Package 'ArchaeoPhases'

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Type Package

Title Post-Processing of the Markov Chain Simulated by 'ChronoModel', 'Oxcal' or 'BCal'

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Description Provides a list of functions for the statistical analysis of archaeological dates and groups of dates. It is based on the post-processing of the Markov Chains whose stationary distribution is the posterior distribution of a series of dates. Such output can be simulated by different applications as for instance 'ChronoModel' (see <https://chronomodel.com/>), 'Oxcal' (see <https://c14.arch.ox.ac.uk/oxcal.html>) or 'BCal' (see <https://bcal.shef.ac.uk/>). The only requirement is to have a csv file containing a sample from the posterior distribution. Note that this package interacts with data available through the 'ArchaeoPhases.dataset' package which is available in a separate repository. The size of the 'ArchaeoPhases.dataset' package is approximately 4 MB.

License GPL-3

Depends R (>= 3.5.0), coda, hdrcde

Imports stats, utils, graphics, grDevices, shiny, shinythemes, DT, readr, ggthemes, toOrdinal, ggplot2, ggalt, reshape2, dplyr, digest, gplots, magrittr, tibble

Suggests knitr, rmarkdown, testthat (>= 2.1.0), ArchaeoPhases.dataset (>= 0.1.0)

VignetteBuilder knitr

BugReports https://github.com/ArchaeoStat/ArchaeoPhases/issues

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R topics documented:

`app_ArchaeoPhases` *Run ArchaeoPhases shiny apps*

Description

Run ArchaeoPhases shiny apps

Usage

```
app_ArchaeoPhases()
```

`ArchaeoPhases` *ArchaeoPhases: Post-Processing of the Markov Chain Simulated by 'Chronomodel', 'OxCal', or 'BCal'.*

Description

Provides a list of functions for the statistical analysis of archaeological dates and groups of dates. It is based on the post-processing of the Markov Chains whose stationary distribution is the posterior distribution of a series of dates. Such output can be simulated by different applications, as for instance ChronoModel, OxCal, or BCal. The only requirement is to have a csv file containing a sample from the posterior distribution.

coda.mcmc *Create an* mcmc.list *object for* **coda** *users*

Description

This wrapper function extracts parallel chains from a data frame to create an mcmc.list object for use with **coda** diagnostic tools

Usage

```
coda.mcmc(data, numberChains = 1, iterationColumn = NULL)
```

Arguments

data	Data frame containing the output of the MCMC algorithm.
numberChains	Number of parallel chains, default = 1.
iterationColumn	Column number corresponding to the iteration values, default = NULL.

Value

An mcmc.list object.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

See Also

mcmc

mcmc.list

Examples

```
data(Events)
mcmcList = coda.mcmc(data = Events, numberChains = 3, iterationColumn = 1)
plot(mcmcList)
gelman.diag(mcmcList)
# The multivariate criterion can not be evaluated when a phase
# contains only one date. This induces colinearity problems.
gelman.diag(mcmcList, multivariate = FALSE)
```

CreateMinMaxGroup *Construct the minimum and maximum for a group of events (phase)*

Description

Constructs a data frame containing the output of the MCMC algorithm corresponding to the minimum and maximum of a group of events

Usage

```
CreateMinMaxGroup(
  data,
  position,
  name = "Phase",
  add = NULL,
  exportFile = NULL
)
```

Arguments

data	Data frame containing the output of the MCMC algorithm.
position	Numeric vector containing the position of the column corresponding to the MCMC chains of all dates included in the phase of interest.
name	Name of the current group of dates or phase.
add	Name of the data frame in which the current minimum and maximum should be added, default = NULL.
exportFile	Name of the final file that will be saved if chosen, default = NULL.

Value

A data frame containing the minimum and maximum of the group of dates included in the phase of interest. These values may be appended to a data frame add if given.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
  data(Events)
  Temp = CreateMinMaxGroup(Events, c(2,4), name = "Phase2")
## Not run:
  #To do for saving the new variables in csv file
  Temp = CreateMinMaxGroup(Events, c(3,5), name = "Phase1", add=Temp,

## End(Not run)                          exportFile = "MinMaxPhases.csv")
```

CredibleInterval *Bayesian credible interval*

Description

Computes the shortest credible interval of the output of the MCMC algorithm for a single parameter

Usage

```
CredibleInterval(a_chain, level = 0.95, roundingOfValue = 0)
```

Arguments

a_chain	Numeric vector containing the output of the MCMC algorithm for the parameter.
level	Probability corresponding to the level of confidence used for the credible interval, default = 0.95.
roundingOfValue	Integer indicating the number of decimal places to be used, default = 0.

Details

A $(100 * level)\backslash$ elements of the sample outside the interval. The $(100 * level)\backslash$

Value

A named vector of values containing the confidence level and the endpoints of the shortest credible interval in calendar years (BC/AD).

Examples

```
data(Events); attach(Events)
CredibleInterval(Event.1)
CredibleInterval(Event.12, 0.50)
```

credible_interval *Bayesian credible interval*

Description

Computes the shortest credible interval for a single parameter.

Usage

```
credible_interval(data, level = 0.95, round_to = 0)
```

Arguments

data	Numeric vector containing the output of the MCMC algorithm for the parameter.
level	Probability corresponding to the level of confidence used for the credible interval, default = 0.95.
round_to	Integer indicating the number of decimal places to be used, default = 0.

Details

A $(100 * level)\backslash$ that keeps $N * (1 - level)$ elements of the sample outside the interval. The $(100 * level)\backslash$ of those intervals.

Value

A list with the following components:

ci Named vector of length 2, with `inf` the lower endpoint of the shortest credible interval as a calendar year; and `sup` the upper endpoint of the shortest credible interval as a calendar year;

level Confidence level for the credible intervals; and

call Function call.

Examples

```
data(Events); attach(Events)
credible_interval(Event.1)
credible_interval(Event.12, 0.50)
```

DatesHiatus *Test for the existence of a hiatus between two parameters*

Description

Finds if a gap exists between two dates and returns the longest interval that satisfies: $P(a_chain < IntervalInf < IntervalSup < b_chain|M) = level$

Usage

```
DatesHiatus(a_chain, b_chain, level = 0.95)
```

Arguments

a_chain	: Numeric vector containing the output of the MCMC algorithm for the first parameter.
b_chain	: Numeric vector containing the output of the MCMC algorithm for the second parameter.
level	Probability corresponding to the confidence level of the interval.

Value

A named vector with the level and the endpoints of the gap in calendar years (AD/BC)

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Events); attach(Events)
DatesHiatus(Event.1, Event.12)
DatesHiatus(Event.1, Event.12, level = 0.5)
```

---

dates_hiatus *Test for the existence of a hiatus between two MCMC chains.*

Description

Determines whether there is a hiatus between two MCMC chains and returns the longest interval that satisfies: $P(a_chain < IntervalInf < IntervalSup < b_chain|M) = level$

Usage

```
dates_hiatus(a_chain, b_chain, level = 0.95)
```

Arguments

a_chain	: Numeric vector containing the output of the MCMC algorithm for the first parameter.
b_chain	: Numeric vector containing the output of the MCMC algorithm for the second parameter.
level	Probability corresponding to the confidence level of the interval.

Value

A list with the following components:

hiatus A named vector where `inf` is the lower endpoint of the hiatus as a calendar year (AD/BC) or `NA` if there is no hiatus at `level`, and `sup` is the upper endpoint of the gap as a calendar year (AD/BC), or `NA` if there is no hiatus at `level`.

duration The duration of the hiatus at `level`.

level Probability corresponding to the confidence level of the interval.

call The function call.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>, and

Thomas S. Dye, <tsd@tsdye.online>

Examples

```
data(Events); attach(Events)
dates_hiatus(Event.1, Event.12)
dates_hiatus(Event.1, Event.12, level = 0.5)
```

---

estimate_range *Estimate ranges from two or more calibrations*

Description

Calculates the ranges of summary statistics from the output of two or more runs of the MCMC algorithm. Results are given in calendar years for statistics that estimate them.

Usage

```
estimate_range(
  mcmc,
  position,
  app = "bcal",
  estimates = c("mean", "q1", "median", "q3", "ci.inf", "ci.sup"),
  quiet = "partial",
  bin_width = 1,
  decimal = ".",
  separator = ","
)
```

Arguments

mcmc	A vector of path names to the MCMC files.
position	Numeric vector containing the positions of the columns corresponding to the MCMC chains of interest, or a vector of column names.
app	Name of the application that created the MCMC files, one of bcal, oxcal, chronomodel.
estimates	Numeric vector containing the positions of the columns corresponding to the statistics of interest returned by the multi_marginal_statistics() function, or a vector of column names.
quiet	One of no (default) to allow messages and warnings, partial to suppress messages and allow warnings, or yes to suppress messages and warnings.

`bin_width` If app is set to `bcal`, the bin width specified for the BCal calibration. Defaults to the BCal default of 1.

`decimal` If app is set to `chronomodel`, either `.` (default) or `,`, the two choices offered by ChronoModel.

`separator` If app is set to `chronomodel`, the character used to separate fields in the CSV file. Defaults to `,`.

Details

This function is useful for estimating the sensitivity of calibration results to different model parameters.

Value

A list with the following components:

range_table A matrix of estimate ranges.

mean The mean of the ranges in `range_table`.

sd The standard deviation of the ranges in `range_table`.

min The minimum of the ranges in `range_table`.

median The median of the ranges in `range_table`.

max The maximum value of the ranges in `range_table`.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

Examples

```
## Not run:
## Generate 0's
res <- estimate_range(mcmc = c("http://tsdye.online/AP/ox.csv",
"http://tsdye.online/AP/ox.csv"), position = c(1, 2),
app = "oxcal", quiet = "yes")
sum(res$range_table)

## End(Not run)
```

Events *Events*

Description

A data set containing information on the ages of four dated events.

Usage

```
Events
```

Format

A data frame with 30,000 rows and 5 variables:

iter iteration of the MCMC algorithm

Event.2 information on event 2

Event.1 information on event 1

Event.22 information on event 22

Event.12 information on event 12

ImportCSV *Importing a CSV file*

Description

Import a CSV file containing the output of the MCMC algorithm

Usage

```
ImportCSV(
  file,
  dec = ".",
  sep = ",",
  comment.char = "#",
  header = TRUE,
  iterationColumn = NULL,
  referenceYear = NULL,
  rowToWithdraw = NULL,
  bin.width = NULL
)
```

Arguments

file	Name of the CSV file containing the output of the MCMC algorithm.
dec	Character used in the file for decimal points for the use of read.csv().
sep	Field separator character for the use of read.csv().
comment.char	Character vector of length one containing a single character or an empty string for the use of read.csv().
header	Logical value indicating whether the file contains the names of the variables as its first line.
iterationColumn	Column number corresponding to the iteration values, default = NULL.
referenceYear	Year of reference for MCMC in date format other than BC/AD, default = NULL.
rowToWithdraw	Number of the row to be withdrawn or "last" for the last row of the data frame, default = NULL.
bin.width	Bin width specified in a BCal project (note that bin.width does not have to be set if the BCal default bin width of 1 is used).

