black") Color to plot node_labels, either as a valid R color name or
a valid hex code.
node_labels_size (numeric; 3) Size of node labels
node_labels_offset (numeric; 0) Horizontal offset of node labels from nodes.
tip_labels (logical; TRUE) Plot tip labels?
tip_labels_italics (logical; FALSE) Plot tip labels in italics?
tip_labels_formatted (logical; FALSE) Do the tip labels contain manually added formatting informa-
tion? Will set parse = TRUE in geom_text() and associated functions to inter-
pret formatting. See ?plotmath for more. Cannot be TRUE if tip_labels_italics
= TRUE.
tip_labels_remove_underscore (logical; FALSE) Should underscores be replaced by spaces in tip labels?
tip_labels_color (character; "black") Color to plot tip labels, either as a valid R color name or a
valid hex code.
tip_labels_size (numeric; 3) Size of tip labels
tip_labels_offset (numeric; 1) Horizontal offset of tip labels from tree.
node_pp (logical; FALSE) Plot posterior probabilities as symbols at nodes? Specify sym-
bol aesthetics with node_pp_shape, node_pp_color, and node_pp_size.
node_pp_shape  (integer; 1) Integer corresponding to point shape (value between 0-25). See ggplot2 documentation for details: \(\text{https://ggplot2.tidyverse.org/articles/ggplot2-specs.html#point}\)

node_pp_color  (character; "black") Color for node_pp symbols, either as valid R color name(s) or hex code(s). Can be a single character string specifying a single color, or a vector of length two specifying two colors to form a gradient. In this case, posterior probabilities will be indicated by color along the specified gradient.

node_pp_size  (numeric or character; 1) Size for node_pp symbols. If numeric, the size will be fixed at the specified value. If a character, it should specify "variable", indicating that size should be scaled by the posterior value. Size regulates the area of the shape, following ggplot2 best practices: \(\text{https://ggplot2.tidyverse.org/reference/scale_size.html}\)

branch_color  (character; "black") A single character string specifying the color (R color name or hex code) for all branches OR a vector of length 2 specifying two colors for a gradient, used to color the branches according to the variable specified in color_branch_by. If only 1 color is provided and you specify color_branch_by, default colors will be chosen (low = "#005ac8", high = "#fa7850").

color_branch_by  (character; NULL ) Optional name of one quantitative variable in the treedata object to color branches, such as a rate.

line_width  (numeric; 1) Change line width for branches

label_sampled_ancs  (logical; FALSE) Label any sampled ancestors? Will inherent tip labels aesthetics for size and color.

...  (various) Additional arguments passed to ggtree::ggtree().

Details

Plots a single tree, such as an MCC or MAP tree, with special features for plotting the output of fossilized birth-death analyses.

Value

returns a single plot object.

Examples

```r
file <- system.file("extdata", "fbd/bears.mcc.tre", package="RevGadgets")
tree <- readTrees(paths = file)
plotFBDTree(tree = tree, timeline = TRUE, tip_labels_italics = FALSE,
tip_labels_remove_underscore = TRUE,
node_age_bars = TRUE, age_bars_colored_by = "posterior",
age_bars_color = rev(colFun(2))) +
ggplot2::theme(legend.position=c(.25, .85))
```
plotHiSSE

Description

plotHiSSE

Usage

plotHiSSE(rates)

Arguments

rates (data.frame; no default) a data frame containing columns "value", "rate", "hidden_state", "observed_state" (such as the output of processSSE())

Value

a ggplot object

Examples

# download the example dataset to working directory
url <- "https://revbayes.github.io/tutorials/intro/data/primates_HiSSE_2.log"
dest_path <- "primates_HiSSE_2.log"
download.file(url, dest_path)

# to run on your own data, change this to the path to your data file
hisse_file <- dest_path
pdata <- processSSE(hisse_file)
p <- plotHiSSE(pdata); p

# change colors:
p + ggplot2::scale_fill_manual(values = c("red","green"))

# change x-axis label
p + ggplot2::xlab("Rate (events/Ma)")

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path)
**plotMassExtinctions**

**Plot Mass Extinction Support**

### Description
Plots the support (as 2ln Bayes factors) for mass extinctions.

### Usage
```r
plotMassExtinctions(
  mass_extinction_trace,  # (list; no default) The processed Rev output of the mass extinction probabilities (output of readTrace()).
  mass_extinction_times,  # (numeric; no default) Vector of the fixed grid of times at which mass extinctions were allowed to occur.
  mass_extinction_name,  # (character; no default) The name of the mass extinction probability parameter (e.g. "mass_extinction_probabilities") for which support is to be calculated/plotted.
  prior_prob,            # (numeric; no default) The per-interval prior probability of a mass extinction (one minus the p parameter in RevBayes’ dnReversibleJumpMixture()).
  return_2lnBF = TRUE    # (logical; TRUE) Should the 2ln(BF) be returned (if TRUE) or simply the BF (if FALSE)?
)
```

### Arguments
- `mass_extinction_trace`
- `mass_extinction_times`
- `mass_extinction_name`
- `prior_prob`
- `return_2lnBF`

### Details
Works only for analyses with a fixed grid where mass extinctions may occur.
The return object can be manipulated. For example, you can change the axis labels, the color palette, whether the axes are to be linked, or the overall plotting style/theme, just as with any ggplot object.

### Value
A ggplot object

### References
Examples

# download the example dataset to working directory
url <-
  "https://revbayes.github.io/tutorials/intro/data/crocs_mass_extinction_probabilities.log"
dest_path <- "crocs_mass_extinction_probabilities.log"
download.file(url, dest_path)

# to run on your own data, change this to the path to your data file
mass_extinction_probability_file <- dest_path

mass_extinction_probabilities <-
  readTrace(mass_extinction_probability_file,burnin = 0.25)

# prior probability of mass extinction at any time
prior_n_expected <- 0.1
n_intervals <- 100
prior_prob <- prior_n_expected/(n_intervals-1)

# times when mass extinctions were allowed
tree_age <- 243.5
interval_times <- tree_age * seq(1/n_intervals,(n_intervals-1) /
  n_intervals,1/n_intervals)

# then plot results:
p <- plotMassExtinctions(mass_extinction_trace=mass_extinction_probabilities,
  mass_extinction_times=interval_times,
  mass_extinction_name="mass_extinction_probabilities",
prior_prob);p

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path)

Description

plotMuSSE

Usage

plotMuSSE(rates)
plotPostPredStats

Arguments

rates (data.frame; no default) a data frame containing columns "value", "rate", "hidden_state", "observed_state" (such as the output of processSSE())

