Package ‘inet’

March 14, 2022

Type Package
Title Performing Inference on Networks with Regularization
Version 0.1.0
Depends R (>= 3.5.0)
Author Lourens Waldorp <waldorp@uva.nl>, Jonas Haslbeck <jonashaslbeck@gmail.com>
Maintainer Jonas Haslbeck <jonashaslbeck@gmail.com>
Description Performs inference with the lasso in Gaussian Graphical Models. The package consists of wrappers for functions from the 'hdi' package.
Encoding UTF-8
LazyData true
License GPL (>= 2)
Imports hdi, glmnet, MASS
NeedsCompilation no
Repository CRAN
Date/Publication 2022-03-14 09:00:02 UTC

R topics documented:

inet-datasets .............................................................. 2
inet-internal ............................................................. 2
lasso .............................................................. 3
lasso_dsp ............................................................ 4
lasso_dsp_boot .......................................................... 6
lasso_ms .............................................................. 7
OLS ................................................................. 9
plot.inet ............................................................. 11

Index 13
**inet-datasets**  
*Datasets included in inet package*

**Description**

The package includes a dataset with measurements of 17 PTSD symptoms taken from 344 individuals. See McNally et al. (2015) for more details.

**Author(s)**

Jonas Haslbeck

**References**


---

**inet-internal**  
*Internal inet functions*

**Description**

Internal inet functions.

**Details**

These are internal functions.

**Value**

The only internal function is one that performs input checks for the estimation functions. They return informative errors, if the inputs are not specified properly.

**Author(s)**

Jonas Haslbeck
Estimate GGM with nodewise regression and the lasso.

Description

Estimate a Gaussian Graphical Model with lasso-regularized nodewise regression, where the regularization parameter is selected with cross-validation. This is a wrapper around the function cv.glmnet() from the glmnet package.

Usage

```r
lasso(data, pbar = TRUE, nfolds = 10, rulereg = "and")
```

Arguments

- `data`: An n x p matrix containing the data, where n are cases and p are variables.
- `pbar`: If `pbar = TRUE`, a progress bar will be displayed.
- `nfolds`: Specifies the number of folds used to select the regularization parameter in each of the p nodewise regressions.
- `rulereg`: Specifies how parameter estimates should be combined across nodewise regressions. The options are the AND-rule (requiring both estimates to be significant) or the OR-rule (only requiring one estimate to be significant). Defaults to `rulereg = "and"`.

Value

The function returns a list with the following entries:

- `est`: A p x p matrix with point estimates for all partial correlations.
- `select`: A p x p indicator matrix indicating which edges have been selected to be present.

Author(s)

Jonas Haslbeck <jonashaslbeck@gmail.com>

References

Examples

# Toy example that runs relatively quickly
library(MASS)
p <- 5 # number of variables
data <- mvrnorm(n=100, mu=rep(0, p), Sigma = diag(p))
set.seed(1)
out <- lasso(data = data)

## Not run:

# Fit GGM to PTSD data
set.seed(1)
out <- lasso(data = ptsd_data)

## End(Not run)

\section*{lasso_dsp}

\textit{Estimate GGMs with the desparsified lasso.}

\subsection*{Description}

Estimate Gaussian Graphical Models using the desparsified lasso. This is a wrapper around the function \texttt{lasso.proj} of the \texttt{hdi} package.

\subsection*{Usage}

\begin{verbatim}
lasso_dsp(data, betainit = "cv lasso", ci.level = 0.95,
correction = TRUE, pbar = TRUE, rulereg = "and")
\end{verbatim}

\subsection*{Arguments}

\begin{itemize}
  \item \textbf{data} \begin{footnotesize}An n x p matrix containing the data, where n are cases and p are variables\end{footnotesize}
  \item \textbf{betainit} \begin{footnotesize}Specifying how to estimate lasso solution in initial estimation. Either betainit = "cv lasso" (default) or betainit = "cv lasso". See the manual of the function \texttt{lasso.proj} of the \texttt{hdi} package for more info.\end{footnotesize}
  \item \textbf{ci.level} \begin{footnotesize}Specifies the width of the confidence interval used for testing the null hypothesis that a parameter is different to zero. Defaults to \texttt{ci.level = 0.95}, which corresponds to a critical threshold of 0.05.\end{footnotesize}
  \item \textbf{correction} \begin{footnotesize}If correction = TRUE, the Bonferroni-Holm correction will be applied to p-values on the level of nodewise regressions (see e.g., Hochberg, 1987).\end{footnotesize}
  \item \textbf{pbar} \begin{footnotesize}If \texttt{pbar} = TRUE, a progress bar will be displayed.\end{footnotesize}
  \item \textbf{rulereg} \begin{footnotesize}Specifies how parameter estimates should be combined across nodewise regressions. The options are the AND-rule (requiring both estimates to be significant) or the OR-rule (only requiring one estimate to be significant). Defaults to \texttt{rulereg = "and"}.\end{footnotesize}
\end{itemize}
lasso_dsp

Value

The function returns a list with the following entries:

