Package 'jlsm'

February 9, 2021

Type Package

Title Joint latent space model for social networks with multivariate attributes

Version 0.1.0

Author Selena Wang

Maintainer Selena Wang <selenashuowang@gmail.com>

Description Joint latent space models for unipartite networks and bipartite networks using variational bayesian EM algorithm.

License MIT + file LICENSE

Encoding UTF-8

LazyData true

Depends R (>= 3.5),
MASS

Imports stats,
utils,
graphics,
ellipse,
mvtnorm,
expm,
boot,
matrixcalc,
lvm4net,
pROC,
network,
Matrix,
grDevices

RoxygenNote 7.1.1

R topics documented:

`jlsm-package` *Create Joint Latent Space Model for Social networks and Multivariate Attributes*

Description

`jlsm` provides a set of latent space models for jointly modeling unipartite social networks with bipartite attribute networks. The latent space models are implemented using a fast variational inference approach.

Details

Latent space models for bipartite networks: the function `blsm` implements the bipartite latent space model (BLSM) outlined in Wang et al. (2021) using variational inference and squared Euclidian distance; the function `aplsm` implements person and attribute latent space model (APLSM) introduced by Wang et.al (2021). These models assume that the person and attribute information can be summarized by latent person and attribute variables. Both the Euclidean distances and the vector distances are used to describe relationships among perons and between persons and attributes.

References

Wang, S. S., Paul, S., Logan, J., & De Boeck, P. (2019). Joint analysis of social and item response networks with latent space models. arXiv preprint arXiv:1910.12128.

`aplsm` *The Attribute Person Latent Space model*

Description

Jointly model social network with multivariate attributes

Usage

```
aplsm(Niter, Y.i, Y.ia, D, type)
```

Arguments

`Niter`	number of iterations
`Y.i`	N by N matrix containing the binary social network
`Y.ia`	N by M matrix containing the binary multivariate attributes
`D`	number of dimensions in the data
`type`	character indicating the types of model. It could be "DD", distance by distance model, "DV", distance by vector model, "VV", vector by vector model

Value

list containing:

- `lsmhEZ.i` (N x D) matrix containing the posterior means of the latent person positions
- `lsmhEZ.a` (M x D) matrix containing the posterior means of the latent item positions
- `lsmhVZ.0` (D x D) matrix containing the posterior variance of the latent person positions
- `lsmhVZ.1` (D x D) matrix containing the posterior variance of the latent item positions
- `lsmhAlpha.0` scaler of mean of the posterior distributions of $\alpha.0$
- `lsmhAlpha.1` scaler of mean of the posterior distributions of $\alpha.1$
- `lsmhKL` expected log-likelihood

Examples

```
attach(french)
a=aplsm(Niter=10,Y.i, Y.ia, D=2, type="DD")
```

`blsm` *The Bipartite Latent Space Model*

Description

Function to fit the bipartite latent space model (BLSM) outlined in Wang et al. (2021)

Usage

```
blsm(Niter, Y.ia, D)
```

Arguments

`Niter`	number of iterations
`Y.ia`	N by M matrix containing the binary multivariate attributes
`D`	number of dimensions in the data

Value

list containing:

- `lsmhEZ.i` (N x D) matrix containing the posterior means of the latent person positions
- `lsmhEZ.a` (M x D) matrix containing the posterior means of the latent item positions
- `lsmhVZ.0` (D x D) matrix containing the posterior variance of the latent person positions
- `lsmhVZ.1` (D x D) matrix containing the posterior variance of the latent item positions
- `lsmhAlpha.1` scaler of mean of the posterior distributions of $\alpha.1$
- `lsmhKL` expected log-likelihood

Examples

```
attach(french)
a=blsm(Niter=10,Y.ia,D=2)
```

french *French Elites Social Networks and Multivariate Attributes*

Description

The dataset contains a social network of french financial elites and their multivariate attributes It includes social interaction between 28 elites and their binary responses to 13 questions. The data were downloaded from the social network Repository created by Prof. Linton Freeman. http://moreno.ss.uci.edu/ffe_trait.dat/ and http://moreno.ss.uci.edu/ffe.dat

