Package ‘RChronoModel’

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

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Description Provides a list of functions for the statistical analysis and the post-processing of the Markov Chains simulated by ChronoModel (see <http://www.chronomodel.fr> for more information). ChronoModel is a friendly software to construct a chronological model in a Bayesian framework. Its output is a sampled Markov chain from the posterior distribution of dates component the chronology. The functions can also be applied to the analyse of mcmc output generated by Oxcal software.

License GPL

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`CreateMinMaxGroup` *Constructing the minimum and the maximum for a group of dates(phase)*

Description

Constructs a dataframe containing the output of the MCMC algorithm corresponding to the minimum and the maximum of a group of dates (phase)

Usage

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

Arguments

`data`	dataframe 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`	the name of the dataframe in which the current minimum and maximum should be added. Null by default.
`exportFile`	the name of the final file that will be saved if chosen. Null by default.

Value

A dataframe containing the minimum and the maximum of the group of dates included in the phase of interest. These values may be added to an already existing file "add" if given.

Author(s)

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Examples

```
data(Events)
Temp = CreateMinMaxGroup(Events, c(2,4), "Phase2")
Temp = CreateMinMaxGroup(Events, c(3,5), "Phase1", Temp)
```

CredibleInterval *Bayesian credible interval*

Description

Computes the shortest credible interval at the desired level.

Usage

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

Arguments

a_chain	numeric vector containing the output of the MCMC algorithm for a one-parameter
level	probability corresponding to the level of confidence used for the credible interval

Details

A (100 * level) % credible intervalgives the shortest interval, whose posterior probability is equal to the desired level. This interval is approximated by constructing the shortest interval such that N*(1-level) elements of the sample are outside the interval.

Value

Returns a vector of values containing the level of confidence and the endpoints of the shortest credible interval.

Author(s)

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

Examples

```
data(Events); attach(Events)

CredibleInterval(Event.1)
CredibleInterval(Event.12, 0.50)
```

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

Description

Finds if it exists a gap between two dates that is 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 one-parameter (date) a
b_chain	numeric vector containing the output of the same MCMC algorithm for the second one-parameter (date) b
level	probability corresponding to the level of confidence used for the credible interval and the highest density region

Value

Returns the endpoints of the longest hiatus between two parameters

Author(s)

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Examples

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

`Events` *Events*

Description

Contains the output of the MCMC algorithm for four events modelled by ChronoModel.

Usage

```
data(Events)
```

Format

A data frame with 30000 observations on the following 5 variables.

`iter` a numeric vector corresponding to iteration number

`Event.1` a numeric vector containing the output of the MCMC algorithm for the parameter Event 1

`Event.12` a numeric vector containing the output of the MCMC algorithm for the parameter Event 12

`Event.2` a numeric vector containing the output of the MCMC algorithm for the parameter Event 2

`Event.22` a numeric vector containing the output of the MCMC algorithm for the parameter Event 22

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Examples

```
data(Events)
summary(Events)
```

`ImportCSV` *Importing a CSV file containing the output of the MCMC algorithm*

Description

Use of the read.csv with th default values for CSV files extracted from ChronoModel software

Usage

```
ImportCSV(file, dec = '.', sep=',', comment.char='#', header = TRUE)
```

Arguments

`file`	the name of the CSV file containing the output of the MCMC algorithm
`dec`	the character used in the file for decimal points for the use of read.csv()
`sep`	the field separator character for the use of read.csv()
`comment.char`	a character vector of length one containing a single character or an empty string for the use of read.csv()
`header`	a logical value indicating whether the file contains the names of the variables as its first line.

Value

Returns a dataframe containing a representation of the data in the file.

Author(s)

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Examples

```
data(Events)
write.csv(Events, "data.csv", row.names=FALSE)
ImportCSV("data.csv")
ImportCSV("data.csv", dec = '.', sep=',', comment.char='#', header = TRUE)
```

`MarginalPlot` *Plot of a marginal posterior density*

Description

This function draws the density of a one-parameter and adds summary statistics.