Details

Use of the read.csv() function with default values for CSV files produced by ChronoModel software. For MCMC in a date format different from BC/AD, use the parameter referenceYear to convert the MCMC to BC/AD, otherwise the remaining functions of **ArchaeoPhases** will not work. MCMC files generated by BCal may contain an empty last row. This row should be withdrawn using the rowToWithdraw parameter. Otherwise, the functions of **ArchaeoPhases** will not work properly.

Value

A data frame containing a representation of the data in the file.

Author(s)

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Thomas S. Dye, <tsd@tsdye.online>, and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

See Also

ImportCSV.BCal

read_chronomodel

read_oxcal

Examples

```
  data(Events)
## Not run:
  write.csv(Events, "data.csv", row.names=FALSE)
  data = ImportCSV("data.csv", dec = '.', sep=',', comment.char='#',
                   header = TRUE, iterationColumn = 1)

  # Import of MCMC generated by BCal and extracted in cal BP
  # (the year of reference is 1950)
  if (requireNamespace("ArchaeoPhases.dataset", quietly = TRUE)) {
  data(Fishpond)
  write.csv(Fishpond, "fishpond_MCMC.csv", row.names=FALSE)
  Fishpond = ImportCSV("fishpond_MCMC.csv", dec = '.', sep=',',
                       header = TRUE, iterationColumn = 1,
                       referenceYear = 1950, rowToWithdraw = "last")}

## End(Not run)
```

`ImportCSV.BCal` *Importing a BCal csv file*

Description

Importing a csv file containing the output of the MCMC algorithm from the BCal software

Usage

```
ImportCSV.BCal(file, bin.width = NULL)
```

Arguments

`file`	Name of the CSV file containing the output of the MCMC algorithm.
`bin.width`	Bin width specified in a BCal project (note: `bin.width` does not have to be set if the BCal default bin width of 1 is used).

Value

A data frame containing a representation of the data in the CSV file

Author(s)

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Thomas S. Dye, <tsd@tsdye.online>, and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
## Not run:
  # Import of MCMC generated by BCal and extracted in cal BP (the year of reference is 1950)
  data(Fishpond)
  write.csv(Fishpond, "fishpond_MCMC.csv", row.names = FALSE)
  Fishpond = ImportCSV.BCal("fishpond_MCMC.csv", bin.width = 1)

## End(Not run)

## Not run:
  # equivalent call
  Fishpond2 = ImportCSV("fishpond_MCMC.csv", dec = '.', sep=',', referenceYear = 1950,
                        rowToWithdraw = "last", bin.width = 1)

## End(Not run)
```

`MarginalPlot` *Plot a marginal posterior density*

Description

Draws a plot of the estimated marginal posterior density for the one-parameter and adds the mean and the credible interval at the desired level

Usage

```
MarginalPlot(
  a_chain,
  level = 0.95,
  GridLength = 1024,
  title = "Characteristics of a date",
  subtitle = NULL,
  caption = "ArchaeoPhases",
  x.label = "Calendar year",
  y.label = NULL,
  y.grid = TRUE,
  x.scale = "calendar",
  elapsed.origin.position = NULL,
  x.min = NULL,
  x.max = NULL,
  height = 7,
  width = 7,
  units = "in",
  file = NULL,
  newWindow = TRUE
)
```

Arguments

a_chain	Numeric vector containing the output of the MCMC algorithm for the parameter.
level	Probability corresponding to the level of confidence.
GridLength	Length of the grid used to estimate the density.
title	Title of the graph.
subtitle	Subtitle of the graph.
caption	Caption of the graph.
x.label	Label of the x-axis.
y.label	Label of the y-axis.
y.grid	Switch for horizontal grid lines.
x.scale	One of "calendar" for calendar years, "BP" for years before present, or "elapsed" for time elapsed from a specified origin.
elapsed.origin.position	Position of the column to use as the origin for elapsed time calculations.
x.min	Minimum x axis value.
x.max	Maximum x axis value.
height	Plot height in units.
width	Plot width in units.
units	String recognized by the ggsave() function, one of "in", "cm", "mm".
file	Name of the file that will be saved if chosen, default = NULL.
newWindow	Whether or not the plot is drawn within a new window.

Details

The density is estimated using density() function with n = GridLength.

Value

NULL, called for its side effects

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Events);
MarginalPlot(a_chain = Events$Event.1, level = 0.95)
```

`MarginalProba` *Bayesian test for anteriority / posteriority between two parameters*

Description

This function estimates the posterior probability that event 'a' is older than event 'b' using the output of the MCMC algorithm. This provides a Bayesian test for checking the following assumption: "Event a is older than event b".

Usage

```
MarginalProba(a_chain, b_chain)
```

Arguments

`a_chain`	: Numeric vector containing the output of the MCMC algorithm for the first parameter.
`b_chain`	: Numeric vector containing the output of the MCMC algorithm for the second parameter.

Details

For a given output of MCMC algorithm, this function estimates the posterior probability of the event 'a' < 'b' by the relative frequency of the event "the value of event 'a' is less than the value of event 'b'" in the simulated Markov chain.

Value

An unnamed vector with the posterior probability of the assumption: "event a is older than event b"

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Events); attach(Events)
# Probability that Event.1 is older than Event.12
MarginalProba(Event.1, Event.12)
# Probability that Event.1 is older than Event.2
MarginalProba(Event.1, Event.2)
# Probability that the beginning of the phase 1 is older than the end of the phase 1
# Should always be 1 for every phase
data(Phases); attach(Phases)
MarginalProba(Phase.1.alpha, Phase.1.beta)
```

`MarginalStatistics` *Marginal summary statistics*

Description

Calculates summary statistics of the output of the MCMC algorithm for a one-parameter. Results are given in calendar years (BC/AD).

Usage

```
MarginalStatistics(a_chain, level = 0.95, roundingOfValue = 0)
```

Arguments

`a_chain`	Numeric vector containing the output of the MCMC algorithm for the parameter.
`level`	Probability corresponding to the level of confidence used for the credible interval and the highest posterior density region.
`roundingOfValue`	Integer indicating the number of decimal places.

Details

The $(100 * level)\backslash$

Value

A named matrix of values corresponding to all the following statistics:

title The title of the summary statistics

mean The mean of the MCMC chain. Use of `mean()` function.

map The maximum a posteriori of the MCMC chain. Use of `hdr()` function.

sd The standard deviation of the MCMC chain. Use of `sd()` function.

Q1, median, Q3 The quantiles of the MCMC chain corresponding to 0.25, 0.50 and 0.75. Use of `quantile` function.

CI The credible interval corresponding to the desired level. Use of `CredibleInterval()` function.

HPDR The highest posterior density regions corresponding to the desired level. Use of `hdr()` function.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

References

Hyndman, R. J. (1996) Computing and graphing highest density regions. American Statistician, 50, 120-126.

Examples

```
data(Events); attach(Events)
MarginalStatistics(Event.1)
MarginalStatistics(Event.2, level = 0.90)
```

`marginal_plot` *Plot a marginal posterior density*

Description

Draws a plot of the marginal posterior density for a single parameter, with an option to add the mean and the credible interval at the desired level

Usage

```
marginal_plot(
  data,
  position = 1,
  level = 0.95,
  grid_length = 1024,
  title = if (is.numeric(position)) names(data)[position] else position,
  subtitle = "Marginal posterior density",
  caption = paste(level * 100, "% credible interval", sep = ""),
  x_label = "Calendar year",
  y_label = "Density",
  y_grid = TRUE,
  x_scale = "calendar",
  elapsed_origin_position = NULL,
  x_min = NULL,
  x_max = NULL,
  height = 7,
  width = 7,
  units = "in",
  file = NULL,
  plot_result = TRUE,
  mean_linetype = "dashed",
  mean_color = "white",
  mean_size = 0.5,
  ci_linetype = "dotted",
  ci_color = mean_color,
  ci_size = mean_size,
```

```
  line_linetype = "solid",
  line_color = "black",
  line_size = 1,
  density_color = "gray30",
  fill_palette = NULL
)
```

Arguments

data	Data frame containing the output of the MCMC algorithm.
position	Index of the column corresponding to the MCMC chain of interest, or a column name.
level	Probability corresponding to the level of confidence.
grid_length	Length of the grid used to estimate the density.
title	Title of the graph. The default uses the data column name.
subtitle	Subtitle of the graph. The default is "Marginal posterior density".
caption	Caption of the graph. The default describes the confidence of the credible interval.
x_label	Label of the x-axis.
y_label	Label of the y-axis.
y_grid	Switch for horizontal grid lines.
x_scale	One of "calendar" for calendar years, "BP" for years before present, or "elapsed" for time elapsed from a specified origin.
elapsed_origin_position	Position of the column to use as the origin for elapsed time calculations.
x_min	Minimum x axis value.
x_max	Maximum x axis value.
height	Plot height in units.
width	Plot width in units.
units	String recognized by the ggsave() function, one of "in", "cm", "mm". This parameter has no effect on the display plot.
file	Name of the file that will be saved if chosen, default = NULL.
plot_result	If TRUE, then draw a plot on the display, else suppress drawing.
mean_linetype	The linetype used to indicate the mean density.
mean_color	The color of the line used to indicate mean density.
mean_size	The width of the line used to indicate the mean density.
ci_linetype	The linetype used to indicate the credible intervals.
ci_color	The color of the lines used to indicate the credible intervals.
ci_size	The width of the lines used to indicate the credible intervals.
line_linetype	The linetype used to indicate the density.
line_color	The color of the line used to indicate the density.
line_size	The width of the line used to indicate the density.
density_color	Color to use if fill_palette is not specified.
fill_palette	Palette to use for fills.

Details

The plot is drawn with the current theme and color scales; the function does not alter or override theme elements.

Value

An `archaeophases_plot` object with the data and metadata needed to reproduce the plot.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>;

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>; and

Thomas S. Dye, <tsd@tsdye.online>

Examples

```
data(Events)
mp <- marginal_plot(data = Events, position = 2, level = 0.95)
## View data and metadata
str(mp)
```

`marginal_statistics` *Marginal summary statistics*

Description

Calculates summary statistics of the output of the MCMC algorithm for a single parameter. Results are given in calendar years (BC/AD).

Usage