Usage

```
french
```

Format

List including a binary adjacency matrix and a binary mutlivariate attributes

Details

social network and multivariate attributes

GOFaplsm *Assess the fit of the APLSM*

Description

assess the fit of the model using ROC curves and auc values

Usage

```
GOFaplsm(model, type, Y.i, Y.ia)
```

Arguments

model	object of class the APLSM
type	character indicating the types of model. It could be "DD", distance by distance model, "DV", distance by vector model, "VV", vector by vector model
Y.i	N by N matrix containing the binary social network
Y.ia	N by M matrix containing the binary multivariate attributes

Value

list containing:

- Yi.auc scaler of the area under the curve for the social network
- Ya.auc scaler of the area under the curve for the multivariate covariates

Examples

```
attach(french)
b=aplsm(Niter=10,Y.i, Y.ia,D=2, type="VV")
GOFaplsm(b, "VV",Y.i, Y.ia)
```

`Gofblsm` *Assess the fit of the BLSM*

Description

assess the fit of the model using ROC curves and auc values

Usage

```
Gofblsm(model, Y.ia)
```

Arguments

`model`	object of class BLSM
`Y.ia`	N by M matrix containing the binary item response matrix

Value

scalar containing:

- `Ya.auc` scaler of the area under the curve for the multivariate covariates

Examples

```
attach(french)
a=blsm(Niter=10,Y.ia,D=2)
Gofblsm(a,Y.ia)
```

`Plotaplsm` *Two dimensional plot of Person Attribute Latent Space Model*

Description

plot the joint latent space with two types of nodes and two types of relations

Usage

```
Plotaplsm(
  Y.i,
  Y.ia,
  model,
  labels = NULL,
  plotedgesSocial = TRUE,
  plotedgesBipartite = FALSE,
  xlab = "",
  ylab = "",
  edgecolor = "black",
  colEll.i = rgb(0.6, 0.6, 0.6, alpha = 0.1),
  colEll.ia = rgb(1, 0.6, 0.6, alpha = 0.1),
  LEVEL = 0.8,
  pchplot = 20,
  pchEll = 19,
  pchPl = 19,
  cexPl = 1.1,
  arrowhead = FALSE,
  curve = 0,
  xlim = c(-2, 2),
  ylim = c(-2, 2),
  lwdLine = 0.001,
  ...
)
```

Arguments

Y.i	N by N matrix containing the binary social network
Y.ia	N by M matrix containing the binary mutlivariate attributes
model	model output from the APLSM
labels	vector of characters containing the attribute names
plotedgesSocial	TRUE or FALSE, whether the social network edges should be plotted
plotedgesBipartite	TRUE or FALSE, whether the bipartite edges should be plotted
xlab	name of the x axis
ylab	name of the y axis
edgecolor	color of the edge. Default edgecolor = "black"
colEll.i	col for the ellipses of persons. Default rgb(.6,.6 ,.6 ,alpha=.1)
colEll.ia	col for the ellipses of atributes. Default rgb(1,.6 ,.6 ,alpha=.1)
LEVEL	levels of confidence bounds shown when plotting the ellipses. Default LEVEL = .95
pchplot	Default pchplot = 20
pchEll	pch for the ellipses. Default pchEll = 19
pchPl	pch for the points representing the nodes. Default pchPl = 19
cexPl	cex for the points representing the nodes. Default cexPl = 1.1
arrowhead	logical, if the arrowed are to be plotted. Default arrowhead = FALSE

curve	curvature of edges. Default curve = 0
xlim	range for x
ylim	range for y
lwdLine	lwd of edges. Default lwdLine = .3
...	Arguments to be passed to methods, such as graphical parameters (see par).