Usage

```
MarginalPlot(a_chain, level = 0.95, title = "Marginal posterior density",
  colors = T, GridLength = 1024)
```

Arguments

`a_chain`	numeric vector containing the output of the MCMC algorithm for a one-parameter
`level`	probability corresponding to the level of confidence
`title`	label of the title
`colors`	if TRUE -> use of colors in the graph
`GridLength`	length of the grid used to estimate the density

Details

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

Value

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

Author(s)

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Examples

```
data(Events); attach(Events)

MarginalPlot(Event.1, 0.95)
MarginalPlot(Event.1, 0.50)

MarginalPlot(Event.2, 0.95, title="Marginal density plot of Event 2")
MarginalPlot(Event.2, 0.95, colors = FALSE)
```

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 one-parameter (date) a
b_chain	numeric vector containing the output of the same MCMC algorithm for the second one-parameter (date) b

Details

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

Value

Returns the posterior probability of the following assumption: "Event a is older than event b"

Author(s)

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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

Gives a list of summary statistics resulting from the output of the MCMC algorithm for a one-parameter.

Usage

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

Arguments

`a_chain`	numeric vector containing the output of the MCMC algorithm for a one-parameter
`level`	probability corresponding to the level of confidence used for the credible interval and the highest density region
`max_decimal`	maximum number of decimal

Details

The 100*level % HPD (highest posterior density) region is estimated using HDR function from Package 'hdrcde'.

Value

A matrix of values corresponding to the following summary 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.

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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)
```

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

Description

Estimation of the shortest credible interval for each variables of simulated Markov chain.

Usage

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

Arguments

`data`	dataframe 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 to estimate the credible interval

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.

Author(s)

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Examples

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

`MultiDatesPlot` *Plot of the endpoints of credible intervals or HPD intervals of a series of dates*

Description

Draws a plot of segments corresponding to the endpoints of the intervals (CI or HPD) of each selected date.

Usage

```
MultiDatesPlot(data, position, level = 0.95,  intervals = c("CI", "HPD"),
title = "Plot of intervals")
```

Arguments

`data`	dataframe 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 to estimate the credible interval
`intervals`	"CI" corresponds to the credible intervals, "HPD" to the highest density regions
`title`	title of the graph

Author(s)

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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")
```

`MultiHPD` *Bayesian highest posterior density regions for a series of MCMC chains*

Description

Estimation of the highest posterior density regions for each variables of simulated Markov chain. This function uses the "hdr" function oincluded in the package "hdrcde.

Usage

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

Arguments

`data`	dataframe 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

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.

Author(s)

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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)
```

MultiPhasePlot — *Plot of the marginal posterior densities of several phases*

Description

Draws a plot with the marginal posterior densities of the minimum and the maximum of the dates included in each phase. No temporal order between phases is required.

Usage

```
MultiPhasePlot(data, position_minimum, position_maximum = position_minimum+1,
level = 0.95,  title = "Phases marginal posterior densities")
```

Arguments

`data`	dataframe containing the output of the MCMC algorithm
`position_minimum`	numeric vector containing the column number corresponding to the minimum of the dates included in each phase
`position_maximum`	numeric vector containing the column number corresponding to the maximum of the dates included in each phase. By default, position_maximum = position_minimum + 1.
`level`	probability corresponding to the level of confidence
`title`	title of the graph

Value

Draws a plot with the marginal posterior densities of the minimum and the maximum of the dates included in each phase and adds the time range of each phase.

Author(s)

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

Examples

```
# Data extracted from ChronoModel software
data(Phases)

# List of the name of the phases
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")
```

MultiPhasesGap *Gap/Hiatus between a succession of phases (for phases in temporal order constraint)*

Description

This function finds, if it exists, the gap between two successive phases. This gap or hiatus is the longest interval [IntervalInf, IntervalSup] that satisfies : P(Phase1Max < IntervalInf < IntervalSup < Phase2Min | M) = level for each successive phase.

Usage