```
marginal_statistics(a_chain, level = 0.95, round_to = 0)
```

Arguments

`a_chain`	Numeric vector containing the output of the MCMC algorithm for the parameter.
`level`	Probability corresponding to the level of confidence used for the credible interval and the highest posterior density region.
`round_to`	Integer indicating the number of decimal places.

Details

The $(100 * level)\backslash$ using `hdr()` function from **hdrcde** package.

Value

A list with the following components:

mean The mean of the MCMC chain.

map The maximum a posteriori of the MCMC chain.

sd The standard deviation of the MCMC chain.

quantiles A vector with the following elements: `min` = minimum value of the MCMC chain; `q1` = first quantile of the MCMC chain; `median` = median of the MCMC chain; `q2` = second quantile of the MCMC chain; and `max` = maximum value of the MCMC chain.

level Confidence level for the credible interval and highest posterior density.

ci A vector with the following elements: `inf` = lower credible interval of the MCMC chain at `level`; and `sup` = upper credible interval of the MCMC chain at `level`.

hpdr A variable length vector with the lower and upper highest posterior density regions of the MCMC chain at `level`. List components are named `inf_n` and `sup_n` for n = 1 to the number of highest posterior density regions.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>, and

Thomas S. Dye, <tsd@tsdye.online>

References

Hyndman, R. J. (1996) Computing and graphing highest density regions. American Statistician, 50, 120-126.

Examples

```
data(Events); attach(Events)
marginal_statistics(Event.1)
marginal_statistics(Event.2, level = 0.90)
## convenient vector
foo <- marginal_statistics(Event.1)
unlist(foo)
```

`MultiCredibleInterval` *Bayesian credible interval for a series of dates*

Description

Estimation of the shortest credible interval for each variable of a simulated Markov chain

Usage

```
MultiCredibleInterval(data, position, level = 0.95, roundingOfValue = 0)
```

Arguments

data	data frame containing the output of the MCMC algorithm.
position	Numeric vector containing the position of the column corresponding to the MCMC chains of interest.
level	Probability corresponding to the level of confidence used for the credible interval.
roundingOfValue	Integer indicating the number of decimal places.

Details

A $(100 * level)\$ The $(100 * level)\$

Value

Returns a matrix of values containing the level of confidence and the endpoints of the shortest credible interval for each variable of the MCMC chain. The name of the resulting rows are the positions of the corresponding columns in the CSV file. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Events)
MultiCredibleInterval(Events, c(2, 4, 3), 0.95)
```

MultiDatesPlot *Plot of credible intervals or HPD regions of a series of events*

Description

Plot of credible intervals or HPD regions of a series of events

Usage

```
MultiDatesPlot(
  data,
  position,
  level = 0.95,
  roundingOfValue = 0,
  intervals = "CI",
  order = "default",
  title = "Plot of intervals",
  subtitle = NULL,
  caption = "ArchaeoPhases",
  labelXaxis = "Calendar Year",
  labelYaxis = NULL,
  height = 7,
  width = 7,
  units = "in",
  x.min = NULL,
  x.max = NULL,
  x.scale = "calendar",
  elapsed.origin.position = NULL,
  dumbbell.size = 3,
  dot.guide = FALSE,
  dot.guide.size = 0.25,
  y.grid = FALSE,
  file = NULL,
  newWindow = TRUE,
  print.data.result = FALSE
)
```

Arguments

data	Data frame containing the output of the MCMC algorithm.
position	Numeric vector containing the position of the column corresponding to the MCMC chains of interest.
level	Probability corresponding to the level of confidence.
roundingOfValue	Integer indicating the number of decimal places to be used.
intervals	One of "CI" for credible intervals, or "HPD" for highest posterior density intervals.
order	Order of the events. If "default" then the order of the csv file is followed, if "increasing" events are ordered by the HPDInf of the first region or the CIInf
title	Title of the plot.
subtitle	Subtitle of the plot.
caption	Caption of the plot.
labelXaxis	X axis label of the plot.

labelYaxis	Y axis label of the plot.
height	Height of the plot in units.
width	Width of the plot in units.
units	A string recognized by ggsave() function, one of "in", "cm", "mm".
x.min	Minimum x axis value.
x.max	Maximum x axis value.
x.scale	One of "calendar" for calendar years, "BP" for years before present, or "elapsed" for years after a specified origin.
elapsed.origin.position	Position of the column corresponding to the origin for elapsed time calculations.
dumbbell.size	Size of the symbols used to plot events.
dot.guide	Switch for guides from y-axis to plot symbols.
dot.guide.size	Size of the dot guides.
y.grid	Switch for horizontal grids.
file	Name of the file to be saved. If NULL then no plot is saved.
newWindow	Whether the plot is drawn within a new window or not.
print.data.result	If TRUE, the list containing the data to plot will be returned.

Value

NULL, called for its side effects. If print.data.result = TRUE then a list containing the data to plot will be returned.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Thomas S. Dye, <tsd@tsdye.online>, and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Events)
MultiDatesPlot(Events, c(2, 4, 3), level = 0.95, intervals = "CI",
               title = "Plot of CI intervals")
MultiDatesPlot(Events, c(2, 4, 3), level = 0.95, intervals = "HPD",
               title = "Plot of HPD intervals")
MultiDatesPlot(Events, c(2, 4, 3), level = 0.95, intervals = "HPD",
               order = "increasing")
```

`MultiHPD` *Bayesian HPD regions for a series of MCMC chains*

Description

Estimation of the highest posterior density regions for each variable of a simulated Markov chain. This function uses the `hdr()` function included in the **hdrcde** package. An HPD region may be a union of several intervals.

Usage

```
MultiHPD(data, position, level = 0.95, roundingOfValue = 0)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position`	Numeric vector containing the position of the column corresponding to the MCMC chains of interest.
`level`	Probability corresponding to the level of confidence.
`roundingOfValue`	Integer indicating the number of decimal places.

Details

Highest posterior density function region using the function `hdr()` from the **hdrcd** package

Value

Returns a matrix of values containing the level of confidence and the endpoints of each interval for each variable of the MCMC chain. The name of the resulting rows are the positions of the corresponding columns in the CSV file. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

References

Hyndman, R.J. (1996) Computing and graphing highest density regions. American Statistician, 50, 120-126.

Examples

```
data(Events)
MultiHPD(Events, c(2, 4, 3), 0.95)
```

`MultiMarginalPlot` *Marginal posterior densities of several events*

Description

Draws a plot of the estimated marginal posterior density for a parameter and adds the mean and the credible interval at the desired level

Usage

```
MultiMarginalPlot(
  data,
  position,
  level = 0.95,
  GridLength = 1024,
  x.scale = rep("calendar", length(position)),
  elapsed.origin = NULL,
  title = "Characteristics of several dates",
  subtitle = NULL,
  caption = "ArchaeoPhases",
  x.label = "Calendar year",
  y.label = NULL,
  y.grid = TRUE,
  x.min = NULL,
  x.max = NULL,
  legend.title = "Legend",
  height = 7,
  width = 7,
  units = "in",
  file = NULL,
  newWindow = TRUE
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position`	Numeric vector containing the position of the column corresponding to the MCMC chains of interest.
`level`	Probability corresponding to the level of confidence.
`GridLength`	Number of equally spaced points at which the density is to be estimated (for `density()` function).
`x.scale`	One of "calendar" for calendar years, "BP" for years before present, or "elapsed" for time elapsed from a specified origin.
`elapsed.origin`	Position of the column to use as the origin for elapsed time calculations.
`title`	Title of the plot.

subtitle	Subtitle of the plot.
caption	Caption of the plot.
x.label	Label of the x-axis.
y.label	Label of the y-axis.
y.grid	Switch for horizontal grid lines.
x.min	Minimum x-axis value.
x.max	Maximum x-axis value.
legend.title	Title for the legend.
height	Plot height in units.
width	Plot width in units.
units	String recognized by the ggsave() function, one of "in", "cm", "mm".
file	Name of the file that will be saved if specified, default = NULL.
newWindow	Whether or not the plot is drawn within a new window.

Details

The density is estimated using density() function with n = GridLength. The input MCMC chains should either be in calendar years or converted to calendar years using x.scale vector or elapsed.origin.

Value

NULL, called for its side effects

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Events);
MultiMarginalPlot(Events, position = c(2, 3, 4), level = 0.95)
```

`MultiPhasePlot` *Several phase density plots*

Description

Plot of the marginal posterior densities of several groups

Usage

```
MultiPhasePlot(
  data,
  position_minimum,
  position_maximum = position_minimum + 1,
  level = 0.95,
  title = "Characterisation of several groups",
  colors = NULL,
  exportFile = NULL,
  exportFormat = "PNG"
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position_minimum`	Numeric vector containing the column number corresponding to the minimum of the events included in each group.
`position_maximum`	Numeric vector containing the column number corresponding to the end of the groups set in the same order as in `position_minimum`.
`level`	Probability corresponding to the level of confidence.
`title`	Title of the plot.
`colors`	Numeric vector of colors for each group of dates.
`exportFile`	Name of the file to be saved. If `NULL` then no plot is saved.
`exportFormat`	Format of the export file, one of "PNG" or "SVG".

Details

Draws a plot with the marginal posterior densities of the minimum and the maximum of the dates included in each group. No temporal order between phases is required. The result is given in calendar years (BC/AD).

Value

`NULL`, called for its side effects

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
# Data extracted from ChronoModel software
data(Phases)
# List of the name of the groups
names(Phases)
# Stipulating position_maximum
MultiPhasePlot(Phases, c(4, 2), c(5, 3), title = "Succession of phase 1 and phase 2")
# In this case, equivalent to
MultiPhasePlot(Phases, c(4, 2), title = "Succession of phase 1 and phase 2", colors = c(3, 4))
```

`MultiPhasesGap` *Gap or hiatus between a succession of groups (for groups in temporal order constraint)*

Description

Finds, if it exists, a gap or hiatus between two successive groups. This gap or hiatus is the longest interval that satisfies $P(Phase1Max < IntervalInf < IntervalSup < Phase2Min|M) = level$

Usage

```
MultiPhasesGap(
  data,
  position_minimum,
  position_maximum = position_minimum + 1,
  level = 0.95
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position_minimum`	Numeric vector containing the column number corresponding to the minimum of the events included in each group.
`position_maximum`	Numeric vector containing the column number corresponding to the end of the phases set in the same order as in `position_minimum`.
`level`	Probability corresponding to the level of confidence.

Details

For each `i`, `MultiPhasesGap()` computes the gap interval for the phase defined by its minimum `position_minimum[i]` and its maximum `position_maximum[i]`. The default value of `position_maximum` corresponds to CSV files exported from ChronoModel software.

Value

Returns a matrix of values containing the level of confidence and the endpoints of the gap for each pair of successive groups. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
# Data extracted from ChronoModel software
data(Phases)
# List of the name of the groups
names(Phases)
# Stipulating position_maximum
MultiPhasesGap(Phases, position_minimum = c(4, 2), position_maximum = c(5, 3))
# In this case, equivalent to
MultiPhasesGap(Phases, position_minimum = c(4, 2))
```