Value

a ggplot object

Examples

# download the example dataset to working directory
url <- "https://revbayes.github.io/tutorials/intro/data/primates_BiSSE_activity_period.log"
dest_path <- "primates_BiSSE_activity_period.log"
download.file(url, dest_path)

# to run on your own data, change this to the path to your data file
bisse_file <- dest_path
pdata <- processSSE(bisse_file)
p <- plotMuSSE(pdata); p

# change colors:
p + ggplot2::scale_fill_manual(values = c("red","green"))

# change x-axis label
p + ggplot2::xlab("Rate (events/Ma)"

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path)

plotPostPredStats plot Posterior Predictive Statistics

Description

Plots the posterior predictive statistics data

Usage

plotPostPredStats(data, prob = c(0.9, 0.95), col = NULL, side = "both")
plotPostPredStats

Arguments

data (list of data frames; no default) A list of data frames of the empirical and simulated values, such as the output of processPostPredStats.R
prob (vector of numerics; default c(0.9, 0.95)) The posterior-predictive intervals to shade.
col (vector of colors; default NULL) The colors for each quantile. Defaults to blue and red.
side (character; default "both") Whether the intervals are on "both" sides, the "left" side, or the "right" side of the distribution.

Details

Produces one ggplot object per metric. Intended to plot the results of the RevBayes tutorial: Assessing Phylogenetic Reliability Using RevBayes and P3 Model adequacy testing using posterior prediction (Data Version).

Each plot shows the rejection region for the provided quantiles, as well as a p-value for the observed statistic. If side="left" ("right"), then the p-value is the fraction of simulated statistics that are less than (greater than) or equal to the observed statistic. If side="both", then the p-value is calculated by first fitting a KDE to the samples, then computing the fraction of simulated statistics with density lower than the density of the observed statistic; in this sense, the "both" option computes the size of HPD defined by the observed statistic.

Value

A list of ggplot objects, where each plot contains a density distribution of the predicted values and a dashed line of the empirical value. The blue shaded region of the density plot corresponds to the 5% two-sided quantile and the orange corresponds to the 2% two-sided quantile.

Examples

# download the example datasets to working directory

url_emp <-
  "https://revbayes.github.io/tutorials/intro/data/empirical_data_pps_example.csv"
dest_path_emp <- "empirical_data_pps_example.csv"
download.file(url_emp, dest_path_emp)

url_sim <-
  "https://revbayes.github.io/tutorials/intro/data/simulated_data_pps_example.csv"
dest_path_sim <- "simulated_data_pps_example.csv"
download.file(url_sim, dest_path_sim)

# to run on your own data, change this to the path to your data file

file_sim <- dest_path_sim
file_emp <- dest_path_emp

t <- processPostPredStats(path_sim = file_sim,
```r
path_emp = file_emp)
plots <- plotPostPredStats(data = t)
plots[[1]]

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_sim, dest_path_emp)
```

---

**plotTrace**

*Plot trace*

**Description**

Plots the posterior distributions of variables from trace file.

**Usage**

```r
plotTrace(trace, color = "default", vars = NULL, match = NULL)
```

**Arguments**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>trace</code></td>
<td>(list of data frames; no default) Name of a list of data frames, such as produced by readTrace(). If the readTrace() output contains multiple traces (such as from multiple runs), summarizeTrace() will provide summaries for each trace individually, as well as the combined trace.</td>
</tr>
<tr>
<td><code>color</code></td>
<td>(&quot;character&quot;: &quot;default&quot;) Colors for parameters. Defaults to default RevGadgets colors. For non-default colors, provide a named vector of length of the number of parameters.</td>
</tr>
<tr>
<td><code>vars</code></td>
<td>(character or character vector; NULL) The specific name(s) of the variable(s) to be summarized.</td>
</tr>
<tr>
<td><code>match</code></td>
<td>(character; NULL) A string to match to a group of parameters. For example, match = &quot;er&quot; will plot the variables &quot;er[1]&quot;, &quot;er[2]&quot;, &quot;er[3]&quot;, etc. match will only work if your search string is followed by brackets in one or more of the column names of the provided trace file. match = &quot;er&quot; will only return the exchangeability parameters, but will not plot &quot;Posterior&quot;.</td>
</tr>
</tbody>
</table>

**Details**

Plots the posterior distributions of continuous variables from one or multiple traces (as in, from multiple runs). Shaded regions under the curve represent the 95% credible interval. If multiple traces are provided, plotTrace() will plot each run independently as well as plot the combined output. Note that for variables with very different distributions, overlaying the plots may result in illegible figures. In these cases, we recommend plotting each parameter separately.
Value

plotTrace() returns a list of the length of provided trace object, plus one combined trace. Each element of the list contains a ggplot object with plots of the provided parameters. These plots may be modified in typical ggplot fashion.

Examples

# example with quantitative parameters

# download the example dataset to working directory
url_gtr <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR.log"
dest_path_gtr <- "primates_cytb_GTR.log"
download.file(url_gtr, dest_path_gtr)

# to run on your own data, change this to the path to your data file
file <- dest_path_gtr

one_trace <- readTrace(paths = file)
plots <- plotTrace(trace = one_trace,
                    vars = c("pi[1]","pi[2]","pi[3]","pi[4]"))
plots[[1]]

# add custom colors
plots <- plotTrace(trace = one_trace,
                    vars = c("pi[3]","pi[4]","pi[1]","pi[2]"),
                    color = c("pi[1]" = "green",
                              "pi[2]" = "red",
                              "pi[3]" = "blue",
                              "pi[4]" = "orange"))
plots[[1]]

# make the same plot, using match
plots <- plotTrace(trace = one_trace, match = "pi")
plots[[1]]

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_gtr)

# plot some qualitative variables

# download the example dataset to working directory
url_rj <- "https://revbayes.github.io/tutorials/intro/data/freeK_RJ.log"
dest_path_rj <- "freeK_RJ.log"
download.file(url_rj, dest_path_rj)

file <- dest_path_rj
trace <- readTrace(path = file)

plots <- plotTrace(trace = trace,
   vars = c("prob_rate_12", "prob_rate_13",
            "prob_rate_31", "prob_rate_32"))
plots[[1]]

# with custom colors
plots <- plotTrace(trace = trace,
   vars = c("prob_rate_12", "prob_rate_13",
            "prob_rate_31", "prob_rate_32"),
   color = c("prob_rate_12" = "green",
            "prob_rate_13" = "red",
            "prob_rate_31" = "blue",
            "prob_rate_32" = "orange"))
plots[[1]]

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_rj)

---

**plotTree**

*Plot tree*

**Description**

Plots a single tree, such as an MCC or MAP tree.

