

Package ‘bootnet’

March 4, 2015

Type Package

Title Bootstrap Methods for Various Network Estimation Routines

Version 0.1

Date 2015-03-04

Author Sacha Epskamp

Maintainer Sacha Epskamp <mail@sachaepskamp.com>

Depends ggplot2, R (>= 3.0.0)

Imports IsingFit, qgraph, dplyr (>= 0.3.0.2), gtools, corpcor

Suggests psych

Description Bootstrap standard errors on various network estimation routines, such as EBIC-glasso from the qgraph package and IsingFit from the IsingFit package.

License GPL-2

NeedsCompilation no

Repository CRAN

Date/Publication 2015-03-04 11:10:30

R topics documented:

anRpackage-package	2
binarize	2
bootnet	3
null	6
plot.bootnet	7
plot.bootnetResult	8
print.bootnet	8
summary.bootnet	9

Index	10
--------------	-----------

anRpackage-package *Bootstrap Methods for Various Network Estimation Routines*

Description

Bootstrap standard errors on various network estimation routines, such as EBICglasso from the qgraph package and IsingFit from the IsingFit package. See [bootnet](#)

Details

Package: bootnet
Type: Package
Version: 0.1
Date: 2015-03-01
License: GPL-2

Author(s)

Sacha Epskamp

Maintainer: Sacha Epskamp <mail@sachaepskamp.com>

See Also

[bootnet](#)

binarize *Binarizes a dataset*

Description

This function will transform data into binary data (0,1). If the data is already binary, this function does nothing.

Usage

```
binarize(x, split = "median", na.rm = TRUE, removeNArows = TRUE)
```

Arguments

<code>x</code>	A data frame or matrix
<code>split</code>	Either a function to split on (as character or as function) or a vector. e.g., <code>split = "mean"</code> will split every variable on the mean of that variable, <code>split=2</code> will make every value above 2 a 1 and every value below 2 a 0 and a vector of the same length as each variable in the dataset will use those elements to split.
<code>na.rm</code>	The <code>na.rm</code> argument used in the <code>split</code> function.
<code>removeNArows</code>	Logical, should rows with NA be removed?

Value

A binarized data frame

Author(s)

Sacha Epskamp <mail@sachaepskamp.com>

bootnet

Bootstrapped network estimation

Description

This function can be used to bootstrap network estimation methods so that the spread of parameter and centrality estimates can be assessed.

Usage

```
bootnet(data, nBoots = 1000, default, prepFun, prepArgs = list(), estFun, estArgs,
        graphFun, graphArgs, intFun, intArgs, verbose = TRUE, labels, alpha = 1)
```

Arguments

<code>data</code>	A data frame or matrix containing the raw data. Must be numeric, integer or ordered factors.
<code>nBoots</code>	Number of bootstraps
<code>default</code>	A string indicating the method to use. Specifying a <code>default</code> sets default values to <code>prepFun</code> , <code>prepArgs</code> , <code>estFun</code> , <code>estArgs</code> , <code>graphFun</code> , <code>graphArgs</code> , <code>intFun</code> and <code>intArgs</code> . Setting a <code>default</code> can be omitted but that does require specifying all above mentioned arguments. Current options are: <ul style="list-style-type: none"> "EBICglasso" Gaussian Markov random field estimation using graphical LASSO and extended Bayesian information criterium to select optimal regularization parameter. Using EBICglasso from the <code>qgraph</code> package. "IsingFit" Ising model estimation using LASSO regularized nodewise logistic regression and extended Bayesian information criterium to select optimal regularization parameter. Using IsingFit from the <code>IsingFit</code> package.