MultiPhasesTransition *Transition range for a succession of groups (for groups in temporal order constraint)*

Description

Finds, if it exists, the shortest interval that satisfies $P(TransitionRangeInf < Phase1Max < Phase2Min < TransitionRangeSup|M) = level$

Usage

```
MultiPhasesTransition(
  data,
  position_minimum,
  position_maximum = position_minimum + 1,
  level = 0.95
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position_minimum`	Numeric vector containing the column number corresponding to the minimum of the events included in each group.
`position_maximum`	Numeric vector containing the column number corresponding to the end of the groups set in the same order as in codeposition_minimum.
`level`	Probability corresponding to the level of confidence.

Details

For each `i`, `MultiPhasesTransition()` computes the transition interval for the phase defined by its minimum `position_minimum[i]` and its maximum `position_maximum[i]`. The default value of `position_maximum` corresponds to CSV files exported from ChronoModel software.

Value

A matrix of values containing the level of confidence and the endpoints of the transition interval for each pair of successive groups. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
# Data extracted from ChronoModel software
data(Phases)
# List of the name of the groups
names(Phases)
# Stipulating position_maximum
MultiPhasesTransition(Phases, position_minimum = c(4, 2), position_maximum = c(5, 3))
# In this case, equivalent to
MultiPhasesTransition(Phases, position_minimum = c(4, 2))
```

`MultiPhaseTimeRange` *Phase time range for multiple groups*

Description

Computes the shortest interval that satisfies $P(PhaseMin < IntervalInf < IntervalSup < PhaseMax|M) = level$ for each phase

Usage

```
MultiPhaseTimeRange(
  data,
  position_minimum,
  position_maximum = position_minimum + 1,
  level = 0.95
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position_minimum`	Numeric vector containing the column number corresponding to the minimum of the events included in each phase.
`position_maximum`	Numeric vector containing the column number corresponding to the maximum of the phases set in the same order as in `position_minimum`.
`level`	Probability corresponding to the desired level of confidence.

Details

For each `i`, `MultiPhaseTimeRange()` computes the time range interval for the phase defined by its minimum `position_minimum[i]` and its maximum `position_maximum[i]`. The default value of `position_maximum` corresponds to CSV files exported from ChronoModel software.

Value

A matrix of values containing the level of confidence and the endpoints of the shortest time range associated with the desired `level`. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
# Data extracted from ChronoModel software
data(Phases)
# List of the name of the groups
names(Phases)
# Stipulating position_maximum
MultiPhaseTimeRange(Phases, position_minimum = c(4, 2), position_maximum = c(5, 3))
# In this case, equivalent to
MultiPhaseTimeRange(Phases, position_minimum = c(4, 2))
```

`MultiSuccessionPlot` *Successive Phases Density Plots (for phases in temporal order constraint)*

Description

This functions draws a plot of the densities of several successive phases and adds several statistics (mean, CI, HPDR). The result is given in calendar years (BC/AD).

Usage

```
MultiSuccessionPlot(
  data,
  position_minimum,
  position_maximum = position_minimum + 1,
  level = 0.95,
  title = "Characterisation of a succession of groups",
  colors = NULL,
  exportFile = NULL,
  exportFormat = "PNG"
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position_minimum`	Numeric vector containing the column number corresponding to the minimum of the events included in each group.
`position_maximum`	Numeric vector containing the column number corresponding to the end of the groups set in the same order as in `position_minimum`.
`level`	Probability corresponding to the level of confidence.
`title`	Title of the plot.
`colors`	Vector of colors corresponding to each group of dates.
`exportFile`	Name of the file to be saved. If `NULL` then no plot is saved.
`exportFormat`	Format of the export file, either "PNG" or "SVG" (default).

Details

Curves represent the density of the minimum (oldest dates) and the maximum (youngest dates) of the dates included in each group. Curves of the same color refer to the same phase. When there is only one curve of one color, it means that there is only one event in the corresponding group and then the minimum equals the maximum. Time range intervals are symbolised by segments above the curves drawn using the same color as the one of the curves of the associated group. Transition and gap range intervals are represented by two-coloured segments using the colors of successive phases. If the gap between the successive groups does not exist, a cross is drawn instead of a segment.

Value

NULL, called for its side effects

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
# Data extracted from ChronoModel software
data(Phases)
# List of the name of the groups
names(Phases)
# Stipulating position_end
MultiSuccessionPlot(Phases, c(4, 2), c(5, 3),
                    title = "Succession of phase 1 and phase 2")
# In this case, equivalent to
MultiSuccessionPlot(Phases, c(4, 2),
                    title = "Succession of phase 1 and phase 2",
                    colors = c(3, 4))
```

---

multi_credible_interval

Bayesian credible interval for a series of dates

Description

Estimate the shortest credible interval for each of several MCMC chains.

Usage

```
multi_credible_interval(data, position, level = 0.95, round_to = 0)
```

Arguments

data	data frame containing the output of the MCMC algorithm.
position	Numeric vector containing the position of the column corresponding to the MCMC chains of interest, or a list of column names.
level	Probability corresponding to the level of confidence used for the credible interval.
round_to	Integer indicating the number of decimal places.

Details

A $(100 * level)\backslash$ that keeps $N * (1 - level)$ elements of the sample outside the interval. The $(100 * level)\backslash$

Value

Returns a list with the following components:

ci A data frame with a row for each column in `data` and two columns: `inf`, the lower credible interval in calendar years (BC/AD); and `sup`, the upper credible interval in calendar years (BC/AD).

level Probability corresponding to the level of confidence used for the credible interval.

call The function call.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>, and

Thomas S. Dye, <tsd@tsdye.online>.

Examples

```
data(Events)
multi_credible_interval(Events, c(2, 4, 3), 0.95)
# round to decade
multi_credible_interval(Events, c(2, 4, 3), 0.95, -1)
```

---

multi_dates_plot *Plot of credible intervals or HPD regions of a series of events*

Description

Plot of credible intervals or HPD regions of a series of events

Usage

```
multi_dates_plot(
  data,
  position = 1:ncol(data),
  level = 0.95,
  plot_result = TRUE,
  round = 0,
  intervals = "CI",
  order = "default",
  title = "Plot of intervals",
  subtitle = NULL,
  caption = "ArchaeoPhases",
  x_label = "Calendar Year",
  y_label = NULL,
  height = 7,
```

```
  width = 7,
  units = "in",
  x_min = NULL,
  x_max = NULL,
  x_scale = "calendar",
  elapsed_origin_position = NULL,
  dumbbell_size = 1,
  dot_guide = FALSE,
  dot_guide_size = 0.25,
  y_grid = FALSE,
  file = NULL,
  new_window = TRUE
)
```

Arguments

data	Data frame containing the output of the MCMC algorithm.
position	Numeric vector containing the positions of the columns corresponding to the MCMC chains of interest, or a vector of column names.
level	Probability corresponding to the level of confidence.
plot_result	If TRUE, then draw a plot on the display, else suppress drawing.
round	Integer indicating the number of decimal places to be used.
intervals	One of "CI" for credible intervals, or "HPD" for highest posterior density intervals.
order	Order of the events. If "default" then the order of the csv file is followed, if "increasing" events are ordered by the HPDInf of the first region or the CIInf
title	Title of the plot.
subtitle	Subtitle of the plot.
caption	Caption of the plot.
x_label	X axis label of the plot.
y_label	Y axis label of the plot.
height	Height of the plot in units.
width	Width of the plot in units.
units	A string recognized by ggsave() function, one of "in", "cm", "mm".
x_min	Minimum x axis value.
x_max	Maximum x axis value.
x_scale	One of "calendar" for calendar years, "BP" for years before present, or "elapsed" for years after a specified origin.
elapsed_origin_position	Position of the column corresponding to the origin for elapsed time calculations.
dumbbell_size	Size of the symbols used to plot events.
dot_guide	Switch for guides from y-axis to plot symbols.

dot_guide_size	Size of the dot guides.
y_grid	Switch for horizontal grids.
file	Name of the file to be saved. If NULL then no plot is saved.
new_window	Whether the plot is drawn within a new window or not.

Value

An archaeophases_plot object with the data and metadata needed to reproduce the plot.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Thomas S. Dye, <tsd@tsdye.online>, and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Events)
multi_dates_plot(Events, c(2, 4, 3), level = 0.95, intervals = "CI",
                 title = "Plot of CI intervals")
multi_dates_plot(Events, c(2, 4, 3), level = 0.95, intervals = "HPD",
                 title = "Plot of HPD intervals")
multi_dates_plot(Events, c(2, 4, 3), level = 0.95, intervals = "HPD",
                 order = "increasing")
```

---

multi_hpd *Bayesian HPD regions for a series of MCMC chains*

Description

Estimation of the highest posterior density regions for each variable of a simulated Markov chain. This function uses the hdr() function included in the **hdrcde** package. An HPD region may be a union of several intervals.

Usage

```
multi_hpd(data, position, level = 0.95, round_to = 0)
```

Arguments

data	Data frame containing the output of the MCMC algorithm.
position	Numeric vector containing the position of the column corresponding to the MCMC chains of interest.
level	Probability corresponding to the level of confidence.
round_to	Integer indicating the number of decimal places.

Details

Highest posterior density function region using the function `hdr()` from the **hdrcd** package

Value

Returns a list with the following components:

results A data frame where the rows correspond to the columns in the selected data set and the columns labeled `inf` and `sup` correspond to the lower and upper endpoints of each highest posterior density interval, respectively.

level Probability corresponding to the level of confidence.

call The function call.

matrix of values containing the level of confidence and for each variable of the MCMC chain. The name of the resulting rows are the positions of the corresponding columns in the CSV file. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

References

Hyndman, R.J. (1996) Computing and graphing highest density regions. American Statistician, 50, 120-126.

Examples

```
data(Events)
multi_hpd(Events, c(2, 4, 3), 0.95)
```

`multi_marginal_plot` *Marginal posterior densities of several events*

Description

Draws a plot of the estimated marginal posterior density for a parameter and adds the mean and the credible interval at the desired level

Usage

```
multi_marginal_plot(
  data,
  position = 1:ncol(data),
  level = 0.95,
  grid_length = 1024,
  x_scale = "calendar",
  elapsed_origin_position = NULL,
  title = "Characteristics of several dates",
  subtitle = "Marginal densities",
  caption = paste(level * 100, "% credible interval", sep = ""),
  x_label = "Calendar year",
  y_label = NULL,
  density_fill = "gray30",
  density_color = "black",
  density_alpha = 1,
  mean_color = "white",
  mean_linetype = "dashed",
  mean_size = 0.5,
  ci_color = mean_color,
  ci_linetype = "dotted",
  ci_size = mean_size,
  y_grid = TRUE,
  x_min = NULL,
  x_max = NULL,
  height = 7,
  width = 7,
  units = "in",
  file = NULL,
  new_window = TRUE,
  plot_result = TRUE,
  fill_palette = NULL,
  colors = NULL,
  color_legend_name = "Legend"
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position`	Numeric vector containing the position of the column corresponding to the MCMC chains of interest, or a vector of column names.
`level`	Probability corresponding to the level of confidence.
`grid_length`	Number of equally spaced points at which the density is to be estimated (for `density()` function).
`x_scale`	One of "calendar" for calendar years, "BP" for years before present, or "elapsed" for time elapsed from a specified origin.

