Package 'HSAR'

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Type Package

Title Hierarchical Spatial Autoregressive Model (HSAR)

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Description A library of the Hierarchical Spatial Autoregressive Model (HSAR), based on a Bayesian Markov Chain Monte Carlo (MCMC) algorithm.

License GPL (>= 2)

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HSAR-package *Hierarchical Spatial Autoregressive Model (HSAR)*

Description

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Details

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Author(s)

Guanpeng Dong, Richard Harris, Angelos Mimis Maintainer: Angelos Mimis <mimis@panteion.gr>

References

Dong, D. and Harris, R. 2014. Spatial Autoregressive Models for Geographically Hierarchical Data Structures. Geographical Analysis, 1-19.

hsar *Hierarchical SAR model estimation*

Description

A Bayesian MCMC approach for estimation of the Hierarchical SAR model of the form:

$$Y = \rho WY + X\beta + Z\gamma + \delta\theta + \epsilon, \theta = \lambda M\theta + u$$

where Y is an Nx1 vector of the outcome variable, X is an NxK matrix of the independent variables, W and M are the weight matrices at the lower and upper level respectively,ρ and λ are the autoregressive parameters indicating the strength of spatial interaction at the lower and higher level respectively, β is a kx1 vector of regression coefficients to estimate, δ is a NxJ block diagonal matrix and θ is a Jx1 vector of the regional effects. Two special cases of HSAR are included as well. In the first one, only the regional effects are considered independent (higher level) so the autoregressive parameter λ is zero. In the second only the lower level effects are considered independent and so the autoregressive parameter ρ is zero.

Usage

```
hsar( X, y, W=NULL, M=NULL, Z, Unum, burnin=5000, Nsim=10000)
```

Arguments

X	matrix of independent variables
y	vector of outcome variable values
W	spatial weight matrix
M	spatial weight matrix at the higher level
Z	matrix of the higher level variables
Unum	Relation between higher level regions and lower level areas
burnin	Number of samples before start collecting points
Nsim	Total number of samples in MC

Details

In order to run the full HSAR model both W and M matrices need to be defined.In case W is set to NULL only the regional effects are considered independent (higher level) so the autoregressive parameter λ is zero. In case M is set to NULL only the lower level effects are considered independent and so the autoregressive parameter ρ is zero. Both W and M can not be set to NULL.

Value

a list with

Mbetas	a vector with the mean values of the vector of the regression coefficients estimated
SDbetas	a vector with the standard deviation of the vector of the regression coefficients estimated
Mrho	Mean values of the strength of the spatial interaction rho
SDrho	Standard deviation of rho
Mlamda	Mean values of the strength of the spatial interaction at the higher level
SDlambda	Standard deviation of lambda
Msigma2e	Mean value of σ_e^2
SDsigma2e	Standard deviation of σ_e^2
Msigma2u	Mean value of σ_u^2
SDsigma2u	Standard deviation of σ_u^2
Mus	Mean values of θ
SDus	Standard deviation of θ
DIC	deviance information criterion (DIC)
pd	effective number of parameters
Log_Likelihood	Log likelihood

R_Squared	pseudo R squared
impact_direct	Direct effect
impact_idirect	Indirect effect
impact_total	Total effect

Author(s)

Guanpeng Dong, Richard Harris, Angelos Mimis <mimis@panteion.gr>

References

Dong, D. and Harris, R. 2014. Spatial Autoregressive Models for Geographically Hierarchical Data Structures. *Geographical Analysis*, 1-19.

See Also

sar

Examples

```
data(land_prices)
result <- hsar( X, y, W, M, Z, Unum, 50, 100)
result$Mrho
```

---

land_prices *Leased residential land parcels, from 2003 to 2009 in Beijing, China*

Description

In the data 1117 land parcels in 111 districts are included, having 16 independent variables.

Usage

```
data(land_prices)
```

Format

A number of variables ready for illustating the HSAR model.

X The matrix of the lower level variables (matrix)

y Leasing price per square meter for each residential land parcel (numeric vector)

M The weight matrix at the higher level (dgCMatrix)

W The weight matrix at the lower level (a dgCMatrix)

Z The matrix of the higher level variables(a dgCMatrix)

Unum Frequency of lower level areas contained in higher level regions (numeric vector)

References

Harris, R., G.P. Dong, and W.Z. Zhang. (2013).Using COntextualised Geographically Weighted Regression to model the Spatial Heterogeneity of Land Prices in Beijing, China. Transaction in GIS 17(6), 901-19.

Examples

```
data(land_prices)
```

`sar` *SAR model estimation*

Description

A Bayesian MCMC approach for estimation of the SAR model (spatial lag model) of the form:

$$Y = \rho WY + X\beta + \epsilon$$

where Y is an Nx1 vector of the outcome variable, X is an NxK matrix of the independent variables and W is the weight matrix.

Usage

```
sar( X, y, W, burnin=5000, Nsim=10000 )
```

Arguments

`X`	matrix of independent variables
`y`	vector of outcome variable values
`W`	spatial weight matrix
`burnin`	Number of samples before start collecting points
`Nsim`	Total number of samples in MC

Value

a list with

`Mbetas`	a vector with the mean values of the vector of the regression coefficients estimated
`SDbetas`	a vector with the standard deviation of the vector of the regression coefficients estimated
`Mrho`	Mean values of the strength of the spatial interaction rho
`SDrho`	Standard deviation of rho
`Msigma2e`	Mean value of σ_e^2
`SDsigma2e`	Standard deviation of σ_e^2

DIC	deviance information criterion (DIC)
pd	effective number of parameters
Log_Likelihood	Log likelihood
R_Squared	pseudo R squared
impact_direct	Direct effect
impact_idirect	Indirect effect
impact_total	Total effect

Author(s)

Guanpeng Dong, Richard Harris, Angelos Mimis <mimis@panteion.gr>

References

Anselin, L. 1988 *Spatial econometrics: methods and models.*(Dordrecht: Kluwer); Dong, D. and Harris, R. 2014. Spatial Autoregressive Models for Geographically Hierarchical Data Structures. *Geographical Analysis*, 1-19.

See Also

hsar

Examples

```
data(land_prices)
result <- sar( X, y, W, 50, 100)
result$Mrho
```

---

summary.mcmc_hsar *summary method for class mcmc_hsar or mcmc_hsar_rho_0 or mcmc_hsar_lambda_0*

Description

Methods used for presenting the results of estimating Hierarchical SAR models.This is extended to include the two simple cases.

Usage

```
## S3 method for class 'mcmc_hsar'
summary(object, ...)
## S3 method for class 'mcmc_hsar_rho_0'
summary(object, ...)
## S3 method for class 'mcmc_hsar_lambda_0'
summary(object, ...)
```

Arguments

object	mcmc_hsar or mcmc_hsar_rho_0, mcmc_hsar_lambda_0 object created from hsar
...	Arguments passed through

See Also

hsar

Examples

```
data(land_prices)
result <- hsar( X, y, W, M, Z, Unum, 50, 100)
summary(result)
```

---

summary.mcmc_sar *summary method for class mcmc_sar*

Description

Methods used for presenting the results of estimating SAR models.

Usage

```
## S3 method for class 'mcmc_sar'
summary(object, ...)
```

Arguments

object	mcmc_sar object from sar
...	Arguments passed through

See Also

sar

Examples

```
data(land_prices)
result <- sar( X, y, W, 50, 100)
summary(result)
```

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