**Usage**

```r
plotTree(
  tree,
  timeline = FALSE,
  geo_units = list("epochs", "periods"),
  geo = timeline,
  time_bars = timeline,
  node_age_bars = FALSE,
  age_bars_color = "blue",
  age_bars_colored_by = NULL,
  node_labels = NULL,
  node_labels_color = "black",
  node_labels_size = 3,
  node_labels_offset = 0,
  tip_labels = TRUE,
  tip_labels_italics = FALSE,
```
plotTree

```
tip_labels_formatted = FALSE,
tip_labels_remove_underscore = TRUE,
tip_labels_color = "black",
tip_labels_size = 3,
tip_labels_offset = 0,
node_pp = FALSE,
node_pp_shape = 16,
node_pp_color = "black",
node_pp_size = "variable",
branch_color = "black",
color_branch_by = NULL,
line_width = 1,
tree_layout = "rectangular",
...
```

Arguments

- **tree** (list of lists of treedata objects; no default) Name of a list of lists of treedata objects, such as produced by readTrees(). This object should only contain only one summary tree from one trace file. If it contains multiple trees or multiple traces, only the first will be used.

- **timeline** (logical; FALSE) Plot time tree with labeled x-axis with timescale in MYA.

- **geo_units** (list; list("epochs", "periods")) Which geological units to include in the geo timescale. May be "periods", "epochs", "stages", "eons", "eras", or a list of two of those units.

- **geo** (logical; timeline) Add a geological timeline? Defaults to the same as timeline.

- **time_bars** (logical; timeline) Add vertical gray bars to indicate geological timeline units if geo == TRUE or regular time intervals (in MYA) if geo == FALSE.

- **node_age_bars** (logical; FALSE) Plot time tree with node age bars?

- **age_bars_color** (character; "blue") Color for node age bars. If age_bars_colored_by specifies a variable (not NULL), you must provide two colors, low and high values for a gradient. Colors must be either R valid color names or valid hex codes.

- **age_bars_colored_by** (character; NULL) Specify column to color node age bars by, such as "posterior". If null, all node age bars plotted the same color, specified by age_bars_color

- **node_labels** (character; NULL) Plot text labels at nodes, specified by the name of the corresponding column in the tidytree object. If NULL, no text is plotted.

- **node_labels_color** (character; "black") Color to plot node_labels, either as a valid R color name or a valid hex code.

- **node_labels_size** (numeric; 3) Size of node labels

- **node_labels_offset** (numeric; 0) Horizontal offset of node labels from nodes.

- **tip_labels** (logical; TRUE) Plot tip labels?
plotTree

- **tip_labels_italics**
  (logical; FALSE) Plot tip labels in italics?

- **tip_labels_formatted**
  (logical; FALSE) Do the tip labels contain manually added formatting information? Will set parse = TRUE in geom_text() and associated functions to interpret formatting. See ?plotmath for more. Cannot be TRUE if tip_labels_italics = TRUE.

- **tip_labels_remove_underscore**
  (logical; TRUE) Remove underscores in tip labels?

- **tip_labels_color**
  (character; "black") Color to plot tip labels, either as a valid R color name or a valid hex code.

- **tip_labels_size**
  (numeric; 3) Size of tip labels

- **tip_labels_offset**
  (numeric; 1) Horizontal offset of tip labels from tree.

- **node_pp**
  (logical; FALSE) Plot posterior probabilities as symbols at nodes? Specify symbol aesthetics with node_pp_shape, node_pp_color, and node_pp_size.

- **node_pp_shape**
  (integer; 1) Integer corresponding to point shape (value between 0-25). See ggplot2 documentation for details: [https://ggplot2.tidyverse.org/articles/ggplot2-specs.html#point](https://ggplot2.tidyverse.org/articles/ggplot2-specs.html#point)

- **node_pp_color**
  (character; "black") Color for node_pp symbols, either as valid R color name(s) or hex code(s). Can be a single character string specifying a single color, or a vector of length two specifying two colors to form a gradient. In this case, posterior probabilities will be indicated by color along the specified gradient.

- **node_pp_size**
  (numeric or character; 1) Size for node_pp symbols. If numeric, the size will be fixed at the specified value. If a character, it should specify "variable", indicating that size should be scaled by the posterior value. Size regulates the area of the shape, following ggplot2 best practices: [https://ggplot2.tidyverse.org/reference/scale_size.html](https://ggplot2.tidyverse.org/reference/scale_size.html)

- **branch_color**
  (character; "black") A single character string specifying the color (R color name or hex code) for all branches OR a vector of length 2 specifying two colors for a gradient, used to color the branches according to the variable specified in color_branch_by. If only 1 color is provided and you specify color_branch_by, default colors will be chosen (low = "#005ac8", high = "#fa7850").

- **color_branch_by**
  (character; NULL) Optional name of one quantitative variable in the treedata object to color branches, such as a rate.

- **line_width**
  (numeric; 1) Change line width for branches

- **tree_layout**
  (character; "rectangular") Tree shape layout, passed to ggtree(). Options are 'rectangular', 'cladogram', 'slanted', 'ellipse', 'roundrect', 'fan', 'circular', 'inward_circular', 'radial', 'equal_angle', 'daylight', or 'ape'.

... (various) Additional arguments passed to ggtree::ggtree().
plotTreeFull

Details

Plots a single tree, such as an MCC or MAP tree, with optionally labeled posterior probabilities at nodes, a timescale plotted on the x-axis, and 95% CI for node ages.

Value

returns a single plot object.

Examples

# Example of standard tree plot

file <- system.file("extdata", 
  "sub_models/primates_cytb_GTR_MAP.tre", 
  package="RevGadgets")

## Root tree before plotting

# Tree

tree <- readTrees(paths = file)

# Plot

p <- plotTree(tree = tree_rooted, node_labels = "posterior");p

# Plot unladderized tree

p <- plotTree(tree = tree_rooted,
  node_labels = "posterior", 
  ladderize = FALSE);p

# We can add a scale bar:

p + ggtree::geom_treescale(x = -0.35, y = -1)

# Example of coloring branches by rate

file <- system.file("extdata", 
  "relaxed_ou/relaxed_OU_MAP.tre", 
  package="RevGadgets")

## Tree

p <- plotTree(tree = tree,
  node_age_bars = FALSE,
  node_pp = FALSE,
  tip_labels_remove_underscore = TRUE,
  tip_labels_italics = FALSE,
  color_branch_by = "branch_thetas",
  line_width = 1.7) +
  ggplot2::theme(legend.position=c(.1, .9));p
Description

Plots a tree, such as an MCC or MAP tree.

