Package 'sphet'

March 16, 2018

Version 1.7

Date 2018-03-16

Title Estimation of Spatial Autoregressive Models with and without Heteroscedasticity

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Depends R (>= 3.0.1)

Imports nlme, spdep (>= 0.5-67), Matrix, sp, methods

Description Generalized Method of Moment estimation of Cliff-Ord-type spatial autoregressive models with and without Heteroscedasticity.

License GPL-2

LazyLoad yes

LazyData no

NeedsCompilation no

Repository CRAN

Date/Publication 2018-03-16 20:50:56 UTC

R topics documented:

`sphet-package` *Estimation of spatial models with heteroskedastic innovations*

Description

A set of functions to estimate spatial models with heteroskedastic innovations

Details

Package:	sphet
Type:	Package
Version:	1.0-0
Date:	2010-06-03
License:	GPL
LazyLoad:	yes

Author(s)

Gianfranco Piras <gpiras@mac.com>

References

Piras, Gianfranco (2010) sphet: Spatial Models with Heteroskedastic Innovations in R, *Journal of Statistical Software* June 2010, Volume 35, Issue 1.

`circular` *Generate "circular" weighting matrices*

Description

The function generates k-ahead and k-behind weighting matrices as in Kelejian and Prucha (1999)

Usage

```
circular(nrow, ncol, ab)
```

Arguments

`nrow`	number of rows
`ncol`	number of columns
`ab`	ahead - behind

Value

An object of class nb.

Author(s)

Gianfranco Piras <gpiras@mac.com>

Examples

```
ab.4<-circular(10, 10, 3)
```

---

col.dis *Object of class distance for Columbus dataset*

Description

Distance object, GWT and txt files for columbus dataset

Usage

```
coldis
```

Format

A list of neighbors and distances for the columbus neighborhoods

---

distance *Writes distance matrices*

Description

Reads points coordinates and generates objects of class distance.matrix

Usage

```
distance(coord,region.id=NULL,output=TRUE,
type=c("NN","distance","inverse"),
measure=c("euclidean","gcircle","chebyshev","braycur","canberra"),
nn=6, cutoff=FALSE, miles=TRUE,R=NULL, shape.name=NULL,region.id.name=NULL,
firstline=FALSE,file.name=NULL)
```

Arguments

coord	a matrix with the (X,Y)-coordinates of the points. The first column can be the region.id variable giving the ordering of the observations
region.id	variable that defines the ordering of the observations
output	when TRUE (default) writes the object to a file
type	one of ("NN","distance","inverse"). Nearest neighbors, distance or inverse distance
measure	one of ("euclidean","gcircle","chebyshev","braycur","canberra").The distance measure to be employed in the calculations.
nn	the number of nearest neighbors
cutoff	If type is distance or inverse. Assumes values 1, 2 or 3. When 1, the cutoff is set to the first quantile of the distribution of distances. When 2 to the median, and when 3 to the third quantile. Only observations with distance less than cutoff distance are neighbors.
miles	If TRUE (default), distances are in miles, otherwise in Km. (See spDists wcich returns km, and are converted if required)
R	deprecated, spDists uses an approximation to the WGS84 spheroid
shape.name	The name of the shape file. See Details
region.id.name	The name of the region.id variable. See Details
firstline	If TRUE, a first line is added to the output file. See Details
file.name	If output, the name of the output file. See Details

Details

The object created is similar to the content of a 'GWT' file. The output file can be of any format. In particular, it could be a 'GWT' file. When firstline is TRUE, an header line is added to the 'GWT' file. The first element is simply a place holder, the second is the number of observations. The name of the shape file and of the id variable can be specified by the options shape.name and region.id.name respectively. The function performs a series of test on the region.id variable. If a region.id variable is not specified and coord only has two columns, a sequence from 1 to the number of observations is generated and used as identification variable. If region.id is specified and the first column of coord contains an id variable they should be the same.