	"pcor" Partial correlation network (non-regularized Gaussian Markov random field), using <code>cor2pcor</code> from the <code>corpcor</code> package.
	See details section for a more detailed description.
<code>prepFun</code>	A function that takes as input the raw data and returns whatever the estimation function needs (as first argument). Typically this function is used to correlate or binarize the data. Defaults to <code>identity</code> if omitted and default is not set.
<code>prepArgs</code>	A list with arguments for <code>prepFun</code> . Defaults to <code>list()</code> if omitted and default is not set.
<code>estFun</code>	A function that takes as input the prepared raw data and estimates a network.
<code>estArgs</code>	A list with arguments for <code>estArgs</code>
<code>graphFun</code>	A function that takes the result of <code>estFun</code> and extracts the estimated weights matrix. Defaults to <code>identity</code> if omitted and default is not set.
<code>graphArgs</code>	A list with arguments for <code>graphFun</code> . Defaults to <code>list()</code> if omitted and default is not set.
<code>intFun</code>	A function that takes the result of <code>estFun</code> and extracts the estimated intercepts. Defaults to <code>null</code> if omitted and default is not set.
<code>intArgs</code>	A list with arguments for <code>intFun</code> . Defaults to <code>list()</code> if omitted and default is not set.
<code>verbose</code>	Logical. Should progress of the function be printed to the console?
<code>labels</code>	A character vector containing the node labels. If omitted the column names of the data are used.
<code>alpha</code>	The centrality tuning parameter as used in <code>centrality</code> .

Details

The following defaults can be used:

default = "EBICglasso" **prepFun** `cor_auto` from the `qgraph` package

prepArgs `list(verbose=FALSE)`

estFun `EBICglasso` from the `qgraph` package

estArgs `list(n = nrow(data), returnAllResults = TRUE)`

graphFun `function(x)x[['optnet']]`

graphArgs `list()`

intFun `null`

intArgs `list()`

default = "IsingFit" **prepFun** `binarize`

prepArgs `list()`

estFun `IsingFit` from the `IsingFit` package

estArgs `list(plot = FALSE, progress = FALSE)`

graphFun `function(x)x[['weiadj']]`

graphArgs `list()`

intFun `function(x)x[['thresholds']]`

intArgs `list()`

```

default = "pcor" prepFun cor_auto from the qgraph package
prepArgs list()
estFun cor2pcor from the corpcor package
estArgs list()
graphFun identity
graphArgs list()
intFun null
intArgs list()

```

Value

A bootnet object with the following elements:

sampleTable	A data frame containing all estimated values on the real sample.
bootTable	A data frame containing all estimated values on all bootstrapped samples.
sample	A bootnetResult object with plot and print method containing the estimated network of the real sample.
boots	A list of bootnetResult objects containing the raw bootstrap results.

Author(s)

Sacha Epskamp <mail@sachaepskamp.com>

See Also

[plot.bootnet](#), [summary.bootnet](#)

Examples

```

# BFI Extraversion data from psych package:
library("psych")
data(bfi)
bfiSub <- bfi[,11:15]

# 10 bootstraps (using Pearson correlations to speed up):
Results <- bootnet(bfiSub, nBoot = 5, default = "EBICglasso", prepFun = cor,
                  prepArgs = list(use = "pairwise.complete.obs"))

## Not run:
# 1000 bootstraps (using Pearson correlations to speed up):
Results <- bootnet(bfiSub, nBoot = 1000, default = "EBICglasso", prepFun = cor,
                  prepArgs = list(use = "pairwise.complete.obs"))

## End(Not run)

# Results:
print(Results)

# Estimated network:

```

```
plot(Results$sample, layout = 'spring')

# Estimated values in sample:
Results$sampleTable

# Estimated samples in bootstraps:
Results$bootTable

# Summary table:
summary(Results)

# Summary of strength only:
summary(Results, "strength")

# Plots of centrality measures:
plot(Results, c("strength", "closeness", "betweenness"), plot = "line")
plot(Results, c("strength", "closeness", "betweenness"), plot = "interval")

# Plots arranged by strength:
plot(Results, c("strength"), plot = "line", order = "value")
plot(Results, c("strength"), plot = "interval", order = "value")
```

null

Returns NULL

Description

This function simply returns NULL.