<table>
<thead>
<tr>
<th>Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>est</td>
<td>A p x p matrix with point estimates for all partial correlations</td>
</tr>
<tr>
<td>est.signf</td>
<td>A p x p matrix with point estimates for all partial correlations with non-significant partial correlations being thresholded to zero.</td>
</tr>
<tr>
<td>signf</td>
<td>A p x p matrix indicating for each partial correlation whether it is significantly different to zero.</td>
</tr>
<tr>
<td>ci.lower</td>
<td>A p x p matrix indicating the lower confidence interval for each partial correlation.</td>
</tr>
<tr>
<td>ci.upper</td>
<td>A p x p matrix indicating the upper confidence interval for each partial correlation.</td>
</tr>
</tbody>
</table>

Author(s)

Jonas Haslbeck <jonashaslbeck@gmail.com>; Lourens Waldorp <waldorp@uva.nl>

References


Examples

# Toy example that runs relatively quickly
library(MASS)
p <- 5  # number of variables
data <- mvrnorm(n=100, mu=rep(0, p), Sigma = diag(p))
set.seed(1)
out <- lasso_dsp(data = data)

## Not run:

# Fit GGM to PTSD data
set.seed(1)
out <- lasso_dsp(data = ptsd_data)

## End(Not run)
lasso_dsp_boot

Estimate GGMs with the desparsified lasso using the bootstrap.

Description
Estimate Gaussian Graphical Models using the desparsified lasso using the bootstrap. This is a wrapper around the function `lasso.proj` of the `hdi` package.

Usage

```r
lasso_dsp_boot(data, betainit = "cv lasso", ci.level = 0.95,
correction = TRUE, B = 1000, pbar = TRUE,
rulereg = "and")
```

Arguments

- **data**: An n x p matrix containing the data, where n are cases and p are variables.
- **betainit**: Specifying how to estimate lasso solution in initial estimation. Either `betainit = "cv lasso"` (default) or `betainit = "cv lasso"`. See the manual of the function `lasso.proj` of the `hdi` package for more info.
- **ci.level**: Specifies the width of the confidence interval used for testing the null hypothesis that a parameter is different to zero. Defaults to `ci.level = 0.95`, which corresponds to a critical threshold of 0.05.
- **correction**: If `correction = TRUE`, the Bonferroni-Holm correction will be applied to p-values on the level of nodewise regressions (see e.g., Hochberg, 1987).
- **B**: The number of bootstrap samples used for estimation. Defaults to `B=1000`.
- **pbar**: If `pbar = TRUE`, a progress bar will be displayed.
- **rulereg**: Specifies how parameter estimates should be combined across nodewise regressions. The options are the AND-rule (requiring both estimates to be significant) or the OR-rule (only requiring one estimate to be significant). Defaults to `rulereg = "and"`.

Value
The function returns a list with the following entries:

- **est**: A p x p matrix with point estimates for all partial correlations.
- **est.signf**: A p x p matrix with point estimates for all partial correlations with non-significant partial correlations being thresholded to zero.
- **signf**: A p x p matrix indicating for each partial correlation whether it is significantly different to zero.
- **ci.lower**: A p x p matrix indicating the lower confidence interval for each partial correlation.
- **ci.upper**: A p x p matrix indicating the upper confidence interval for each partial correlation.
lasso_ms

Author(s)
Jonas Haslbeck <jonashaslbeck@gmail.com>; Lourens Waldorp <waldorp@uva.nl>

References

Examples

```r
# Toy example that runs relatively quickly
library(MASS)
p <- 5 # number of variables
data <- mvrnorm(n=100, mu=rep(0, p), Sigma = diag(p))
set.seed(1)
out <- lasso_dsp_boot(data = data, B=2)
# !!! NOTE: this is just for testing purposes; B should be a lot higher (default = 1000)

## Not run:
# Fit GGM to PTSD data
set.seed(1)
out <- lasso_dsp_boot(data = ptsd_data)

## End(Not run)
```

lasso_ms

Estimate GMM with inference via the multi-split method.

Description
Estimate Gaussian Graphical Models with inference base don the multi-split method. This is a wrapper of the function multi.split of the hdi package.

Usage

```
lasso_ms(data, B = 50, fraction = 0.5, ci.level = 0.95,
correction = TRUE, pbar = TRUE, rulereg = "and")
```
**Arguments**

- `data`: An n x p matrix containing the data, where n are cases and p are variables.
- `B`: The number of sample-splits. Defaults to B=50.
- `fraction`: A number in (0,1), the fraction of data used at each sample split for the model selection process. The remaining data is used for calculating the p-values.
- `ci.level`: Specifies the width of the confidence interval used for testing the null hypothesis that a parameter is different to zero. Defaults to `ci.level = 0.95`, which corresponds to a critical threshold of 0.05.
- `correction`: If `correction = TRUE`, the Bonferroni-Holm correction will be applied to p-values on the level of nodewise regressions (see e.g., Hochberg, 1987).
- `pbar`: If `pbar = TRUE`, a progress bar will be displayed.
- `rulereg`: Specifies how parameter estimates should be combined across nodewise regressions. The options are the AND-rule (requiring both estimates to be significant) or the OR-rule (only requiring one estimate to be significant). Defaults to `rulereg = "and"`.