Value

A matrix of three columns: from, to, and distance

Author(s)

Gianfranco Piras <gpiras@mac.com>

Examples

```
X<-runif(100,0,70)
Y<-runif(100,-30,20)
coord1<-cbind(seq(1,100),X,Y)
thm2 <- distance(coord1,region.id=NULL,output=FALSE,type="NN", nn=6)
thm2 <- distance(coord1,region.id=NULL,output=FALSE,type="distance", cutoff=1)
```

`dist_functions` *Distance measures available in distance*

Description

The great circle distance is calculated by the function `rdist.earth` in library `fields`.

Details

The distance measures implemented in `sphet` are:

- `'euclidean'`: $\sqrt{\sum (x_i - y_i)^2}$
- `'chebyshev'`: $max(|x_i - y_i|)$
- `'braycur'`: $\frac{\sum |x_i - y_i|}{\sum |x_i + y_i|}$
- `'canberra'`: $\frac{\sum |x_i - y_i|}{\sum |x_i| + |y_i|}$
- `'gcircle'`: see `spDists`, which uses an approximation to the WGS84 spheroid.

Author(s)

Gianfranco Piras <gpiras@mac.com>

See Also

`gstslshet`, `distance`, `distance`

gstslshet *GM estimation of a Cliff-Ord type model with Heteroskedastic Innovations*

Description

Multi step GM/IV estimation of a linear Cliff and Ord -type of model of the form:

$$y = \lambda W y + X\beta + u$$

$$u = \rho W u + e$$

with

$$e\ N(0, \sigma_i^2)$$

The model allows for spatial lag in the dependent variable and disturbances. The innovations in the disturbance process are assumed heteroskedastic of an unknown form.

Usage

```
gstslshet(formula, data=list(), listw, na.action=na.fail,
zero.policy=NULL,initial.value=0.2, abs.tol=1e-20,
rel.tol=1e-10, eps=1e-5, inverse=T,sarar=T)
## S3 method for class 'gstsls'
impacts(obj, ..., tr, R = NULL, listw = NULL,
tol = 1e-06, empirical = FALSE, Q=NULL)
```

Arguments

formula	a description of the model to be fit
data	an object of class data.frame. An optional data frame containing the variables in the model.
listw	an object of class listw created for example by nb2listw
na.action	a function which indicates what should happen when the data contains missing values. See lm for details.
zero.policy	See lagsarlm for details
initial.value	The initial value for ρ. It can be either numeric (default is 0.2) or set to 'SAR', in which case the optimization will start from the estimated coefficient of a regression of the 2SLS residuals over their spatial lag (i.e. a spatial AR model)
abs.tol	Absolute tolerance. See nlminb for details.
rel.tol	Relative tolerance. See nlminb for details.
eps	Tolerance level for the approximation. See Details.
inverse	TRUE. If FALSE, an appoximated inverse is calculated. See Details.
sarar	TRUE. If FALSE, a spatial error model is estimated.

obj	A gstsls spatial regression object created by gstslshet
...	Arguments passed through to methods in the **coda** package
tr	A vector of traces of powers of the spatial weights matrix created using trW, for approximate impact measures; if not given, listw must be given for exact measures (for small to moderate spatial weights matrices); the traces must be for the same spatial weights as were used in fitting the spatial regression
R	If given, simulations are used to compute distributions for the impact measures, returned as mcmc objects
tol	Argument passed to mvrnorm: tolerance (relative to largest variance) for numerical lack of positive-definiteness in the coefficient covariance matrix
empirical	Argument passed to mvrnorm (default FALSE): if true, the coefficients and their covariance matrix specify the empirical not population mean and covariance matrix
Q	default NULL, else an integer number of cumulative power series impacts to calculate if tr is given

Details

The procedure consists of two steps alternating GM and IV estimators. Each step consists of substeps. In step one $\delta = [\beta', \lambda]'$ is estimated by 2SLS. The 2SLS residuals are first employed to obtain an initial (consistent but not efficient) GM estimator of ρ and then a consistent and efficient estimator (involving the variance-covariance matrix of the limiting distribution of the normalized sample moments). In step two, the spatial Cochrane-Orcutt transformed model is estimated by 2SLS. This corresponds to a GS2SLS procedure. The GS2SLS residuals are used to obtain a consistent and efficient GM estimator for ρ.

The initial value for the optimization in step 1b is taken to be initial.value. The initial value in step 1c is the optimal parameter of step 1b. Finally, the initial value for the optimization of step 2b is the optimal parameter of step 1c.