Usage

plotTreeFull(
  tree,
  timeline,
  geo,
  geo_units,
  time_bars,
  node_age_bars,
  tip_age_bars,
  age_bars_color,
  age_bars_colored_by,
  node_labels,
  node_labels_color,
  node_labels_size,
  node_labels_offset,
  tip_labels,
  tip_labels_italics,
  tip_labels_formatted,
  tip_labels_remove_underscore,
  tip_labels_color,
  tip_labels_size,
  tip_labels_offset,
  label_sampled_ancs,
  node_pp,
  node_pp_shape,
  node_pp_color,
  node_pp_size,
  branch_color,
  color_branch_by,
  line_width,
  tree_layout,
  ...
)

Arguments

- **tree** (list of lists of treedata objects; no default) Name of a list of lists of treedata objects, such as produced by readTrees(). This object should only contain only one summary tree from one trace file. If it contains multiple trees or multiple traces, only the first will be used.
- **timeline** (logical; FALSE) Plot time tree with labeled x-axis with timescale in MYA.
- **geo** (logical; timeline) Add a geological timeline? Defaults to the same as timeline.
geo_units (list; list("epochs", "periods")) Which geological units to include in the geo
timescale. May be "periods", "epochs", "stages", "eons", "eras", or a list of
two of those units.

time_bars (logical; timeline) Add vertical gray bars to indicate geological timeline units if
geo == TRUE or regular time intervals (in MYA) if geo == FALSE.

node_age_bars (logical; TRUE) Plot time tree with node age bars?
tip_age_bars (logical; FALSE) Plot node age bars for the tips as well? Useful for plotting
serial sampled analyses or fossilized birth-death analyses, or any cases where
some tip ages are estimated.

age_bars_color (character; "blue") Color for node/tip age bars. If age_bars_colored_by specifies
a variable (not NULL), you must provide two colors, low and high values for a
gradient. Colors must be either R valid color names or valid hex codes.

age_bars_colored_by (character; NULL) Specify column to color node/tip age bars by, such as "pos-
terior". If null, all age bars plotted the same color, specified by age_bars_color

node_labels (character; NULL) Plot text labels at nodes, specified by the name of the corre-
sponding column in the tidytree object. If NULL, no text is plotted.

node_labels_color (character; "black") Color to plot node_labels, either as a valid R color name or
a valid hex code.

node_labels_size (numeric; 3) Size of node labels

node_labels_offset (numeric; 0) Horizontal offset of node labels from nodes.

tip_labels (logical; TRUE) Plot tip labels?
tip_labels_italics (logical; FALSE) Plot tip labels in italics?
tip_labels_formatted (logical; FALSE) Do the tip labels contain manually added formatting information?
Will set parse = TRUE in geom_text() and associated functions to inter-
pret formatting. See ?plotmath for more. Cannot be TRUE if tip_labels_italics
= TRUE.
tip_labels_remove_underscore (logical; FALSE) Should underscores be replaced by spaces in tip labels?

tip_labels_color (character; "black") Color to plot tip labels, either as a valid R color name or a
valid hex code.

tip_labels_size (numeric; 3) Size of tip labels

label_sampled_ancs (logical; FALSE) Label any sampled ancestors? Will inherent tip labels aesthet-
ics for size and color.
# added in from plotTree
node_pp  (logical; FALSE) Plot posterior probabilities as symbols at nodes? Specify symbol aesthetics with node_pp_shape, node_pp_color, and node_pp_size.

node_pp_shape (integer; 1) Integer corresponding to point shape (value between 0-25). See ggplot2 documentation for details: https://ggplot2.tidyverse.org/articles/ggplot2-specs.html#point

node_pp_color (character; "black") Color for node_pp symbols, either as valid R color name(s) or hex code(s). Can be a single character string specifying a single color, or a vector of length two specifying two colors to form a gradient. In this case, posterior probabilities will be indicated by color along the specified gradient.

node_pp_size (numeric or character; 1) Size for node_pp symbols. If numeric, the size will be fixed at the specified value. If a character, it should specify "variable", indicating that size should be scaled by the posterior value. Size regulates the area of the shape, following ggplot2 best practices: https://ggplot2.tidyverse.org/reference/scale_size.html

branch_color (character; "black") A single character string specifying the color (R color name or hex code) for all branches OR a vector of length 2 specifying two colors for a gradient, used to color the branches according to the variable specified in color_branch_by. If only 1 color is provided and you specify color_branch_by, default colors will be chosen (low = "#005ac8", high = "#fa7850").

color_branch_by (character; NULL) Optional name of one quantitative variable in the treedata object to color branches, such as a rate.

line_width (numeric; 1) Change line width for branches

tree_layout (character; "rectangular") Tree shape layout, passed to ggtree(). Options are 'rectangular', 'cladogram', 'slanted', 'ellipse', 'roundrect', 'fan', 'circular', 'inward_circular', 'radial', 'equal_angle', 'daylight' or 'ape'.

... (various) Additional arguments passed to ggtree::ggtree().

Details

Plots a single tree, such as an MCC or MAP tree, with the full set of functionality to be called by plotTree() and plotFBDTree()

Value

returns a single plot object.

See Also

called by plotTree and plotFBDTree
posteriorSamplesToParametricPrior

Priors from MCMC samples

Description

Turn posterior samples collected by MCMC into a parametric prior distribution.

Usage

```r
posteriorSamplesToParametricPrior(
  samples,
  distribution,
  variance_inflation_factor = 2
)
```

Arguments

- **samples** (numeric vector; no default) MCMC samples for a single parameter.
- **distribution** (character; no default) The distribution to fit. Options are gamma for strictly positive parameters and normal for unbounded parameters.
- **variance_inflation_factor** (single numeric value; default = 2.0) Makes the prior variance larger than the variance of the posterior

Details

The distributions are fit by the method of moments. The function allows inflating the prior variance relative to the posterior being supplied.

Value

Numeric vector of parameters with names (to avoid rate/scale and var/sd confusion).