```
MultiPhasesGap(data, position_minimum, position_maximum = position_minimum+1,
 level = 0.95, max_decimal = 0)
```

Arguments

data	dataframe containing the output of the MCMC algorithm
position_minimum	numeric vector containing the column number corresponding to the minimum of the dates included in each phase
position_maximum	numeric vector containing the column number corresponding to the maximum of the dates included in each phase. By default, position_maximum = position_minimum + 1.
level	probability corresponding to the level of confidence
max_decimal	maximum number of decimal

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 phases

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 phases
names(Phases)

# Stipulating position_maximum
MultiPhasesGap(Phases, c(4,2), c(5,3))

# In this case, equivalent to
MultiPhasesGap(Phases, c(4,2))
```

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

Description

Finds if it exists the shortest interval [TransitionRangeInf, TransitionRangeSup] that satisfies : P(TransitionRangeInf < Phase1Max < Phase2Min < TransitionRangeSup | M) = level for each phase

Usage

```
MultiPhasesTransition(data, position_minimum, position_maximum = position_minimum+1,
level = 0.95, max_decimal = 0)
```

Arguments

`data`	dataframe containing the output of the MCMC algorithm
`position_minimum`	numeric vector containing the column number corresponding to the minimum of the dates included in each phase
`position_maximum`	numeric vector containing the column number corresponding to the maximum of the dates included in each phase. By default, position_maximum = position_minimum + 1.
`level`	probability corresponding to the level of confidence
`max_decimal`	maximum number of decimal

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

Returns a matrix of values containing the level of confidence and the endpoints of the transition interval for each pair of successive phases

Author(s)

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Examples

```
# Data extracted from ChronoModel software
data(Phases)

# List of the name of the phases
names(Phases)

# Stipulating position_maximum
MultiPhasesTransition(Phases, c(4,2), c(5,3))

# In this case, equivalent to
MultiPhasesTransition(Phases, c(4,2))
```

MultiPhaseTimeRange *Phase Time Range for multiple phases*

Description

Computes the shortest interval that satisfies : P(PhaseMin < IntervalInf < IntervalSup < PhaseMax | M) = level

Usage

```
MultiPhaseTimeRange(data, position_minimum, position_maximum = position_minimum+1,
 level = 0.95, max_decimal = 0)
```

Arguments

- `data` dataframe containing the output of the MCMC algorithm
- `position_minimum` numeric vector containing the column number corresponding to the minimum of the dates included in each phase
- `position_maximum` numeric vector containing the column number corresponding to the maximum of the dates included in each phase. By default, position_maximum = position_minimum + 1.
- `level` probability corresponding to the desired level of confidence
- `max_decimal` maximum number of decimal

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

Returns a matrix of values containing the level of confidence and the endpoints of the shortest time range associated with the desired level

Author(s)

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

Examples

```
# Data extracted from ChronoModel software
data(Phases)

# List of the name of the phases
names(Phases)

# Stipulating position_maximum
MultiPhaseTimeRange(Phases, c(4,2), c(5,3))

# In this case, equivalent to
MultiPhaseTimeRange(Phases, 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)

Usage

```
MultiSuccessionPlot(data, position_minimum, position_maximum = position_minimum+1,
 level = 0.95, title = "Characterisation of a succession of phases")
```

Arguments

`data` dataframe containing the output of the MCMC algorithm

`position_minimum` numeric vector containing the column number corresponding to the minimum of the dates included in each phase

`position_maximum` numeric vector containing the column number corresponding to the maximum of the dates included in each phase. By default, position_maximum = position_minimum + 1.

`level` probability corresponding to the level of confidence

`title` title of the graph

Details

Curves represent the density of the minimum (oldest dates) and the maximum (youngest dates) of the dates included in each phase. 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 phase 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 phase. Transition and gap range intervals are represented by two-coloured segments using the colors of successive phases. If the gap between the successive phases does not exist, a cross is drawn instead of a segment.

Value

Returns a plot of all densities and adds several summary statistics

Author(s)

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Examples