Examples

```
library(jlsm)
attach(french)
b=aplsm(Niter=10,Y.i, Y.ia,D=2, type="VV")
Plotaplsm(Y.i, Y.ia, b)
```

Plotblsm *Two dimensional plot of the Bipartite Latent Space Model*

Description

plot the latent space with two types of nodes and one type of relations

Usage

```
Plotblsm(
  Y.ia,
  model,
  labels = NULL,
  xlab = "",
  ylab = "",
  plotedges = TRUE,
  edgecolor = "black",
  colEll.i = rgb(0.6, 0.6, 0.6, alpha = 0.1),
  colEll.ia = rgb(1, 0.6, 0.6, alpha = 0.1),
  LEVEL = 0.8,
  pchplot = 20,
  pchEll = 19,
  pchPl = 19,
  cexPl = 1.1,
  arrowhead = FALSE,
  curve = 0,
  xlim = c(-2, 2),
  ylim = c(-2, 2),
  lwdLine = 0.001,
  ...
)
```

Arguments

Y.ia	N by M matrix containing the binary multivariate attributes
model	model output from BLSM
labels	vector of characters containing the item names

xlab	name of the x axis
ylab	name of the y axis
plotedges	TRUE or FALSE, whether the bipartite edges should be plotted
edgecolor	color of the edge. Default edgecolor = "black"
colEll.i	col for the ellipses of persons. Default rgb(.6,.6 ,.6 ,alpha=.1)
colEll.ia	col for the ellipses of attributes Default rgb(1,.6 ,.6 ,alpha=.1)
LEVEL	levels of confidence bounds shown when plotting the ellipses. Default LEVEL = .95
pchplot	Default pchplot = 20
pchEll	pch for the ellipses. Default pchEll = 19
pchPl	pch for the points representing the nodes. Default pchPl = 19
cexPl	cex for the points representing the nodes. Default cexPl = 1.1
arrowhead	logical, if the arrowed are to be plotted. Default arrowhead = FALSE
curve	curvature of edges. Default curve = 0
xlim	range for x
ylim	range for y
lwdLine	lwd of edges. Default lwdLine = .3
...	Arguments to be passed to methods, such as graphical parameters (see par).

Examples

```
attach(french)
a=blsm(Niter=10,Y.ia,D=2)
Plotblsm(Y.ia,  a)
```

Predictaplsm *Predict from the APLSM*

Description

This function allows you to obtain the posterior edge values based on the APLSM

Usage

```
Predictaplsm(model, type)
```

Arguments

model	object of class the APLSM
type	character indicating the types of model. It could be "DD", distance by distance model, "DV", distance by vector model, "VV", vector by vector model

Value

list containing:

- est.P.i (N x N) matrix containing the predicted probabilities of an edge
- est.P.ia (N x M) matrix containing the predicted probabilities of an edge

Examples

```
library(jlsm)
attach(french)
b=aplsm(Niter=10,Y.i, Y.ia,D=2, type="VV")
Predictaplsm(b,"VV")
```

Predictblsm *Predict from BLSM model*

Description

This function allows you to obtain the posterior mean of the edges from the BLSM model

Usage

```
Predictblsm(model)
```

Arguments

model	object of class BLSM

Value

list containing:

- est.P.ia (N x M) matrix containing the predicted probabilities of an edge

Examples

```
attach(french)
a=blsm(Niter=10,Y.ia,D=2)
Predictblsm(a)
```

Simulateaplsm *Simulate from the APLSM*

Description

function to simulate networks from the APLSM

Usage

```
Simulateaplsm(model, type)
```

Arguments

model	object of class APlsm
type	character indicating the types of model. It could be "DD", distance by distance model, "DV", distance by vector model, "VV", vector by vector model

Value

list containing:

- `Y.i` (`N` x `N`) matrix containing the simulated Y.i
- `Y.ia` (`N` x `M`) matrix containing the simulated Y.ia

Examples

```
attach(french)
b=aplsm(Niter=10,Y.i, Y.ia,D=2, type="VV")
Simulateaplsm(b,"VV")
```

`Simulateblsm` *Simulate from the BLSM model*

Description

function to simulate networks from the BLSM

Usage

```
Simulateblsm(model)
```

Arguments

`model`	object of class BLSM

Value

list containing:

- `Y.ia` (`N` x `M`) matrix containing the simulated Y.ia

Examples

```
attach(french)
a=blsm(Niter=10,Y.ia,D=2)
Simulateblsm(a)
```

Index