Examples

```r
# download the example datasets to working directory

url_ex_times <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_extinction_times.log"
dest_path_ex_times <- "primates_EBD_extinction_times.log"
download.file(url_ex_times, dest_path_ex_times)

url_ex_rates <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_extinction_rates.log"
dest_path_ex_rates <- "primates_EBD_extinction_rates.log"
```
download.file(url_ex_rates, dest_path_ex_rates)

url_sp_times <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_speciation_times.log"
  dest_path_sp_times <- "primates_EBD_speciation_times.log"
download.file(url_sp_times, dest_path_sp_times)

url_sp_rates <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_speciation_rates.log"
download.file(url_sp_rates, dest_path_sp_rates)

# to run on your own data, change this to the path to your data file
speciation_time_file <- dest_path_sp_times
speciation_rate_file <- dest_path_sp_rates
extinction_time_file <- dest_path_ex_times
extinction_rate_file <- dest_path_ex_rates

primates <- processDivRates(speciation_time_log = speciation_time_file,
  speciation_rate_log = speciation_rate_file,
  extinction_time_log = extinction_time_file,
  extinction_rate_log = extinction_rate_file,
  burnin = 0.25)

speciation_rates <-
  dplyr::pull(primates[which(primates$item == "speciation rate"),],
  "value")
speciation_1_gamma_prior <-
  posteriorSamplesToParametricPrior(speciation_rates,"gamma")

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_sp_times, dest_path_ex_times,
  dest_path_sp_rates, dest_path_ex_rates)

processAncStates

---

**Description**

Process data for ancestral states plotting

**Usage**

```r
processAncStates(
  path,
  state_labels = NULL,
```
labels_as_numbers = FALSE,
missing_to_NA = TRUE
)

Arguments

path (character string; no default) File path to annotated tree.

state_labels (character vector; NULL) Vector of labels for ancestral states named with the current state labels in annotated tree file (as characters).

labels_as_numbers (logical; FALSE) Should the state labels be treated as integers (for example, as chromosome numbers)?

missing_to_NA (logical; TRUE) Should missing data, coded as "?", be coded to NA? If TRUE, the state will not be plotted. If FALSE, it will be considered an additional state when plotting.

Value

A treedata object

Examples

# standard ancestral state estimation example
file <- system.file("extdata",

"comp_method_disc/ase_freeK.tree",

package="RevGadgets")

element <- processAncStates(file,

state_labels = c("1" = "Awesome",

"2" = "Beautiful",

"3" = "Cool!")

# chromosome evolution example
file <- system.file("extdata",

"chromo/ChromEvol_simple_final.tree",

package="RevGadgets")

chromo_element <- processAncStates(file, labels_as_numbers = TRUE)
Usage

processBranchData(
  tree,
  dat,
  burnin = 0.25,
  parnames = c("avg_lambda", "avg_mu", "num_shifts"),
  summary = "median",
  net_div = FALSE
)

Arguments

tree (treedata object; no default) a phylogenetic tree in the treedata format, or a list of lists of a single tree data object, such as the output of readTrees().
dat (data.frame or list; no default) a data frame, or a list (of length 1) of a data frame, with branch specific data, such as the output of readTrace().
burnin (numeric; 0.25) fraction of the markov-chain to discard
parnames (character vector; c("avg_lambda", "avg_mu", "num_shifts")) Names of parameters to process
summary (character; "median") function to summarize the continuous parameter. Typically mean or median
net_div (logical; FALSE) Calculate net diversification?

Value

a treedata file with attached branch-specific data

Examples

# download the example dataset to working directory
url_rates <- "https://revbayes.github.io/tutorials/intro/data/primates_BDS_rates.log"
dest_path_rates <- "primates_BDS_rates.log"
download.file(url_rates, dest_path_rates)

url_tree <- "https://revbayes.github.io/tutorials/divrate/data/primates_tree.nex"
dest_path_tree <- "primates_tree.nex"
download.file(url_tree, dest_path_tree)

# to run on your own data, change this to the path to your data file
treefile <- dest_path_tree
logfile <- dest_path_rates

branch_data <- readTrace(logfile)
tree <- readTrees(paths = treefile)
annotated_tree <- processBranchData(tree, branch_data, summary = "median")

# you can plot this output
p <- plotTree(tree = annotated_tree,
              node_age_bars = FALSE,
              node_pp = FALSE,
              tip_labels = FALSE,
              color_branch_by = "avg_lambda",
              line_width = 0.8) +
ggplot2::theme(legend.position=c(.1, .9)); p

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_tree, dest_path_rates)

---

processDivRates  Process Diversification Rates

Description
Processing the output of a episodic diversification rate analysis with mass-extinction events.

Usage

processDivRates(
  speciation_time_log = "",
  speciation_rate_log = "",
  extinction_time_log = "",
  extinction_rate_log = "",
  fossilization_time_log = "",
  fossilization_rate_log = "",
  burnin = 0.25,
  probs = c(0.025, 0.975),
  summary = "mean"
)

Arguments

speciation_time_log
  (vector of character strings or single character string; ") Path to speciation times log file(s)

speciation_rate_log
  (vector of character strings or single character string; ") Path to speciation rates log file(s)

extinction_time_log
  (vector of character strings or single character string; ") Path to extinction times log file(s)
**processDivRates**

- **extinction_rate_log**
  - (vector of character strings or single character string; "") Path to extinction rates log file(s)
- **fossilization_time_log**
  - (vector of character strings or single character string; "") Path to fossilization times log file(s)
- **fossilization_rate_log**
  - (vector of character strings or single character string; "") Path to fossilization rates log file(s)
- **burnin**
  - (single numeric value; default = 0) Fraction of generations to discard (if value provided is between 0 and 1) or number of generations (if value provided is greater than 1). Passed to readTrace().
- **probs**
  - (numeric vector; c(0.025, 0.975)) a vector of length two containing the upper and lower bounds for the confidence intervals.
- **summary**
  - typically "mean" or "median"; the metric to summarize the posterior distribution. Defaults to "Mean"

**Details**

For processing the output of an episodic diversification rate analysis. processDivRates() assumes that the epochs are fixed rather than inferred. Additionally, it assumes that times correspond to rates such that the first rate parameter (i.e. speciation[1]) corresponds to the present. Conversely, the first time parameter (i.e. interval_times[1]) corresponds to the first time interval after the present, moving backwards in time. processDivRates() relies on readTrace and produces a list object that can be read by plotDivRates() to visualize the results. For now, only one log file per parameter type is accepted (i.e. log files from multiple runs must be combined before reading into the function).

**Value**

List object with processed rate and time parameters.