Internally, the object of class listw is transformed into a Matrix using the function listw2dgCMatrix.

The expression of the estimated variance covariance matrix of the limiting distribution of the normalized sample moments based on 2SLS residuals involves the inversion of $I - \rho W'$. When inverse is FALSE, the inverse is calculated using the approximation $I+\rho W'+\rho^2 W'^2+...+\rho^n W'^n$. The powers considered depend on a condition. The function will keep adding terms until the absolute value of the sum of all elements of the matrix $\rho^i W^i$ is greater than a fixed ϵ (eps). By default eps is set to 1e-5.

Value

A list object of class sphet

coefficients	Generalized Spatial two stage least squares coefficient estimates of δ and GM estimator for ρ.
var	variance-covariance matrix of the estimated coefficients
s2	GS2SLS residuals variance
residuals	GS2SLS residuals

yhat	difference between GS2SLS residuals and response variable
call	the call used to create this object
model	the model matrix of data
method	'gs2slshac'
W	Wald test for both ρ and λ are zero

Author(s)

Gianfranco Piras <gpiras@mac.com>

References

Arraiz, I. and Drukker, M.D. and Kelejian, H.H. and Prucha, I.R. (2007) A spatial Cliff-Ord-type Model with Heteroskedastic Innovations: Small and Large Sample Results, *Department of Economics, University of Maryland*'

Kelejian, H.H. and Prucha, I.R. (2007) Specification and Estimation of Spatial Autoregressive Models with Autoregressive and Heteroskedastic Disturbances, *Journal of Econometrics*, forthcoming.

Kelejian, H.H. and Prucha, I.R. (1999) A Generalized Moments Estimator for the Autoregressive Parameter in a Spatial Model, *International Economic Review*, **40**, pages 509–533.

Kelejian, H.H. and Prucha, I.R. (1998) A Generalized Spatial Two Stage Least Square Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances, *Journal of Real Estate Finance and Economics*, **17**, pages 99–121.

See Also

stslshac

Examples

```
library(spdep)
data(columbus)
listw<-nb2listw(col.gal.nb)
res<-gstslshet(CRIME~HOVAL + INC, data=columbus, listw=listw)
summary(res)
```

---

kernel *Spatial two stages least square with HAC standard errors*

Description

Main functions to calculate the kernels in stslshac

Details

Six different kernel functions are implemented:

- 'Epanechnikov': $K(z) = 1 - z^2$
- 'Triangular': $K(z) = 1 - z$
- 'Bisquare': $K(z) = (1 - z^2)^2$
- 'Parzen': $K(z) = 1 - 6z^2 + 6|z|^3$ if $z \leq 0.5$ and $K(z) = 2(1 - |z|)^3$ if $0.5 < z \leq 1$
- 'TH' (Tukey - Hanning): $K(z) = \frac{1+\cos(\pi z)}{2}$
- 'QS' (Quadratic Spectral): $K(z) = \frac{25}{12\pi^2 z^2}(\frac{\sin(6\pi z)/5)}{6\pi z/5} - \cos(6\pi z)/5))$.

If the kernel type is not one of the six implemented, the function will terminate with an error message. The spatial two stage least square estimator is based on the matrix of instruments $H = [X, WX, W^2X^2]$.

Author(s)

Gianfranco Piras <gpiras@mac.com>

See Also

gstslshet, distance, distance

---

listw2dgCMatrix *Interface between Matrix class objects and weights list*

Description

Interface between Matrix class objects and weights list

Usage

```
listw2dgCMatrix(listw, zero.policy = NULL)
```

Arguments

listw	a listw object created for example by nb2listw
zero.policy	See lagsarlm for details

Value

Matrix class object: a sparse Matrix

Author(s)

Gianfranco Piras <gpiras@mac.com>

Examples

```
library(spdep)
data(columbus)
listw<-nb2listw(col.gal.nb)
spW<-listw2dgCMatrix(listw)
```

---

print.sphet *print method for class sphet*

Description

Method used to print objects of class 'summary.sphet' and 'sphet'

Usage

```
## S3 method for class 'sphet'
print(x, digits = max(3,getOption("digits") -3), ...)
```

Arguments

x	an object of class 'summary.sphet' and sphet
digits	minimal number of significant digits, see print.default
...	additional argument to be passed

Details

The summary function summary.sphet returns an objects of class 'sphet' organized in a coefficient matrix.