elapsed_origin_position
: Position of the column to use as the origin for elapsed time calculations.

title
: Title of the plot.

subtitle
: Subtitle of the plot.

caption
: Caption of the plot.

x_label
: Label of the x-axis.

y_label
: Label of the y-axis.

density_fill
: A color specification for the fill under the density line.

density_color
: A color specification for the density line.

density_alpha
: A number between 0 for transparent and 1 for opaque.

mean_color
: A color specification for the mean line.

mean_linetype
: A line type specification for the mean line.

mean_size
: A size specification for the mean line.

ci_color
: A color specification for the credible interval lines.

ci_linetype
: A line type specification for the credible interval lines.

ci_size
: A size specification of the credible interval lines.

y_grid
: Switch for horizontal grid lines.

x_min
: Minimum x-axis value.

x_max
: Maximum x-axis value.

height
: Plot height in `units`.

width
: Plot width in `units`.

units
: String recognized by the `ggsave()` function, one of "in", "cm", "mm".

file
: Name of the file that will be saved if specified, default = `NULL`.

new_window
: Whether or not the plot is drawn within a new window.

plot_result
: If `TRUE`, then draw a plot on the display, else suppress drawing.

fill_palette
: A vector of colors for qualitative data.

colors
: A vector of indices into palette keyed by position.

color_legend_name
: A label for the legend.

Details

The density is estimated using `density()` function with `n = grid_length`. The input MCMC chains should either be in calendar years or converted to calendar years using `x_scale` vector or `elapsed_origin_position`.

Value

An `archaeophases_plot` object with the data and metadata needed to reproduce the plot.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>;

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>; and

Thomas S. Dye, <tsd@tsdye.online>

Examples

```
data(Events);
multi_marginal_plot(Events, position = c(2, 3, 4), level = 0.95)
```

`multi_marginal_statistics` *Marginal summary statistics for multiple MCMC chains*

Description

Calculates summary statistics of the output of the MCMC algorithm for multiple parameters. Results are given in calendar years (BC/AD).

Usage

```
multi_marginal_statistics(
  data,
  position = 1:ncol(data),
  level = 0.95,
  round_to = 0
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position`	Numeric vector containing the positions of the columns corresponding to the MCMC chains of interest, or a vector of column names.
`level`	Probability corresponding to the level of confidence used for the credible interval and the highest posterior density region.
`round_to`	Integer indicating the number of decimal places.

Value

A data frame where the rows correspond to the chains of interest and columns to the following statistics:

mean The mean of the MCMC chain.

sd The standard deviation of the MCMC chain.

min Minimum value of the MCMC chain;

q1 First quantile of the MCMC chain;

median Median of the MCMC chain;

q3 Third quantile of the MCMC chain; and

max Maximum value of the MCMC chain.

ci.inf Lower credible interval of the MCMC chain at `level`.

ci.sup Upper credible interval of the MCMC chain at `level`.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>, and

Thomas S. Dye, <tsd@tsdye.online>

Examples

```
data(Events)
multi_marginal_statistics(Events, 2:5)
multi_marginal_statistics(Events, 2:5, level = 0.90)
## round to decades
multi_marginal_statistics(Events, 2:5, round_to = -1)
```

---

new_archaeophases_mcmc

Constructor for `archaeophases_mcmc` *object*

Description

Object to be returned by functions that read MCMC data from csv files.

Usage

```
new_archaeophases_mcmc(x = list(), call = match.call(), hash = character())
```

Arguments

`x`	A data frame with the data from the csv file.
`call`	How the function was called.
`hash`	A SHA256 hash of the csv file.

Details

The SHA256 hash should be secure against intentional and unintentional alterations of the MCMC csv file.

Value

An `archaeophases_mcmc` object that inherits from `tbl_df`.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

See Also

`read_chronomodel`

`read_bcal`

`read_oxcal`

`new_archaeophases_plot` *Constructor for* `archaeophases_plot` *object*

Description

Objects returned by ArchaeoPhases plot functions.

Usage

```
new_archaeophases_plot(x = list(), mcmc = list(), call = match.call())
```

Arguments

`x`	A data frame with the plot data.
`mcmc`	An `archaeophases_mcmc` object.
`call`	How the function was called.

Value

An `archaeophases_plot` object that inherits from `archaeophases_mcmc`.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

See Also

`read_chronomodel`

`read_bcal`

`read_oxcal`

`OccurrencePlot` *Plot occurrences*

Description

A statistical graphic designed for the archaeological study of when events of a specified kind occurred

Usage

```
OccurrencePlot(
  data,
  position,
  plot.result = NULL,
  level = 0.95,
  intervals = "CI",
  title = "Occurrence plot",
  subtitle = NULL,
  caption = "ArchaeoPhases",
  labelXaxis = "Calendar year",
  labelYaxis = NULL,
  language = "English",
  occurrence = "occurrence",
  height = 7,
  width = 7,
  units = "in",
  x.min = NULL,
  x.max = NULL,
  x.scale = "calendar",
  elapsed.origin.position = NULL,
  dumbbell.size = 1,
  dot.guide = FALSE,
  dot.guide.size = 0.25,
  y.grid = FALSE,
  file = NULL,
  newWindow = TRUE,
  print.data.result = FALSE
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position`	Numeric vector containing the position of the column corresponding to the MCMC chains of interest.
`plot.result`	If `TRUE`, then draw a plot on the display, else suppress drawing.
`level`	Probability corresponding to the level of confidence.

intervals	One of "CI" for credible intervals or "HPD" for highest posterior density intervals.
title	Title of the plot.
subtitle	Subtitle of the plot.
caption	Caption of the plot.
labelXaxis	Label of the x-axis.
labelYaxis	Label of the y-axis.
language	String indicating a language recognized by the **toOrdinal** package.
occurrence	String to append to each y-axis tic label.
height	Plot height in units.
width	Plot width in units.
units	String recognized by the ggsave() function, one of "in", "cm", "mm".
x.min	Minimum x-axis value.
x.max	Maximum x-axis value.
x.scale	One of "calendar" for calendar years, "BP" for years before present, or "elapsed" for time elapsed from a specified origin.
elapsed.origin.position	Position of the column to use as the origin for elapsed time calculations.
dumbbell.size	Size of the plot symbol.
dot.guide	Switch for a horizontal guide from the y axis.
dot.guide.size	Size of the dot guide.
y.grid	Switch for horizontal grid lines.
file	Name of the file that will be saved if specified. If NULL no plot will be saved.
newWindow	Whether or not the plot is drawn within a new window.
print.data.result	If TRUE, the list containing the data to plot will be returned.

Details

If we have k events, then we can estimate the calendar date t corresponding to the smallest date such that the number of events observed before t is equal to k. The OccurrencePlot() estimates these occurrences and gives the credible interval or the highest posterior density (HPD) region with a desired level of confidence.

Value

NULL, called for its side effects. It may also return a list containing the data to plot (if print.data.result = TRUE).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Thomas S. Dye, <tsd@tsdye.online>, and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Events);
OccurrencePlot(Events[1:1000, ], c(2:5),  print.data.result = FALSE)
```

`occurrence_plot` *Plot occurrences*

Description

A statistical graphic designed for the archaeological study of when events of a specified kind occurred

Usage

```
occurrence_plot(
  data,
  position = 1:ncol(data),
  level = 0.95,
  plot_result = TRUE,
  intervals = "CI",
  title = "Occurrence plot",
  subtitle = NULL,
  caption = "ArchaeoPhases",
  x_label = "Calendar year",
  y_label = NULL,
  language = "English",
  occurrence = "occurrence",
  height = 7,
  width = 7,
  units = "in",
  x_min = NULL,
  x_max = NULL,
  x_scale = "calendar",
  elapsed_origin_position = NULL,
  dumbbell_size = 1,
  dot_guide = FALSE,
  dot_guide_size = 0.25,
  y_grid = FALSE,
  file = NULL,
  new_window = TRUE
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.

position	Numeric vector containing the positions of the columns corresponding to the MCMC chains of interest, or a vector of column names.
level	Probability corresponding to the level of confidence.
plot_result	If TRUE, then draw a plot on the display, else suppress drawing.
intervals	One of "CI" for credible intervals or "HPD" for highest posterior density intervals.
title	Title of the plot.
subtitle	Subtitle of the plot.
caption	Caption of the plot.
x_label	Label of the x-axis.
y_label	Label of the y-axis.
language	String indicating a language recognized by the **toOrdinal** package.
occurrence	String to append to each y-axis tic label.
height	Plot height in units.
width	Plot width in units.
units	String recognized by the ggsave() function, one of "in", "cm", "mm".
x_min	Minimum x-axis value.
x_max	Maximum x-axis value.
x_scale	One of "calendar" for calendar years, "BP" for years before present, or "elapsed" for time elapsed from a specified origin.
elapsed_origin_position	Position of the column to use as the origin for elapsed time calculations.
dumbbell_size	Size of the plot symbol.
dot_guide	Switch for a horizontal guide from the y axis.
dot_guide_size	Size of the dot guide.
y_grid	Switch for horizontal grid lines.
file	Name of the file that will be saved if specified. If NULL no plot will be saved.
new_window	Whether or not the plot is drawn within a new window.

Details

If we have k events, then we can estimate the calendar date t corresponding to the smallest date such that the number of events observed before t is equal to k. The OccurrencePlot() estimates these occurrences and gives the credible interval or the highest posterior density (HPD) region with a desired level of confidence.

