Package ‘eigenmodel’
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Title  Semiparametric factor and regression models for symmetric relational data
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Description This package estimates the parameters of a model for symmetric relational data (e.g., the above-diagonal part of a square matrix), using a model-based eigenvalue decomposition and regression. Missing data is accommodated, and a posterior mean for missing data is calculated under the assumption that the data are missing at random. The marginal distribution of the relational data can be arbitrary, and is fit with an ordered probit specification.

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Description

This package estimates the parameters of a model for symmetric relational data (e.g., the above-diagonal part of a square matrix), using a model-based eigenvalue decomposition and regression. Missing data is accommodated, and a posterior mean for missing data is calculated under the assumption that the data are missing at random. The marginal distribution of the relational data can be arbitrary, and is fit with an ordered probit specification.

Details

Package: eigenmodel
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Date: 2012-03-23
License: GPL Version 2

Author(s)

Peter Hoff <hoff@stat.washington.edu>

References

Hoff (2007) “Modeling homophily and stochastic equivalence in symmetric relational data”

Examples

data(YX_Friend)

fit<-eigenmodel_mcmc(Y=YX_Friend$Y,X=YX_Friend$X,R=2,S=750,burn=250)

# in general you should run the Markov chain longer than 750 scans
addlines

plot(fit)

# people familiar with MCMC might want to implement their own Markov chains:
Y<-YX_Friend$Y
X<-YX_Friend$X
eigenmodel_setup(R=2)
for(s in 1:100) { # you should run your chain longer than 100 scans
  Z<-rZ_fc()
  UL<-rUL_fc()
  b<-rb_fc()}

#fit.Gen<-eigenmodel_mcmc(Y=Y_Gen,R=3,S=10000)
#fit.Pro<-eigenmodel_mcmc(Y=Y_Pro,R=3,S=10000)

---

addlines

*Adds lines between nodes to an existing plot of nodes*

**Description**

Adds lines between nodes to an existing plot of nodes

**Usage**

`addlines(U, Y, col = "green", lwd = 1, lty = 1)`

**Arguments**

- **U**: an n x 2 matrix of node locations
- **Y**: a symmetric matrix
- **col**: color of the lines
- **lwd**: width of the lines
- **lty**: line type

**Value**

NULL
Author(s)
Peter Hoff

eigenmodel_mcmc
Approximate the posterior distribution of parameters in an eigenmodel

Description
Construct approximate samples from the posterior distribution of the parameters and latent variables in an eigenmodel for symmetric relational data.

Usage
eigenmodel_mcmc(Y, X = NULL, R = 2, S = 1000, seed = 1, Nss = min(S-burn, 1000), burn = 0)

Arguments
Y an n x n symmetric matrix with missing diagonal entries. Off-diagonal missing values are allowed.
X an n x n x p array of regressors
R the rank of the approximating factor matrix
S number of samples from the Markov chain
seed a random seed
Nss number of samples to be saved
burn number of initial scans of the Markov chain to be dropped

Value
a list with the following components:
Z_postmean posterior mean of the latent variable in the probit specification
ULU_postmean posterior mean of the reduced-rank approximating matrix
Y_postmean the original data matrix with missing values replaced by posterior means
L_postsamp samples of the eigenvalues
b_postsamp samples of the regression coefficients
Y original data matrix
X original regressor array
S number of scans of the Markov chain

Author(s)
Peter Hoff
Examples

```r
data(YX_Friend)
fit<-eigenmodel_mcmc(Y=YX_Friend$Y,X=YX_Friend$X,R=2,S=750,burn=250)
# in general you should run the Markov chain longer than 750 scans
plot(fit)
#fit<-eigenmodel_mcmc(Y=Y_Gen,R=3,S=10000)
#fit<-eigenmodel_mcmc(Y=Y_Pro,R=3,S=10000)
```

---

**eigenmodel_setup**  
Setup constants and starting values for an eigenmodel fit

**Description**

Setup constants and starting values for an eigenmodel fit

**Usage**

```r
eigenmodel_setup(R = 0, seed = 1, em_env = .GlobalEnv)
```

**Arguments**

- `R`: non-negative integer rank of the approximating matrix
- `seed`: a random seed
- `em_env`: environment within which to do the fitting

**Value**

`NULL`

**Author(s)**

Peter Hoff
plot.eigenmodel_post  

Plot the output of an eigenmodel fit

Description

A graphical display of MCMC output and posterior estimates of model parameters in an eigenmodel fit. Includes 95 percent quantile-based posterior confidence intervals of regression coefficients.