Author(s)

Gianfranco Piras<gpiras@mac.com>

See Also

gstslshet, stslshac

Examples

```
library(spdep)
data(columbus)
listw<-nb2listw(col.gal.nb)
res<-gstslshet(CRIME~HOVAL + INC, data=columbus, listw=listw)
summary(res)
```

`read.gwt2dist` *Read distance ojbects*

Description

The function reads "GWT" files (i.e. generated using distance. It will read also other more general formats (as for example .txt files).

Usage

```
read.gwt2dist(file, region.id=NULL, skip=1)
```

Arguments

`file`	name of file to be read
`region.id`	variable that defines the ordering of the observations
`skip`	skip number of lines

Details

The first line of a `'GWT'` file generally contains some information (e.g. the name of the shape file, the number of observations), in which case, `skip` should be equal to 1. When the `file` has a `'GWT'` extension, the number of observations is generally retrived from the first line. Alternatively, it is fixed to the length of the unique `region.id` variable.

Value

An object of class `distance`.

Author(s)

Gianfranco Piras <gpiras@mac.com>

Examples

```
## Not run: dist<-read.gwt2dist(file='knn10columbus.GWT', region.id=POLYID)
```

spreg *GM estimation of a Cliff-Ord type model with Heteroskedastic Innovations*

Description

Multi step GM/IV estimation of a linear Cliff and Ord -type of model of the form:

$$y = \lambda W y + X\beta + u$$

$$u = \rho W u + e$$

with

$$e\ N(0, \sigma_i^2)$$

The model allows for spatial lag in the dependent variable and disturbances. The innovations in the disturbance process are assumed heteroskedastic of an unknown form.

Usage

```
spreg(formula, data=list(), listw, listw2=NULL, endog = NULL, instruments= NULL,
lag.instr = FALSE, initial.value=0.2,
model = c("sarar", "lag", "error", "ivhac", "ols"), het = FALSE, verbose=FALSE,
na.action = na.fail,  HAC = FALSE,
distance = NULL, type=c("Epanechnikov","Triangular","Bisquare","Parzen", "QS","TH"),
bandwidth="variable" , step1.c = FALSE, control = list())
```

Arguments

formula	a description of the model to be fit
data	an object of class data.frame. An optional data frame containing the variables in the model.
listw	an object of class listw, matrix, or Matrix
listw2	an object of class listw, matrix, or Matrix specified only when sarar is true
endog	additional endogenous variables. Default NULL. If not NULL should be specified as a formula with no dependent variable (endog = ~ x1 + x2). Note the ~ before the expression.
instruments	external instruments. Default NULL. If not NULL should be specified as a formula with no dependent variable (instruments = ~ x1 + x2). Note the ~ before the expression.
lag.instr	should the external instruments be spatially lagged?
initial.value	The initial value for ρ. It can be either numeric (default is 0.2) or set to 'SAR', in which case the optimization will start from the estimated coefficient of a regression of the 2SLS residuals over their spatial lag (i.e. a spatial AR model)
model	one of lag, error, sarar, ivhac, or ols. If HAC is TRUE, model should be one of ivhac, or ols.

het	default FALSE: if TRUE uses the methods developed for heteroskedasticity
verbose	print optimization details
na.action	a function which indicates what should happen when the data contains missing values. See lm for details.
HAC	perform the HAC estimator of Kelejian and Prucha, 2007.
distance	an object of class distance created for example by read.gwt2dist The object contains the specification of the distance measure to be employed in the estimation of the VC matrix. See Details.
type	One of c("Epanechnikov","Triangular","Bisquare","Parzen", "QS","TH"). The type of Kernel to be used. See Details.
bandwidth	"variable" (default) - or numeric when a fixed bandwidth is specified by the user.
step1.c	Should step 1.c from Arraiz et al. 2012 be performed?
control	A list of control arguments. See nlminb

Details

The procedure consists of two steps alternating GM and IV estimators. Each step consists of substeps. In step one $\delta = [\beta', \lambda]'$ is estimated by 2SLS. The 2SLS residuals are first employed to obtain an consistent GM estimator of ρ.