Usage

```
null(...)
```

Arguments

... Anything

Author(s)

Sacha Epskamp <mail@sachaepskamp.com>

Examples

```
null("Not NULL")
```

`plot.bootnet`*Plots bootnet results*

Description

This function can be used to plot bootnet results by plotting all bootstrapped statistics as line or by plotting confidence intervals (not yet implemented).

Usage

```
## S3 method for class 'bootnet'  
plot(x, types = c("strength", "closeness", "betweenness"),  
      plot = c("line", "interval"), sampleColor = "darkred", samplelwd = 1.1,  
      bootColor = "black", bootAlpha = 0.01, bootlwd = 1, order = c("id", "value"),  
      decreasing = TRUE, ...)
```

Arguments

<code>x</code>	A bootnet object
<code>types</code>	The types of statistics to plot. <code>c("intercept", "strength", "closeness", "betweenness")</code> plots all nodewise statistics whereas <code>c("edge", "distance")</code> plots all pairwise statistics.
<code>plot</code>	Character string indicating what to plot. "line" will produce a line graph and "interval" a 95% confidence interval graph
<code>sampleColor</code>	Color of the original sample line
<code>samplelwd</code>	Line width of the original sample line
<code>bootColor</code>	Color of the bootstrap lines
<code>bootAlpha</code>	Alpha of the bootstrap lines
<code>bootlwd</code>	Line width of the bootstrap lines
<code>order</code>	String indicating how to order nodes. "id" will order nodes based on their name and "value" will order nodes based on the first entry in type.
<code>decreasing</code>	Logical indicating if the ordering is decreasing or increasing.
<code>...</code>	Not used.

Value

A ggplot2 object.

Author(s)

Sacha Epskamp <mail@sachaepskamp.com>

plot.bootnetResult *Plot method for bootnetResult objects*

Description

Plots the graph using the qgraph package and the [qgraph](#) function. Defined as `qgraph::qgraph(x[['graph']], labels=x[`

Usage

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

Arguments

x A bootnetResult object
... Arguments sent to [qgraph](#).

Author(s)

Sacha Epskamp <mail@sachaepskamp.com>

print.bootnet *Print method for bootnet and bootnetResult objects*

Description

Prints a short overview of the results of [bootnet](#)

Usage

```
## S3 method for class 'bootnet'  
print(x, ...)  
## S3 method for class 'bootnetResult'  
print(x, ...)  
## S3 method for class 'bootnetResult'  
summary(object, ...)
```

Arguments

x A bootnet or bootnetResult object
object A bootnetResult object
... Not used.

Author(s)

Sacha Epskamp <mail@sachaepskamp.com>

summary.bootnet	<i>Summarize bootnet results</i>
-----------------	----------------------------------

Description

Creates a data frame (wrapped as `tbl_df`) containing summarized results of the bootstraps.

Usage

```
## S3 method for class 'bootnet'  
summary(object, types = c("edge", "intercept", "strength",  
                          "closeness", "betweenness", "distance"), ...)
```

Arguments

object	A bootnet object
types	The types of statistics to include in the summary table
...	Not used.

Value

A `tbl_df` (data frame) containing summarized statistics.

Author(s)

Sacha Epskamp <mail@sachaepskamp.com>

Index

`anRpackage` (`anRpackage-package`), [2](#)
`anRpackage-package`, [2](#)

`binarize`, [2, 4](#)
`bootnet`, [2, 3, 8](#)

`centrality`, [4](#)
`cor2pcor`, [4, 5](#)
`cor_auto`, [4, 5](#)

`EBICglasso`, [3, 4](#)

`identity`, [4, 5](#)
`IsingFit`, [3, 4](#)

`null`, [4, 6](#)

`plot.bootnet`, [5, 7](#)
`plot.bootnetResult`, [8](#)
`print.bootnet`, [8](#)
`print.bootnetResult` (`print.bootnet`), [8](#)

`qgraph`, [8](#)

`summary.bootnet`, [5, 9](#)
`summary.bootnetResult` (`print.bootnet`), [8](#)

`tbl_df`, [9](#)