```
# Data extracted from ChronoModel software
data(Phases)

# List of the name of the phases
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")
```

PhaseDurationPlot *Plot of the marginal posterior densities of the duration of a phase*

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 the phase", colors = T, GridLength=1024)
```

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 time range
title	title of the graph
colors	if TRUE -> use of colors in the graph
GridLength	length of the grid used to estimate the density

Value

A plot with the marginal posterior densities of the duration of a phase and adds several summary statistics (mean, Credible interval, Time range)

Author(s)

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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 of the marginal posterior densities of a phase*

Description

This function draws the marginal posterior densities of the minimum and the maximum of the dates included in the phase

Usage

```
PhasePlot(PhaseMin_chain, PhaseMax_chain, level = 0.95,
  title = "Characterisation of a phase", colors = T,
  GridLength = 1024)
```

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 time range
title	title of the graph
colors	if TRUE -> use of colors in the graph
GridLength	length of the grid used to estimate the density

Value

A plot with the marginal posterior densities of the minimum and the maximum of the dates included in the phase and adds several summary statistics (mean, Credible interval, Time range)

Author(s)

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

Examples

```
data(Phases); attach(Phases)

PhasePlot(Phase.1.alpha, Phase.1.beta, 0.95, "Densities of Phase 1")
PhasePlot(Phase.2.alpha, Phase.2.beta, 0.95, "Densities of Phase 2",colors = FALSE)
```

`Phases` *Phases*

Description

Contains the output of the MCMC algorithm for all the phases (beginning and end) of two successive phases modelled in ChronoModel. Phase 1 is assued to be older than Phase 2.

Usage

```
data(Phases)
```

Format

A data frame with 30000 observations on the following 5 variables.

`iter` a numeric vector corresponding to iteration number

`Phase.1.alpha` a numeric vector containing the output of the MCMC algorithm for the beginning of the phase "Phase 1"

`Phase.1.beta` a numeric vector containing the output of the MCMC algorithm for the end of the phase "Phase 1"

`Phase.2.alpha` a numeric vector containing the output of the MCMC algorithm for the the beginning of the phase "Phase 2"

`Phase.2.beta` a numeric vector containing the output of the MCMC algorithm for the end of the phase "Phase 2"

Author(s)

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Examples

```
data(Phases)
attach(Phases)
PhasePlot(Phase.1.alpha, Phase.1.beta)
PhaseTimeRange(Phase.1.alpha, Phase.1.beta)

PhasesGap(Phase.1.beta, Phase.2.alpha)
PhasesTransition(Phase.1.beta, Phase.2.alpha)
```

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

Description

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

Usage

```
PhasesGap(Phase1Max_chain, Phase2Min_chain, level = 0.95,
  max_decimal = 0)
```

Arguments

`Phase1Max_chain`
: numeric vector containing the output of the MCMC algorithm for the maximum of the dates included in the oldest phase

`Phase2Min_chain`
: numeric vector containing the output of the MCMC algorithm for the minimum of the dates included in the youngest phase

`level`
: probability corresponding to the level of confidence

`max_decimal`
: maximum number of decimal

Value

Returns a vector of values containing the level of confidence and the endpoints of the gap between the successive phases

Author(s)

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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 for a phase*

Description

Estimation of several summary statistics of the minimum, the maximum and the duration of the dates included in the phase.