**Value**

The function returns a list with the following entries:

- `est`: A p x p matrix with point estimates for all partial correlations.
- `est.signf`: A p x p matrix with point estimates for all partial correlations with non-significant partial correlations being thresholded to zero.
- `signf`: A p x p matrix indicating for each partial correlation whether it is significantly different to zero.
- `ci.lower`: A p x p matrix indicating the lower confidence interval for each partial correlation.
- `ci.upper`: A p x p matrix indicating the upper confidence interval for each partial correlation.

**Author(s)**

Jonas Haslbeck <jonashaslbeck@gmail.com>; Lourens Waldorp <waldorp@uva.nl>

**References**


Examples

# Toy example that runs relatively quickly
library(MASS)
p <- 5 # number of variables
data <- mvrnorm(n=100, mu=rep(0, p), Sigma = diag(p))
set.seed(1)
out <- lasso_ms(data = data, B=2)
# !!! NOTE: this is just for testing purposes; B should a lot higher (default = 50)

## Not run:

# Fit GGM to empirical PTSD data
set.seed(1)
out <- lasso_ms(data = ptsd_data)

## End(Not run)

---

**OLS**

Estimate GMM via nodewise regression and hypothesis tests.

Description

Estimate Gaussian Graphical Model with nodewise regression, selecting edges with standard hypothesis tests and the Bonferroni-Holm Correction.

Usage

```r
OLS(data, pbar = TRUE, correction = TRUE,
ci.level = 0.95, rulereg = "and")
```

Arguments

data An n x p matrix containing the data, where n are cases and p are variables
pbar If pbar = TRUE, a progress bar will be displayed.
correction If correction = TRUE, the Bonferroni-Holm correction will be applied to p-values on the level of nodewise regressions (see e.g., Hochberg, 1987).
ci.level Specifies the width of the confidence interval used for testing the null hypothesis that a parameter is different to zero. Defaults to ci.level = 0.95, which corresponds to a critical threshold of 0.05.
rulereg Specifies how parameter estimates should be combined across nodewise regressions. The options are the AND-rule (requiring both estimates to be significant) or the OR-rule (only requiring one estimate to be significant). Defaults to rulereg = "and".
Value

The function returns a list with the following entries:

- `est`: A $p \times p$ matrix with point estimates for all partial correlations.
- `est.signf`: A $p \times p$ matrix with point estimates for all partial correlations with non-significant partial correlations being thresholded to zero.
- `signf`: A $p \times p$ matrix indicating for each partial correlation whether it is significantly different to zero.
- `ci.lower`: A $p \times p$ matrix indicating the lower confidence interval for each partial correlation.
- `ci.upper`: A $p \times p$ matrix indicating the upper confidence interval for each partial correlation.

Author(s)

Jonas Haslbeck <jonashaslbeck@gmail.com>

References


Examples

```r
# Toy example that runs relatively quickly
library(MASS)
p <- 5 # number of variables
data <- mvrnorm(n=100, mu=rep(0, p), Sigma = diag(p))
out <- OLS(data = data)

## Not run:

# Fit GGM to PTSD data
out <- OLS(data = ptsd_data)

## End(Not run)
```
Description

Plot point estimates and confidence intervals for models estimated with the `lasso_ms`, `lasso_dsp`, `lasso_dsp_boot` and OLS functions.

Usage

```r
## S3 method for class 'inet'
plot(x, labels = NULL, order = FALSE, subset = NULL,
cex.labels = 0.80, cex.axis = 0.75, ...)
```

Arguments

- `x`: The output object from either `lasso_ms`, `lasso_dsp`, `lasso_dsp_boot` or OLS.
- `labels`: A p-vector of characters specifying the labels for variables.
- `order`: If `order = TRUE`, the edges are listed in decreasing order based on the point estimate.
- `subset`: Allows to only display a subset of the edges. For example, if `subset = 1:20` the first 20 edges are displayed. This is especially useful for larger networks, in which all edges are unlikely to fit into a single figure.
- `cex.labels`: The font size of the edge labels.
- `cex.axis`: The font size of the axes.
- `...`: Additional arguments.

Value

Plots a figure showing point estimates and confidence intervals for all interaction parameters.

Author(s)

Jonas Haslbeck <jonashaslbeck@gmail.com>

Examples

```r
# Quick toy example
library(MASS)
p <- 5  # number of variables
data <- mvrnorm(n=100, mu=rep(0, p), Sigma = diag(p))
out <- OLS(data = data)

# point estimates + CIs; show 3 largest effects only
plot(out, labels = colnames(ptsd_data),
```
## Not run:

# Fit GGM to empirical PTSD data
set.seed(1)
out <- lasso_dsp(data = ptsd_data)

# Plot first 20 edges
plot(out, labels = colnames(ptsd_data),
     order=TRUE, subset = 1:20)

## End(Not run)
Index

inet-datasets, 2
inet-internal, 2
input_checks/inet-internal), 2

lasso, 3
lasso_dsp, 4
lasso_dsp_boot, 6
lasso_ms, 7

OLS, 9

plot.inet, 11
ptsd_data/inet-datasets), 2