Usage

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

Arguments

- `x`: an object of class `eigenmodel_post`
- `...`: additional plotting options

Value

NULL

Author(s)

Peter Hoff

---

rb_fc  

Sample from the full conditional distribution of the regression coefficients

Description

Sample from the full conditional distribution of the regression coefficients in an eigenmodel

Usage

```r
rb_fc(E = Z - ULU(UL))
```

Arguments

- `E`: a symmetric matrix

Value

- a p x 1 vector
**rmvnorm**

*Sample from the multivariate normal distribution*

**Description**

Sample from the multivariate normal distribution

**Usage**

`rmvnorm(mu, Sig)`

**Arguments**

- `mu` a p x 1 vector
- `Sig` a p x p positive definite matrix

**Value**

a p x 1 vector

**Author(s)**

Peter Hoff

**Examples**

`rmvnorm( c(0,0,0), diag(rep(3,1)) )`

---

**rul_fc**

*Sample UL from its full conditional distribution*

**Description**

Samples the components of a reduced rank approximating matrix from their full conditional distributions

**Usage**

`rul_fc(E = Z - XB(X, b))`

**Arguments**

- `E` an n x n symmetric matrix to be modeled with a reduced rank matrix
**Value**

A list with the following components:

- \( U \) an \( n \times r \) matrix of eigenvectors
- \( L \) an \( r \times r \) diagonal matrix of eigenvalues

**Author(s)**

Peter Hoff

---

**rZ.fc**  
*Sample from the full conditional distribution of the probit latent variables*

**Description**

Sample from the full conditional distribution of the latent variables in the ordered probit model

**Usage**

\[
\text{rZ.fc}(EZ = XB(X, b) + ULU(UL), MH = TRUE)
\]

**Arguments**

- \( EZ \) a symmetric matrix with elements equal to the expected values of the latent variables
- \( MH \) whether or not to do a Metropolis update in addition to the Gibbs sampling

**Value**

a symmetric matrix

**Author(s)**

Peter Hoff
ULU

Computes a matrix from its eigenvalue decomposition

Description

Computes a matrix from its eigenvalue decomposition

Usage

ULU(UL)

Arguments

UL

a list with first component “U”, an n x r matrix and the second component “L”
a r x r diagonal matrix

Value

an n x n matrix

Author(s)
Peter Hoff

XB

Computes a sociomatrix of regression effects

Description

Computes a sociomatrix of regression effects

Usage

XB(X, b)

Arguments

X

an n x n x p array

b

a p x 1 vector

Value

an n x n matrix

Author(s)
Peter Hoff
**YX_Friend**

*Sex, race and friendship data from a 12th grade classroom*

**Description**

A list in which \( Y \) encodes the presence of a friendship tie between 90 12th graders. The array \( X \) indicates pairs of the same sex and of the same race.

**Usage**

```r
data(YX_Friend)
```

**Source**

http://www.cpc.unc.edu/projects/addhealth/design

**Examples**

```r
data(YX_Friend)
```

---

**Y_Gen**

*Relations between words in the 1st chapter of Genesis*

**Description**

The \( i,j \) th entry of this matrix is the numerical count of the number of times word \( i \) was next to word \( j \) in the first chapter of Genesis.

**Usage**

```r
data(Y_Gen)
```

**Examples**

```r
data(Y_Gen)
```
Y_impute

Impute missing values of a sociomatrix

Description
Impute missing values of a sociomatrix

Usage
Y_impute()

Details
Imputes missing values of a sociomatrix from a matrix of latent variables and an ordered-probit specification.

Value
symmetric matrix

Author(s)
Peter Hoff

Y_Pro
Butland's protein-protein interaction data

Description
Butland's protein-protein interaction data

Usage
data(Y_Pro)

References

Examples
data(Y_Pro)
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