**Examples**

```r
# download the example datasets to working directory

url_ex_times <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_extinction_times.log"
dest_path_ex_times <- "primates_EBD_extinction_times.log"
download.file(url_ex_times, dest_path_ex_times)

url_ex_rates <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_extinction_rates.log"
dest_path_ex_rates <- "primates_EBD_extinction_rates.log"
download.file(url_ex_rates, dest_path_ex_rates)

url_sp_times <-
  "https://revbayes.github.io/tutorials/intro/data/primates_EBD_speciation_times.log"
```
dest_path_sp_times <- "primates_EBD_speciation_times.log"
download.file(url_sp_times, dest_path_sp_times)

url_sp_rates <- "https://revbayes.github.io/tutorials/intro/data/primates_EBD_speciation_rates.log"
dest_path_sp_rates <- "primates_EBD_speciation_rates.log"
download.file(url_sp_rates, dest_path_sp_rates)

# to run on your own data, change this to the path to your data file
speciation_time_file <- dest_path_sp_times
speciation_rate_file <- dest_path_sp_rates
extinction_time_file <- dest_path_ex_times
extinction_rate_file <- dest_path_ex_rates

rates <- processDivRates(speciation_time_log = speciation_time_file,
                         speciation_rate_log = speciation_rate_file,
                         extinction_time_log = extinction_time_file,
                         extinction_rate_log = extinction_rate_file,
                         burnin = 0.25)

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_sp_times, dest_path_ex_times,
            dest_path_sp_rates, dest_path_ex_rates)

---

**processPostPredStats**       process Posterior Predictive Statistics

**Description**

Reads in and processes posterior-predictive statistics

**Usage**

`processPostPredStats(path_sim, path_emp)`

**Arguments**

- `path_sim` (character string; no default) Path to the .csv file containing the simulated data results
- `path_emp` (character string; no default) Path to the .csv file containing the empirical values

**Value**

A list of data frames
Examples

# download the example datasets to working directory
url_emp <-
  "https://revbayes.github.io/tutorials/intro/data/empirical_data_pps_example.csv"
dest_path_emp <- "empirical_data_pps_example.csv"
download.file(url_emp, dest_path_emp)

url_sim <-
  "https://revbayes.github.io/tutorials/intro/data/simulated_data_pps_example.csv"
dest_path_sim <- "simulated_data_pps_example.csv"
download.file(url_sim, dest_path_sim)

# to run on your own data, change this to the path to your data file
file_sim <- dest_path_sim
file_emp <- dest_path_emp

t <- processPostPredStats(path_sim = file_sim,
                          path_emp = file_emp)

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_sim, dest_path_emp)

---

<table>
<thead>
<tr>
<th>processSSE</th>
<th>Title</th>
</tr>
</thead>
</table>

Description

Title

Usage

processSSE(
    path,
    speciation = "speciation",
    extinction = "extinction",
    speciation_hidden = "speciation_hidden",
    rates = c(speciation, extinction, "net-diversification"),
    ...
  )
Arguments

- **path** (vector of character strings; no default) File path(s) to trace file.
- **speciation** (single character string; "speciation") RevBayes variable name
- **extinction** (single character string; "extinction") RevBayes variable name
- **speciation_hidden** (single character string; "speciation_hidden") RevBayes variable name
- **rates** (vector; c(speciation, extinction, "net-diversification").) names of rates to be included in plot
  ...
  additional arguments passed to readTrace()

Value

a data frame

Examples

```r
# download the example dataset to working directory
url <-
  "https://revbayes.github.io/tutorials/intro/data/primates_BiSSE_activity_period.log"
dest_path <- "primates_BiSSE_activity_period.log"
download.file(url, dest_path)

# to run on your own data, change this to the path to your data file
bisse_file <- dest_path

pdata <- processSSE(bisse_file)

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path)
```

Description

Reads and formats the outputs of an analysis with the Occurrence Birth Death Process (MCMC parameter inference + diversity estimation)
Usage

readOBDP(
    start_time_trace_file,
    popSize_distribution_matrices_file,
    trees_trace_file
)

Arguments

start_time_trace_file
    (character; no default) Trace of the starting times along the MCMC chain.

popSize_distribution_matrices_file
    (character; no default) Kt matrices computed with `fnInferAncestralPopSize` in RevBayes.

trees_trace_file
    (character; no default) Trace of the trees.

Value

A data.frame

Examples

## Not run:
# first run readOBDP()
start_time_trace_file <-
    system.file("extdata", "obdp/start_time_trace.p", package="RevGadgets")
popSize_distribution_matrices_file <-
    system.file("extdata", "obdp/Kt_trace.p", package="RevGadgets")
trees_trace_file <-
    system.file("extdata", "obdp/mcmc_OBDP_trees.p", package="RevGadgets")

Kt_mean <- readOBDP( start_time_trace_file=start_time_trace_file,
                      popSize_distribution_matrices_file=popSize_distribution_matrices_file,
                      trees_trace_file=trees_trace_file )

# then get the customized ggplot object with plotDiversityOBDP()
p <- plotDiversityOBDP( Kt_mean,
    xlab="Time (My)",
    ylab="Number of lineages",
    xticks_n_breaks=21,
    col_Hidden="dodgerblue3",
    col_LTT="gray25",
    col_Total="forestgreen",
    col_Hidden_interval="dodgerblue2",
    col_Total_interval="darkolivegreen4",
    palette_Hidden=c("transparent", "dodgerblue2", "dodgerblue3",
                    "dodgerblue4", "black"),
    palette_Total=c("transparent", "green4", "forestgreen", "black"),
    line_size=0.7,
interval_line_size=0.5,
show_Hidden=TRUE,
show_LTT=TRUE,
show_Total=TRUE,
show_intervals=TRUE,
show_densities=TRUE,
show_expectations=TRUE,
use_interpolate=TRUE )

# basic plot
p

# option: add a stratigraphic scale
library(deeptime)
library(ggplot2)
q <- gggeo_scale(p, dat="periods", height=unit(1.3, "line"), abbrv=F, size=4.5, neg=T)
r <- gggeo_scale(q, dat="epochs", height=unit(1.1, "line"), abbrv=F, size=3.5, neg=T, skip=c("Paleocene", "Pliocene", "Pleistocene", "Holocene"))
s <- gggeo_scale(r, dat="stages", height=unit(1, "line"), abbrv=T, size=2.5, neg=T)
s

## End(Not run)

---

**readTrace**  
*Read trace*

**Description**  
Reads in MCMC log files

**Usage**

```r
readTrace(
  paths,
  format = "simple",
  delim = "\t",
  burnin = 0.1,
  check.names = FALSE,
  ...
)
```

**Arguments**

- **paths** (vector of character strings; no default) File path(s) to trace file.
- **format** (single character string; default = simple) Indicates type of MCMC trace, complex indicates cases where trace contains vectors of vectors/ matrices - StochasticVariable monitor will sometimes be of this type.
- **delim** (single character string; default = "\t") Delimiter of file.
burnin (single numeric value; default = 0.1) Fraction of generations to discard (if value provided is between 0 and 1) or number of generations (if value provided is greater than 1).

check.names (logical; default = FALSE) Passed to utils::read.table(); indicates if utils::read.table() should check column names and replace syntactically invalid characters.