Value

An archaeophases_plot object with the data and metadata needed to reproduce the plot.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Thomas S. Dye, <tsd@tsdye.online>, and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
  data(Events);
  OccurrencePlot(Events[1:1000, ], c(2:5),  print.data.result = FALSE)


## Not run:
# Read from connection
ox <- read_oxcal("http://tsdye.online/AP/ox.csv")
# Plot all the columns
op <- occurrence_plot(ox, position = 1:ncol(ox))
# Plot again
plot(op)
# View metadata
str(op)

## End(Not run)
```

---

original_file *Check for an original mcmc file*

Description

Checks whether or not a file is identical to the one used to create an archaeophases_mcmc object.

Usage

```
original_file(x, ...)
```

Arguments

x	An archaeophases_mcmc object.
...	Either a path to a CSV file, a connection, or the value clipboard() to read from the system clipboard. The CSV file can be compressed or plain.

Value

A boolean, TRUE if the files match, FALSE otherwise.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

Examples

```
## Not run:
rem <- read_chronomodel("http://tsdye.online/AP/cm/Chain_all_Events.csv")
original_file(rem, "http://tsdye.online/AP/cm/Chain_all_Events.csv")

## End(Not run)
```

`original_file.archaeophases_mcmc`
Check for an original mcmc file

Description

Checks whether or not a file is identical to the one used to create an `archaeophases_mcmc` object.

Usage

```
## S3 method for class 'archaeophases_mcmc'
original_file(x, file = NULL, ...)
```

Arguments

`x`	An `archaeophases_mcmc` object.
`file`	Either a path to a CSV file, a connection, or the value `clipboard()` to read from the system clipboard. The CSV `file` can be compressed or plain.
`...`	Other parameters.

Details

If called with a single argument, checks the file indicated by the `file_path` attribute.

Value

A boolean, `TRUE` if the files match, `FALSE` otherwise.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

original_file.archaeophases_plot *Check for an original* archaeophases_plot *file*

Description

Checks whether or not a file is identical to the one used to create an archaeophases_plot object.

Usage

```
## S3 method for class 'archaeophases_plot'
original_file(x, file = NULL, ...)
```

Arguments

x	An archaeophases_plot object.
file	Either a path to a plot file, a connection, or the value clipboard() to read from the system clipboard.
...	Other parameters.

Details

If called with a single argument, checks the file indicated by the file_path attribute.

Value

A boolean, TRUE if the files match, FALSE otherwise.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

PhaseDurationPlot *Plot the duration of a group*

Description

This function draws the marginal posterior densities of the time elapsed between the minimum and the maximum of the dates included in a phase, and adds summary statistics (mean, CI)

Usage

```
PhaseDurationPlot(
  PhaseMin_chain,
  PhaseMax_chain,
  level = 0.95,
  title = "Duration of a group of dates",
  colors = TRUE,
  exportFile = NULL,
  exportFormat = "PNG",
  GridLength = 1024
)
```

Arguments

PhaseMin_chain	Numeric vector containing the output of the MCMC algorithm for the minimum of the events included in the phase.
PhaseMax_chain	Numeric vector containing the output of the MCMC algorithm for the maximum of the events included in the phase.
level	Probability corresponding to the level of confidence used for the credible interval and the time range.
title	Title of the plot.
colors	If TRUE, use colors in the plot, otherwise produce a black and white plot.
exportFile	Name of the file to be saved. If NULL, then no plot is saved.
exportFormat	Format of the export file, either "PNG" or "SVG".
GridLength	Length of the grid used to estimate the density.

Details

Plot of the density of the time elapsed between the minimum and the maximum calendar years of the events included in a phase, along with mean and credible interval

Value

NULL, called for its side effects

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Phases); attach(Phases)
PhaseDurationPlot(Phase.1.alpha, Phase.1.beta, 0.95, "Duration of Phase 1")
PhaseDurationPlot(Phase.2.alpha, Phase.2.beta, 0.95, "Duration of Phase 2", colors = FALSE)
```

PhasePlot *Plot the characteristics of a group of events*

Description

This function draws the marginal posterior densities of the minimum and the maximum of the events included in the phase and summary statistics including mean, credible interval, and time range. The result is given in calendar years (BC/AD).

Usage

```
PhasePlot(
  PhaseMin_chain,
  PhaseMax_chain,
  level = 0.95,
  title = "Characterisation of a group of dates",
  colors = TRUE,
  exportFile = NULL,
  exportFormat = "PNG",
  GridLength = 1024
)
```

Arguments

PhaseMin_chain	Numeric vector containing the output of the MCMC algorithm for the minimum of the events included in the phase.
PhaseMax_chain	Numeric vector containing the output of the MCMC algorithm for the maximum of the events included in the phase.
level	Probability corresponding to the level of confidence used for the credible interval and the time range.
title	The title of the plot
colors	If TRUE, then use of colors in the plot, otherwise draw the plot in black and white.
exportFile	Name of the file to be saved. If NULL, then no plot is saved.
exportFormat	Format of the export file, either "PNG" or "SVG".
GridLength	Length of the grid used to estimate the density.

Value

NULL, called for its side effects

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Phases); attach(Phases)
 PhasePlot(Phase.1.alpha, Phase.1.beta, level = 0.95, title = "Densities of Phase 1")
```

`Phases` *Phases*

Description

A data set containing information on the start and end dates of two phases.

Usage

```
Phases
```

Format

A data frame with 30,000 rows and 5 variables:

iter iteration of the MCMC algorithm

Phase.2.alpha start date of Phase 2

Phase.2.beta end date of Phase 2

Phase.1.alpha start date of Phase 1

Phase.1.beta end date of Phase 1

`PhasesGap` *Gap or hiatus between two successive phases (for phases in temporal order constraint)*

Description

This function finds, if it exists, a gap or hiatus between two successive phases. This gap or hiatus is the longest interval that satisfies $P(Phase1Max_chain < IntervalInf < IntervalSup < Phase2Min_chain|M) = level$

Usage

```
PhasesGap(Phase1Max_chain, Phase2Min_chain, level = 0.95)
```

Arguments

`Phase1Max_chain`	Numeric vector containing the output of the MCMC algorithm for the maximum of the events included in the oldest phase.
`Phase2Min_chain`	Numeric vector containing the output of the MCMC algorithm for the minimum of the events included in the following phase.
`level`	Probability corresponding to the level of confidence.

Value

Returns a vector of values containing the level of confidence and the endpoints of the gap between the successive phases. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Phases); attach(Phases)
PhasesGap(Phase.1.beta, Phase.2.alpha, 0.95)
PhasesGap(Phase.1.beta, Phase.2.alpha, 0.50)
```

`PhaseStatistics` *Summary statistics of a phase*

Description

Estimation of summary statistics, including the beginning and end of a phase, and the duration of the phase

Usage

```
PhaseStatistics(
  PhaseMin_chain,
  PhaseMax_chain,
  level = 0.95,
  roundingOfValue = 0
)
```

Arguments

PhaseMin_chain	Numeric vector containing the output of the MCMC algorithm for the minimum of the dates included in the phase.
PhaseMax_chain	Numeric vector containing the output of the MCMC algorithm for the maximum of the dates included in the phase.
level	Probability corresponding to the level of confidence used for the credible interval and the highest density region.
roundingOfValue	Integer indicating the number of decimal places.

Details

The summary statistics are those given by the MarginalStatistics() function. The time range is given by PhaseTimeRange() function. The duration is computed as follows: $duration = maximum - minimum$ at each iteration of the MCMC output.

Value

A matrix of values corresponding to the summary statistics:

1 Statistics of the minimum of the dates included in the phase

2 Statistics of the maximum of the dates included in the phase

3 Statistics of the duration of the dates included in the phase

The results are given in calendar year (in format BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Phases); attach(Phases)
PhaseStatistics(Phase.1.alpha, Phase.1.beta, 0.95)
PhaseStatistics(Phase.2.alpha, Phase.2.beta, 0.95)
```

PhasesTransition *Transition range between two successive phases (for phases in temporal order constraint)*

Description

Finds, if it exists, the shortest interval that satisfies $P(TransitionRangeInf < Phase1Max_chain < Phase2Min_chain < TransitionRangeSup|M) = level$

Usage

```
PhasesTransition(Phase1Max_chain, Phase2Min_chain, level = 0.95)
```

Arguments

Phase1Max_chain	Numeric vector containing the output of the MCMC algorithm for the maximum of the events included in the oldest phase.
Phase2Min_chain	Numeric vector containing the output of the MCMC algorithm for the minimum of the events included in the following phase.
level	Probability corresponding to the level of confidence.

Value

a vector of values containing the level of confidence and the endpoints of the transition interval between the successive phases. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Phases); attach(Phases)
PhasesTransition(Phase.1.beta, Phase.2.alpha, 0.95)
PhasesTransition(Phase.1.beta, Phase.2.alpha, 0.50)
```

phases_gap *Gap or hiatus between two successive phases (for phases in temporal order constraint)*

Description

This function finds, if it exists, a gap or hiatus between two successive phases. This gap or hiatus is the longest interval that satisfies $P(Phase1Max_chain < IntervalInf < IntervalSup < Phase2Min_chain|M) = level$

Usage

```
phases_gap(a_chain, b_chain, level = 0.95)
```

Arguments

a_chain	Numeric vector containing the output of the MCMC algorithm for the upper boundary of the older phase.
b_chain	Numeric vector containing the output of the MCMC algorithm for the lower boundary of the younger phase.
level	Probability corresponding to the level of confidence.

Value

A list with the following components:

hiatus A named vector where `inf` is the lower endpoint of the hiatus as a calendar year (AD/BC) or `NA` if there is no hiatus at `level`, and `sup` is the upper endpoint of the gap as a calendar year (AD/BC), or `NA` if there is no hiatus at `level`.

level Probability corresponding to the confidence level of the interval.

call The function call.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>, and

Thomas S. Dye, <tsd@tsdye.online>

Examples

```
data(Phases); attach(Phases)
phases_gap(Phase.1.beta, Phase.2.alpha, 0.95)
phases_gap(Phase.1.beta, Phase.2.alpha, 0.50)
```

PhaseTimeRange *Phase time range*

Description

Computes the shortest interval that satisfies $P(PhaseMin_chain =< IntervalInf < IntervalSup =< PhaseMax_chain|M) = level$

Usage

```
PhaseTimeRange(PhaseMin_chain, PhaseMax_chain, level = 0.95)
```

Arguments

PhaseMin_chain	: Numeric vector containing the output of the MCMC algorithm for the minimum of the events included in the phase.
PhaseMax_chain	: Numeric vector containing the output of the MCMC algorithm for the maximum of the events included in the phase.
level	Probability corresponding to the desired level of confidence.

Value

A vector of values containing the desired level of confidence and the endpoints of the shortest time range associated with this desired level. The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Examples

```
data(Phases); attach(Phases)
PhaseTimeRange(Phase.1.alpha, Phase.1.beta, 0.95)
PhaseTimeRange(Phase.2.alpha, Phase.2.beta, 0.90)
```

phase_statistics *Summary statistics of a phase*

Description

Estimation of summary statistics for the beginning, end, and duration of a phase.

Usage

```
phase_statistics(min_chain, max_chain, level = 0.95, round_to = 0)
```

Arguments

min_chain	Numeric vector containing the output of the MCMC algorithm for the start of the phase.
max_chain	Numeric vector containing the output of the MCMC algorithm for the end of the phase.
level	Probability corresponding to the level of confidence used for the credible interval and the highest density region.
round_to	Integer indicating the number of decimal places.