Usage

```
PhaseStatistics(PhaseMin_chain, PhaseMax_chain, level = 0.95,
  max_decimal = 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
max_decimal	maximum number of decimal

Details

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

Value

Returns a list 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
4	The endpoints of the phase time range

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, 0)
PhaseStatistics(Phase.2.alpha, Phase.2.beta, 0.95, 0)
```

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

Description

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

Usage

```
PhasesTransition(Phase1Max_chain, Phase2Min_chain, level = 0.95,
  max_decimal = 0)
```

Arguments

`Phase1Max_chain`
: numeric vector containing the output of the MCMC algorithm for the maximum of the dates included in the oldest phase

`Phase2Min_chain`
: numeric vector containing the output of the MCMC algorithm for the minimum of the dates included in the youngest phase

`level`
: probability corresponding to the level of confidence

`max_decimal`
: maximum number of decimal

Value

Returns a vector of values containing the level of confidence and the endpoints of the transition interval between the successive phases

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)
```

PhaseTimeRange *Phase Time Range*

Description

Computes the shortest interval [IntervalInf ; IntervalSup] that satisfies : P(PhaseMin_chain =< IntervalInf < IntervalSup =< PhaseMax_chain | M) = level.

Usage

```
PhaseTimeRange(PhaseMin_chain, PhaseMax_chain, level = 0.95,
  max_decimal = 2)
```

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 desired level of confidence
max_decimal	maximum number of decimal

Value

A vector of values containing the desired level of confidence and the endpoints of the shortest time range associated with this desired level.

Examples

```
data(Phases); attach(Phases)
PhaseTimeRange(Phase.1.alpha, Phase.1.beta, 0.95)
PhaseTimeRange(Phase.2.alpha, Phase.2.beta, 0.95, 0)
```

SuccessionPlot *Density Plots of two successive phases (for phases in temporal order constraint)*

Description

Plot of the densities of the minimum and the maximum of the dates included in each phase and adds several summary statistics (mean, CI, HPDR)

Usage

```
SuccessionPlot(Phase1Min_chain, Phase1Max_chain, Phase2Min_chain,
  Phase2Max_chain, level = 0.95,
  title = "Characterisation of several phases", GridLength = 1024)
```

Arguments

`Phase1Min_chain`
: numeric vector containing the output of the MCMC algorithm for the minimum of the dates included in the oldest phase

`Phase1Max_chain`
: numeric vector containing the output of the MCMC algorithm for the maximum of the dates included in the oldest phase

`Phase2Min_chain`
: numeric vector containing the output of the MCMC algorithm for the minimum of the dates included in the youngest phase

`Phase2Max_chain`
: numeric vector containing the output of the MCMC algorithm for the maximum of the dates included in the youngest phase

`level`
: probability corresponding to the level of confidence

`title`
: title of the graph

`GridLength`
: length of the grid used to estimate the density

Details

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

Value

Plot of the densities of the minimum and the maximum of the dates included in each phase

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, 0.95)
```

TempoActivityPlot *Plot of the activity of events*

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, level=0.95,  count = TRUE,
title = "Activity plot")
```

Arguments

data	dataframe 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
count	if TRUE the counting process is given as a number, otherwise it is a probability
title	title of the graph

Value

It calculates the cumulative frequency of specified events by calculating how many events took place before each date in a specified range of dates.

Author(s)

Anne Philippe <Anne.Philippe@univ-nantes.fr>, Thomas S. Dye <TSD@tsdye.com> 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))
TempoActivityPlot(Events[1:1000,], c(2:5), count = TRUE)
```

`TempoPlot`	*Plot of the occurence of events*

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, level=0.95,  count = TRUE, Gauss=FALSE, title = "Tempo plot")
```

Arguments

`data`	dataframe 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
`count`	if TRUE the counting process is given as a number, otherwise it is a probability
`Gauss`	if TRUE, the Gaussian approximation of the CI is used
`title`	title of the graph

Value

It calculates the cumulative frequency of specified events by calculating how many events took place before each date in a specified range of dates.

Author(s)

Anne Philippe <Anne.Philippe@univ-nantes.fr>, Thomas S. Dye <TSD@tsdye.com> 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);
TempoPlot(Events[1:1000,], c(2:5))
TempoPlot(Events[1:1000,], c(2:5), count = TRUE)
```

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