... (various) Additional arguments passed to utils::read.table().

Details

Reads in one or multiple MCMC log files from the same analysis and discards a user-specified burn-in, compatible with multiple monitor types. If the trace contains vectors of vectors and the user does not specify format = "complex", readTrace() will read in those columns as factors rather than as numeric vectors.

Value

List of dataframes (of length 1 if only 1 log file provided).

Examples

# read and process a single trace file

# download the example dataset to working directory
url_gtr <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR.log"
dest_path_gtr <- "primates_cytb_GTR.log"
download.file(url_gtr, dest_path_gtr)

# to run on your own data, change this to the path to your data file
file_single <- dest_path_gtr

one_trace <- readTrace(paths = file_single)

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_gtr)

# read and process multiple trace files, such as from multiple runs of
# the same analysis

# download the example dataset to working directory
url_1 <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR_run_1.log"
dest_path_1 <- "primates_cytb_GTR_run_1.log"
download.file(url_1, dest_path_1)

url_2 <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR_run_2.log"
dest_path_2 <- "primates_cytb_GTR_run_2.log"
download.file(url_2, dest_path_2)

# to run on your own data, change this to the path to your data file
file_1 <- dest_path_1
file_2 <- dest_path_2

# read in the multiple trace files
multi_trace <- readTrace(path = c(file_1, file_2), burnin = 0.0)

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_1, dest_path_2)

---

**readTrees**

**Read trees**

**Description**

Reads in a tree file containing one or multiple trees

**Usage**

```r
readTrees(paths, tree_name = "psi", burnin = 0, n_cores = 1L, verbose = TRUE)
```

**Arguments**

- `paths` (vector of character strings; no default) File path(s) to tree(s).
- `tree_name` (character string; default psi) Name of the tree variable.
- `burnin` (single numeric value; default = 0.1) Fraction of generations to discard (if value provided is between 0 and 1) or number of generations (if value provided is greater than 1).
- `n_cores` (integer; default 1) Number of cores for parallelizing.
- `verbose` (logical; default true) Display a status bar?

**Details**

Reads in a tree file in either nexus or newick format, and containing a single tree or multiple trees (as in the results of a Bayesian analysis). For reading in annotated tree files of continuous character evolution, the parameter must be considered a node parameter rather than branch parameter. Set `isNodeParameter = TRUE` in the extended newick monitor (mnExtNewick)

**Value**

A list (across runs) of lists (across samples) of treedata objects.
Examples

```r
# read in a single nexus file

# download the example dataset to working directory
url_nex <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR_MAP.tre"
dest_path_nex <- "primates_cytb_GTR_MAP.tre"
download.file(url_nex, dest_path_nex)

# to run on your own data, change this to the path to your data file
file <- dest_path_nex
tree_single_old <- readTrees(paths = file)

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_nex)

# read in a single newick string

# download the example dataset to working directory
url_new <-
  "https://revbayes.github.io/tutorials/intro/data/primates.tre"
dest_path_new <- "primates.tre"
download.file(url_new, dest_path_new)

# to run on your own data, change this to the path to your data file
file_new <- dest_path_new
tree_new <- readTrees(paths = file_new)

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_new)

# read in a tree trace (may take a few seconds)

# download the example dataset to working directory
url_multi <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR.trees"
dest_path_multi <- "primates_cytb_GTR.trees"
download.file(url_multi, dest_path_multi)

# to run on your own data, change this to the path to your data file
file_multi <- dest_path_multi
tree_multi <- readTrees(paths = file_multi)

# remove file
# WARNING: only run for example dataset!
```
removeBurnin

# otherwise you might delete your data!
file.remove(dest_path_multi)

---

removeBurnin  Remove Burnin

### Description

Removes burnin from MCMC trace

### Usage

```r
removeBurnin(trace, burnin)
```

### Arguments

- **trace**: (list of data frames; no default) Name of a list of data frames, such as produced by `readTrace()`.
- **burnin**: (single numeric value; 0.1) Fraction of generations to discard (if value provided is between 0 and 1) or number of generations (if value provided is greater than 1).

### Details

Removes burnin from an MCMC trace, such as the output of `readTrace()`. If multiple traces are provided, this function will remove the burnin from each.

### Value

List of dataframes (of length 1 if only 1 log file provided).

### Examples

```r
# download the example dataset to working directory
url_gtr <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR.log"
dest_path_gtr <- "primates_cytb_GTR.log"
download.file(url_gtr, dest_path_gtr)

# to run on your own data, change this to the path to your data file
file_single <- dest_path_gtr

one_trace <- readTrace(paths = file_single)
one_trace_burnin <- removeBurnin(trace = one_trace, burnin = 0.1)
```
# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_gtr)

---

rerootPhylo  

**Reroot Phylo**

**Description**

Reroots a phylogeny given an outgroup taxon or clade

**Usage**

rerootPhylo(tree, outgroup)

**Arguments**

- **tree**  
  (list of lists of treedata objects; no default) Name of a list of lists of treedata objects, such as produced by readTrees().

- **outgroup**  
  (character, no default) Name of the outgroup(s). Either a single taxon name or a character vector of length two to specify a clade; in this case the root will be placed at the midpoint of the branch subtending the two taxa’s MRCA. Modified from phytools::reroot().

**Details**

Modifies a tree object by rerooting using a specified outgroup taxon or clade. Places the root at the midpoint of the branch subtending the outgroup. If the input contains multiple trees, all trees will be rerooted.

**Value**

returns a list of list of treedata objects, with the trees rooted.

**See Also**

phytools: reroot.

**Examples**

```r
cat <- system.file("extdata",
  "sub_models/primates_cytb_GTR_MAP.tre",
  package="RevGadgets")
tree <- readTrees(paths = cat)
# root with one taxon
```
tree_rooted <- rerootPhylo(tree = tree, outgroup = "Galeopterus_variegatus")
# root with clade, specified by two taxa
plotPhylo(tree = tree_rooted)

tree_rooted <- rerootPhylo(tree = tree,
    outgroup = c("Varecia_variegata_variegata",
        "Propithecus_coquereli"))

---

**Description**

This package provides functions to process and plot the output of RevBayes analyses.