Details

The summary statistics are those given by the `MarginalStatistics()` function. The time range is given by `PhaseTimeRange()` function. The duration is computed as follows: $duration = maximum - minimum$ at each iteration of the MCMC output.

Value

A list with the following components:

statistics A data frame where the rows correspond to the summary statistics and the columns include: `start`, the start of the phase in calendar years (BC/AD); `end` the end of the phase in calendar years (BC/AD); and `duration` the duration of the phase in years.

level Probability corresponding to the level of confidence used for the credible interval and the highest density region.

call The function call.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>, and

Thomas S. Dye, <tsd@tsdye.online>

Examples

```
data(Phases); attach(Phases)
phase_statistics(Phase.1.alpha, Phase.1.beta, 0.95)
phase_statistics(Phase.2.alpha, Phase.2.beta, 0.95)
## round to decade
phase_statistics(Phase.2.alpha, Phase.2.beta, 0.95, -1)
```

---

plot.archaeophases_plot

Recreate a graphical plot

Description

Recreates a graphic from data and metadata held in a `archaeophases_plot` object.

Usage

```
## S3 method for class 'archaeophases_plot'
plot(x, ...)
```

Arguments

`x`	An `archaeophases_plot` object.
`...`	Other parameters.

Details

Uses data stored in the `archaeophases_plot` object, along with metadata from the call of the plotting function, to recreate the original graphic on the display.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

See Also

`tempo_plot`

`occurrence_plot`

`marginal_plot`

`multi_marginal_plot`

`tempo_activity_plot`

`multi_dates_plot`

Examples

```
## Not run:
# Read from connection
  ox <- read_oxcal("http://tsdye.online/AP/ox.csv")
  tp_1 <- tempo_plot(ox, position = 1:ncol(ox))
# Recreate the tempo_plot with the original arguments
  plot(tp_1)

## End(Not run)
```

`read_bcal` *Read MCMC output from BCal*

Description

Import a CSV file containing the output of the MCMC algorithm produced by BCal.

Usage

```
read_bcal(file, bin_width = 1, quiet = "no")
```

Arguments

`file`	Either a path to a CSV file, a connection, or the value `clipboard()` to read from the system clipboard. The CSV file can be compressed or plain. See `read_csv` for details.
`bin_width`	The bin width specified for the BCal calibration. Defaults to the BCal default of 1.
`quiet`	One of "no" (default) to allow messages and warnings, "partial" to suppress messages and allow warnings, or "yes" to suppress messages and warnings.

Details

The `read_bcal` function is built on `read_csv`. It aims to be fast and simple, and to return the marginal posteriors free of extraneous artifacts. The iteration column in the CSV file is discarded, as are an empty last column and an empty last row.

Value

An `archaeophases_mcmc` object containing the marginal posterior(s) as a data frame.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

See Also

read_csv

ImportCSV

new_archaeophases_mcmc

Examples

```
## Not run:
  # Import of MCMC output from BCal
  data(Fishpond)
  write.csv(Fishpond, "fishpond_MCMC.csv", row.names=FALSE)
  fishpond <- read_bcal("fishpond_MCMC.csv")

# Read from connection
  bc_1 <- read_bcal("http://tsdye.online/AP/bc-1.csv")
  bc_17 <- read_bcal("http://tsdye.online/AP/bc-17.csv", bin_width = 17)

## End(Not run)
```

---

read_chronomodel *Read MCMC output from ChronoModel*

Description

Import a CSV file containing the output of the MCMC algorithm produced by ChronoModel.

Usage

```
read_chronomodel(file, decimal = ".", separator = ",", quiet = "no")
```

Arguments

file	Either a path to a CSV file, a connection, or the value clipboard() to read from the system clipboard. The CSV file can be compressed or plain. See read_delim for details.
decimal	Either "." (default) or ",", the two choices offered by ChronoModel.
separator	The character used to separate fields in the CSV file. Defaults to ",".
quiet	One of "no" (default) to allow messages and warnings, "partial" to suppress messages and allow warnings, or "yes" to suppress messages and warnings.

Details

The read_chronomodel function is built on read_delim. It aims to be fast and simple, and to return the marginal posteriors free of extraneous artifacts. The iteration column in the CSV file is discarded.

Value

An archaeophases_mcmc object containing the marginal posterior(s) from file.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

See Also

read_delim

ImportCSV

new_archaeophases_mcmc

Examples

```
  data(Events)
## Not run:
  write.csv(Events, "events.csv", row.names=FALSE)
  events = read_chronomodel("events.csv", decimal = ".", separator = ",")
  # equivalent
  events = read_chronomodel("events.csv")


   rem <- read_chronomodel("http://tsdye.online/AP/cm/Chain_all_Events.csv")

## End(Not run)
```

---

read_oxcal *Read MCMC output from OxCal*

Description

Import a CSV file containing the output of the MCMC algorithm produced by OxCal.

Usage

```
read_oxcal(file, quiet = "no")
```

Arguments

file	Either a path to a CSV file, a connection, or the value clipboard() to read from the system clipboard. The CSV file can be compressed or plain. See read_csv for details.
quiet	One of "no" (default) to allow messages and warnings, "partial" to suppress messages and allow warnings, or "yes" to suppress messages and warnings.

Details

The `read_oxcal` function is built on `read_csv`. It aims to be fast and simple, and to return the marginal posteriors free of extraneous artifacts. The iteration column in the CSV file is discarded, as is an empty last column.

Value

An `archaeophases_mcmc` object containing the marginal posterior(s) as a data frame.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

See Also

`read_csv`

`ImportCSV`

Examples

```
## Not run:
  # Import of MCMC output from OxCal
  data(Events)
  #To do for saving in csv file
  # write.csv(Events, "events.csv", row.names = FALSE)
  fishpond <- read_oxcal("events.csv")

  # Read from connection
  oxc <- read_oxcal("http://tsdye.online/AP/ox.csv")

## End(Not run)
```

`reproduce.archaeophases_mcmc` *Reproduce an MCMC data frame*

Description

Reproduces a data frame from metadata held in an `archaeophases_mcmc` object.

Usage

```
## S3 method for class 'archaeophases_mcmc'
reproduce(x, file = NULL, ...)
```

Arguments

x	An archaeophases_mcmc object.
file	A path to the original MCMC csv file, or a copy of the file.
...	Other parameters.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

See Also

original_file

Examples

```
## Not run:
x <- read_bcal("http://tsdye.online/AP/bc-1.csv")
y <- reproduce(x)
# TRUE
identical(x, y)

## End(Not run)
```

---

reproduce.archaeophases_plot

Reproduce an ArchaeoPhases plot

Description

Reproduces a plot from metadata held in an archaeophases_plot object.

Usage

```
## S3 method for class 'archaeophases_plot'
reproduce(x, file = NULL, ...)
```

Arguments

x	An archaeophases_plot object.
file	Path to the original MCMC csv file, or a copy of the file.
...	Other parameters.

Author(s)

Thomas S. Dye, <tsd@tsdye.online>

See Also

original_file

Examples

```
## Not run:
x <- read_bcal("http://tsdye.online/AP/bc-1.csv")
y <- multi_dates_plot(x)
z <- reproduce(y)
# TRUE
identical(y, z)

#ERROR, Not the original file.
z <- reproduce(y, file = "foo.csv")

## End(Not run)
```

SuccessionPlot *Density plots of two successive groups (for groups in temporal order constraint)*

Description

Plot of the densities of the minimum and the maximum of the events included in each group, with summary statistics including the mean, credible interval, and highest posterior density. The result is given in calendar years (BC/AD).

Usage

```
SuccessionPlot(
  Phase1Min_chain,
  Phase1Max_chain,
  Phase2Min_chain,
  Phase2Max_chain,
  level = 0.95,
  title = "Characterisation of a succession of groups",
  exportFile = NULL,
  exportFormat = "PNG",
  GridLength = 1024
)
```

Arguments

Phase1Min_chain

Numeric vector containing the output of the MCMC algorithm for the minimum of the events included in the oldest phase.

`Phase1Max_chain`
: Numeric vector containing the output of the MCMC algorithm for the maximum of the events included in the oldest phase.

`Phase2Min_chain`
: Numeric vector containing the output of the MCMC algorithm for the minimum of the events included in the youngest phase.

`Phase2Max_chain`
: Numeric vector containing the output of the MCMC algorithm for the maximum of the events included in the youngest phase.

`level`
: Probability corresponding to the level of confidence.

`title`
: Title of the plot.

`exportFile`
: Name of the file to be saved. If `NULL` then no plot is saved.

`exportFormat`
: Format of the export file, either "PNG" or "SVG".

`GridLength`
: Length of the grid used to estimate the density.

Details

Curves represent the density of the minimum (oldest event) and the maximum (youngest event) of the events included in each group. Curves of the same color refer to the same group. Time range intervals are symbolised by segments above the curves drawn using the same color as curves of the associated group. Transition and gap range intervals are represented by two-coloured segments using the colors of the both groups in succession. If the gap between the successive groups does not exist, a cross is drawn instead of a segment.

Value

`NULL`, called for its side effects

Author(s)

Anne Philippe, `<Anne.Philippe@univ-nantes.fr>` and

Marie-Anne Vibet, `<Marie-Anne.Vibet@univ-nantes.fr>`

Examples

```
data(Phases); attach(Phases)
SuccessionPlot(Phase.1.alpha, Phase.1.beta, Phase.2.alpha, Phase.2.beta, level = 0.95)
```

`TempoActivityPlot` *Plot the derivative of the tempo plot Bayesian estimate*

Description

A statistical graphic designed for the archaeological study of rhythms of the long term that embodies a theory of archaeological evidence for the occurrence of events

Usage

```
TempoActivityPlot(
  data,
  position,
  plot.result = NULL,
  level = 0.95,
  title = "Activity plot",
  subtitle = NULL,
  caption = "ArcheoPhases",
  x.label = "Calendar year",
  y.label = "Activity",
  line.types = c("solid"),
  width = 7,
  height = 7,
  units = "in",
  x.min = NULL,
  x.max = NULL,
  file = NULL,
  x.scale = "calendar",
  elapsed.origin.position = NULL,
  newWindow = TRUE,
  print.data.result = FALSE
)
```

Arguments

`data`	Data frame containing the output of the MCMC algorithm.
`position`	Numeric vector containing the position of the column corresponding to the MCMC chains of interest.
`plot.result`	List containing the data to plot, typically the result of a previous run of `TempoActivityPlot()`.
`level`	Probability corresponding to the level of confidence.
`title`	Title of the plot.
`subtitle`	Subtitle of the plot.
`caption`	Caption of the plot.
`x.label`	Label of the x-axis.
`y.label`	Label of the y-axis.

line.types	Type of the lines drawn on the plot.
width	Width of the plot in units.
height	Height of the plot in units.
units	Units used to specify width and height, one of "in" (default),"cm", or "mm".
x.min	Minimum value for x-axis.
x.max	Maximum value for x-axis.
file	Name of the file to be saved if specified. If Null, then no file is saved.
x.scale	One of "calendar", "bp", or "elapsed".
elapsed.origin.position	If x.scale is "elapsed", the position of the column corresponding to the event from which elapsed time is calculated.
newWindow	Whether or not the plot is drawn within a new window .
print.data.result	If TRUE, the list containing the data to plot is returned.