---

### setMRFGlobalScaleHyperpriorNShifts

*Sets a global scale parameter for a GMRF or HSMRF model given a prior mean number of effective shifts.*

**Description**

This function finds the global scale parameter value that produces the desired prior mean number of "effective" rate shifts. Given a specified magnitude for an effective shift, shift_size, an effective shift occurs when two adjacent values are more than shift_size-fold apart from each other. That is, an effective shift is the event that rate[i+1]/rate[i] > shift_size or rate[i+1]/rate[i] < 1/shift_size.

**Usage**

```r
setMRFGlobalScaleHyperpriorNShifts(
    n_episodes,
    model,
    prior_n_shifts = log(2),
    shift_size = 2
)
```

**Arguments**

- **n_episodes** (numeric; no default) The number of episodes in the random field (the parameter vector will be this long).
- **model** (character; no default) What model should the global scale parameter be set for? Options are "GMRF" and "HSMRF" for first-order models (also allowable: "GMRF1" and "HSMRF1") and "GMRF2" and "HSMRF2" for second-order models.
- **prior_n_shifts** (numeric; log(2)) The desired prior mean number of shifts.
- **shift_size** (numeric; 2) The magnitude of change that defines an effective shift (measured as a fold-change).
Details
Finding these values for a HSMRF model can take several seconds for large values of n_episodes because of the required numerical integration.

Value
The hyperprior.

References
Magee et al. (2019) Locally adaptive Bayesian birth-death model successfully detects slow and rapid rate shifts. doi: https://doi.org/10.1101/853960

Examples

# Get global scale for a HSMRF model with 100 episodes.
gs <- setMRFGlobalScaleHyperpriorNShifts(100, "HSMRF")

# Plot a draw from this HSMRF distribution
trajectory <- simulateMRF(n_episodes = 100,
  model = "HSMRF",
  global_scale_hyperprior = gs)

plot(1:100,
  rev(trajectory),
  type = "l",
  xlab = "time",
  ylab = "speciation rate")

simulateMRF
Simulates a single Markov random field trajectory.

Description
This function simulates a draw from a HSMRF or GMRF distribution given a user-specified global scale parameter. The MRF can be taken to be on the log-scale (such as for a birth rate) or the real-scale. The first value must be specified.

Usage

simulateMRF(
  n_episodes,
  model,
  global_scale_hyperprior,
  initial_value = NULL,
  exponentiate = TRUE
)
Arguments

- **n_episodes** (numeric; no default) The number of episodes in the random field (the parameter vector will be this long).
- **model** (character; no default) What model should the global scale parameter be set for? Options are "GMRF" and "HSMRF".
- **global_scale_hyperprior** (numeric; no default) The hyperprior on the global scale parameter.
- **initial_value** (numeric; NULL) The first value in the MRF. If no value is specified, the field is assumed to start at 0 (if exponentiate=FALSE) or 1 (if exponentiate=TRUE).
- **exponentiate** (logical; TRUE) If TRUE, the MRF model is taken to be on the log-scale and the values are returned on the real-scale (note this means that the specified initial value will be the log of the true initial value). If FALSE, the model is taken to be on the real scale.

Value

A vector drawn from the specified MRF model on the specified (log- or real-) scale.

References


Examples

```r
# Simulate a 100-episode HSMRF model for a speciation-rate through time
trajectory <- simulateMRF(n_episodes = 100, 
  model = "HSMRF", 
  global_scale_hyperprior = 0.0021)
```

```r
plot(1:100, 
  rev(trajectory), 
  type = "l", 
  xlab = "time", 
  ylab = "speciation rate")
```

summarizeTrace

**Summarize trace**

Description

Summarizes trace file(s) that have been read into memory
summarizeTrace

Usage

`summarizeTrace(trace, vars)`

Arguments

- `trace` (list of data frames; no default) Name of a list of data frames, such as produced by `readTrace()`. If the `readTrace()` output contains multiple traces (such as from multiple runs), `summarizeTrace()` will provide summaries for each trace individually, as well as the combined trace.
- `vars` (character or character vector; no default) The name of the variable(s) to be summarized.

Details

Summarizes a trace file for continuous or discrete characters by computing the mean and 95% credible interval for quantitative character and the 95% credible set for discrete characters.

Value

`summarizeTrace()` returns a list of the length of provided variables. For quantitative variables, it returns the mean and 95% credible interval. For discrete variables, it returns the 95% associated probabilities.

Examples

```r
# continuous character only example, one run
# download the example dataset to working directory
url_gtr <-
  "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR.log"
dest_path_gtr <- "primates_cytb_GTR.log"
download.file(url_gtr, dest_path_gtr)

# to run on your own data, change this to the path to your data file
file_single <- dest_path_gtr
one_trace <- readTrace(paths = file_single)
trace_sum <- summarizeTrace(trace = one_trace,
                           vars = c("pi[1]","pi[2]","pi[3]","pi[4]"))
trace_sum["pi[1]"]

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_gtr)

# continuous character example, multiple runs
# download the example dataset to working directory
url_1 <-
```
```r
# download example trace files
url_1 <- "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR_run_1.log"
dest_path_1 <- "primates_cytb_GTR_run_1.log"
download.file(url_1, dest_path_1)

url_2 <- "https://revbayes.github.io/tutorials/intro/data/primates_cytb_GTR_run_2.log"
dest_path_2 <- "primates_cytb_GTR_run_2.log"
download.file(url_2, dest_path_2)

# to run on your own data, change this to the path to your data file
file_1 <- dest_path_1
file_2 <- dest_path_2

# read in the multiple trace files
multi_trace <- readTrace(path = c(file_1, file_2), burnin = 0.0)

trace_sum_multi <- summarizeTrace(trace = multi_trace,
                                   vars = c("pi[1]","pi[2]","pi[3]","pi[4]"))

# remove files
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_1, dest_path_2)

# discrete character example

# download the example dataset to working directory
url_rj <- "https://revbayes.github.io/tutorials/intro/data/freeK_RJ.log"
dest_path_rj <- "freeK_RJ.log"
download.file(url_rj, dest_path_rj)

file <- dest_path_rj
trace <- readTrace(path = file)

trace_sum_discrete <- summarizeTrace(trace = trace,
                                       vars = c("prob_rate_12",
                                                "prob_rate_13",
                                                "prob_rate_31",
                                                "prob_rate_32"))

trace_sum_discrete[["prob_rate_12"]]

# remove file
# WARNING: only run for example dataset!
# otherwise you might delete your data!
file.remove(dest_path_rj)
```

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