Value

NULL, called for its side effects. It may also return a list containing the data to plot (if print.data.result = TRUE). The result is given in calendar years (BC/AD).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

References

Dye, T.S. (2016) Long-term rhythms in the development of Hawaiian social stratification. Journal of Archaeological Science, 71, 1–9.

Examples

```
data(Events);
TempoActivityPlot(Events[1:1000, ], c(2:5), print.data.result = FALSE)
TempoActivityPlot(Events[1:1000, ], c(2:5), print.data.result = FALSE)
```

TempoPlot *Tempo plot*

Description

A statistical graphic designed for the archaeological study of rhythms of the long term that embodies a theory of archaeological evidence for the occurrence of events

Usage

```
TempoPlot(
  data,
  position,
  plot.result = NULL,
  level = 0.95,
  count = TRUE,
  Gauss = FALSE,
  title = "Tempo plot",
  subtitle = NULL,
  caption = "ArcheoPhases",
  legend.title = "Legend",
  legend.labels = c("Bayes estimate", "Credible interval, low",
   "Credible interval, high", "Gaussian approx., high", "Gaussian approx., low"),
  x.label = "Calendar year",
  y.label = "Cumulative events",
  line.types = c("solid", "12", "11", "28", "28"),
  width = 7,
  height = 7,
  units = "in",
  x.min = NULL,
  x.max = NULL,
  colors = TRUE,
  file = NULL,
  x.scale = "calendar",
  elapsed.origin.position = NULL,
  newWindow = TRUE,
  print.data.result = FALSE
)
```

Arguments

data	Data frame containing the output of the MCMC algorithm.
position	Numeric vector containing the position of the column corresponding to the MCMC chains of interest.
plot.result	List containing the data to plot, typically the result of a previous run of TempoPlot().
level	Probability corresponding to the level of confidence.

count	If TRUE the counting process is a number, otherwise it is a probability.
Gauss	If TRUE, the Gaussian approximation of the credible interval is used.
title	Title of the plot.
subtitle	Subtitle of the plot.
caption	Caption of the plot.
legend.title	Title of the plot legend.
legend.labels	Vector of strings to label legend entries.
x.label	Label of the x-axis.
y.label	Label of the y-axis.
line.types	Type of the lines drawn on the plot in the order of legend.labels.
width	Width of the plot in units.
height	Height of the plot in units.
units	Units used to specify width and height, one of "in" (default), "cm", or "mm".
x.min	Minimum value for x-axis.
x.max	Maximum value for x-axis.
colors	If TRUE, the plot is drawn with colors, otherwise it is drawn in black and white.
file	Name of the file that will be saved if specified. If NULL no file is saved.
x.scale	One of "calendar", "bp", or "elapsed".
elapsed.origin.position	If x.scale is "elapsed", the position of the column corresponding to the event from which elapsed time is calculated.
newWindow	Whether or not the plot is drawn within a new window.
print.data.result	If TRUE, a list containing the data to plot will be returned.

Details

The tempo plot is one way to measure change over time: it estimates the cumulative occurrence of archaeological events in a Bayesian calibration. The tempo plot yields a graphic where the slope of the plot directly reflects the pace of change: a period of rapid change yields a steep slope and a period of slow change yields a gentle slope. When there is no change, the plot is horizontal. When change is instantaneous, the plot is vertical.

Value

NULL, called for its side effects. It may also return a list containing the data to plot (if print.data.result = TRUE).

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Thomas S. Dye, <tsd@tsdye.online>, and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

References

Dye, T.S. (2016) Long-term rhythms in the development of Hawaiian social stratification. Journal of Archaeological Science, 71, 1–9

See Also

tempo_plot

Examples

```
data(Events);
TempoPlot(Events[1:1000, ], c(2:5), print.data.result = FALSE)
TempoPlot(Events[1:1000, ], c(2:5), count = TRUE,  print.data.result = FALSE)
```

---

tempo_activity_plot *Plot the derivative of the tempo plot Bayesian estimate*

Description

A statistical graphic designed for the archaeological study of rhythms of the long term that embodies a theory of archaeological evidence for the occurrence of events

Usage

```
tempo_activity_plot(
  data,
  position = 1:ncol(data),
  title = "Tempo Activity Plot",
  subtitle = NULL,
  caption = "ArcheoPhases",
  x_label = "Calendar year",
  y_label = "Activity",
  line_types = c("solid"),
  width = 7,
  height = 7,
  units = "in",
  x_min = NULL,
  x_max = NULL,
  file = NULL,
  x_scale = "calendar",
  elapsed_origin_position = NULL,
  new_window = TRUE,
  plot_result = TRUE
)
```

Arguments

data	Data frame containing the output of the MCMC algorithm.
position	Numeric vector containing the position of the column corresponding to the MCMC chains of interest, or a vector of column names.
title	Title of the plot.
subtitle	Subtitle of the plot.
caption	Caption of the plot.
x_label	Label of the x-axis.
y_label	Label of the y-axis.
line_types	Type of the lines drawn on the plot.
width	Width of the plot in units.
height	Height of the plot in units.
units	Units used to specify width and height, one of "in" (default),"cm", or "mm".
x_min	Minimum value for x-axis.
x_max	Maximum value for x-axis.
file	Name of the file to be saved if specified. If Null, then no file is saved.
x_scale	One of "calendar", "bp", or "elapsed".
elapsed_origin_position	If x_scale is "elapsed", the position of the column corresponding to the event from which elapsed time is calculated.
new_window	Whether or not the plot is drawn within a new window.
plot_result	If TRUE, then draw a plot on the display, else suppress drawing.

Value

An archaeophases_plot object with the data and metadata needed to reproduce the plot.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr> and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

Thomas S. Dye, <tsd@tsdye.online>

References

Dye, T.S. (2016) Long-term rhythms in the development of Hawaiian social stratification. Journal of Archaeological Science, 71, 1–9.

Examples

```
data(Events);
tempo_activity_plot(Events[1:1000, ], c(2:5))
```

tempo_plot *Tempo plot*

Description

A statistical graphic designed for the archaeological study of rhythms of the long term that embodies a theory of archaeological evidence for the occurrence of events

Usage

```
tempo_plot(
  data,
  position = 1:ncol(data),
  level = 0.95,
  count = TRUE,
  Gauss = FALSE,
  title = NULL,
  subtitle = NULL,
  caption = NULL,
  legend_title = NULL,
  legend_position = "bottom",
  legend_labels = c("Bayes estimate", "Credible interval high",
    "Credible interval low"),
  x_label = "Calendar year",
  y_label = "Cumulative events",
  line_types = c("solid", "dotted", "dotted"),
  line_sizes = c(1.2, 0.8, 0.8),
  line_colors = c("black", "grey50", "grey50"),
  width = 7,
  height = 7,
  units = "in",
  x_min = NULL,
  x_max = NULL,
  color_palette = NULL,
  file = NULL,
  x_scale = "calendar",
  elapsed_origin_position = NULL,
  new_window = TRUE,
  plot_result = TRUE
)
```

Arguments

data	Data frame or archaeophases_mcmc object containing the output of the MCMC algorithm.
position	Numeric vector containing the position of the column corresponding to the MCMC chains of interest, or a vector of column names.

level	Probability corresponding to the level of confidence.
count	If TRUE the counting process is a number, otherwise it is a probability.
Gauss	If TRUE, the Gaussian approximation of the credible interval is used.
title	Title of the plot.
subtitle	Subtitle of the plot.
caption	Caption of the plot.
legend_title	Title of the plot legend.
legend_position	One of "top", "bottom" (default), "left", "right".
legend_labels	Vector of three strings to label legend entries. The strings must be unique. The first string labels the central tendency and the second and third strings label the high and low spreads.
x_label	Label of the x-axis.
y_label	Label of the y-axis.
line_types	Type of the lines drawn on the plot in the order of legend_labels.
line_sizes	Width of the lines drawn on the plot in the order of legend_labels.
line_colors	Color names for the lines drawn on the plot in the order of legend_labels. If color_palette is NULL, then standard color names are expected, otherwise the color names are from the supplied color_palette.
width	Width of the plot in units.
height	Height of the plot in units.
units	Units used to specify width and height, one of "in" (default), "cm", or "mm".
x_min	Minimum value for x-axis.
x_max	Maximum value for x-axis.
color_palette	A palette that supplies the colors used in the plot.
file	Name of the file that will be saved if specified. If NULL no file is saved.
x_scale	One of "calendar", "bp", or "elapsed".
elapsed_origin_position	If x.scale is "elapsed", the position of the column corresponding to the event from which elapsed time is calculated.
new_window	Whether or not the plot is drawn within a new window.
plot_result	If TRUE, then draw a plot on the display, else suppress drawing.

Details

The tempo plot is one way to measure change over time: it estimates the cumulative occurrence of archaeological events in a Bayesian calibration. The tempo plot yields a graphic where the slope of the plot directly reflects the pace of change: a period of rapid change yields a steep slope and a period of slow change yields a gentle slope. When there is no change, the plot is horizontal. When change is instantaneous, the plot is vertical.

Value

An archaeophases_plot object with the data and metadata needed to reproduce the plot.

Author(s)

Anne Philippe, <Anne.Philippe@univ-nantes.fr>,

Thomas S. Dye, <tsd@tsdye.online>, and

Marie-Anne Vibet, <Marie-Anne.Vibet@univ-nantes.fr>

References

Dye, T.S. (2016) Long-term rhythms in the development of Hawaiian social stratification. Journal of Archaeological Science, 71, 1–9

See Also

TempoPlot

new_archaeophases_plot

Examples

```
  data(Events);
  tempo_plot(Events[1:1000, ], c(2:5))
  tempo_plot(Events[1:1000, ], c(2:5), count = TRUE)

## Not run:
# Read from connection
ox <- read_oxcal("http://tsdye.online/AP/ox.csv")
# Plot all the columns
tp <- tempo_plot(ox)
# Reproduce the tempo plot
plot(tp)
# View metadata
str(tp)
# Check that the MCMC data file hasn't changed
original_file(tp)

# Use a custom palette
library(khroma)
light <- colours("light")
tp <- tempo_plot(ox, color_palette = light(2),
line_colors = c("light blue", "pale grey", "pale grey"))

## End(Not run)
```

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