In step two, the spatial Cochrane-Orcutt transformed model is estimated by 2SLS. This corresponds to a GS2SLS procedure. The GS2SLS residuals are used to obtain a consistent and efficient GM estimator for ρ.

The initial value for the optimization in step 1b is taken to be initial.value. The initial value for the optimization of step 2b is the optimal parameter of step 1b.

Internally, the object of class listw is transformed into a Matrix using the function listw2dgCMatrix.

For the HAC estimator (Kelejian and Prucha, 2007), there are four possibilities:

- A model with only Wy
- A model with Wy and additional endogenous
- Only additional endogenous (with no Wy)
- No additional endogenous variables

Furthermore, the default sets the bandwith for each observation to the maximum distance for that observation (i.e. the max of each element of the list of distances).

Six different kernel functions are implemented:

- 'Epanechnikov': $K(z) = 1 - z^2$
- 'Triangular': $K(z) = 1 - z$
- 'Bisquare': $K(z) = (1 - z^2)^2$
- 'Parzen': $K(z) = 1 - 6z^2 + 6|z|^3$ if $z \leq 0.5$ and $K(z) = 2(1 - |z|)^3$ if $0.5 < z \leq 1$
- 'TH' (Tukey - Hanning): $K(z) = \frac{1+\cos(\pi z)}{2}$
- 'QS' (Quadratic Spectral): $K(z) = \frac{25}{12\pi^2 z^2}(\frac{\sin(6\pi z)/5)}{6\pi z/5} - \cos(6\pi z)/5))$.

If the kernel type is not one of the six implemented, the function will terminate with an error message. The spatial two stage least square estimator is based on the matrix of instruments $H = [X, WX, W^2X^2]$.

Value

A list object of class `sphet`

`coefficients`	Generalized Spatial two stage least squares coefficient estimates of δ and GM estimator for ρ.
`var`	variance-covariance matrix of the estimated coefficients
`s2`	GS2SLS residuals variance
`residuals`	GS2SLS residuals
`yhat`	difference between GS2SLS residuals and response variable
`call`	the call used to create this object
`model`	the model matrix of data
`method`	`'gs2slshac'`

Author(s)

Gianfranco Piras <gpiras@mac.com>

References

Arraiz, I. and Drukker, M.D. and Kelejian, H.H. and Prucha, I.R. (2010) A spatial Cliff-Ord-type Model with Heteroskedastic Innovations: Small and Large Sample Results, *Journal of Regional Sciences*, **50**, pages 592–614.

Drukker, D.M. and Egger, P. and Prucha, I.R. (2013) On Two-step Estimation of a Spatial Auto regressive Model with Autoregressive Disturbances and Endogenous Regressors, *Econometric Review*, **32**, pages 686–733.

Kelejian, H.H. and Prucha, I.R. (2010) Specification and Estimation of Spatial Autoregressive Models with Autoregressive and Heteroskedastic Disturbances, *Journal of Econometrics*, **157**, pages 53–67.

Kelejian, H.H. and Prucha, I.R. (1999) A Generalized Moments Estimator for the Autoregressive Parameter in a Spatial Model, *International Economic Review*, **40**, pages 509–533.

Kelejian, H.H. and Prucha, I.R. (1998) A Generalized Spatial Two Stage Least Square Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances, *Journal of Real Estate Finance and Economics*, **17**, pages 99–121.

Gianfranco Piras (2010). sphet: Spatial Models with Heteroskedastic Innovations in R. *Journal of Statistical Software*, 35(1), 1-21. http://www.jstatsoft.org/v35/i01/.

Roger Bivand, Gianfranco Piras (2015). Comparing Implementations of Estimation Methods for Spatial Econometrics. *Journal of Statistical Software*, 63(18), 1-36. http://www.jstatsoft.org/v63/i18/.

See Also

`stslshac`

Examples

```
library(spdep)
data(columbus)
listw<-nb2listw(col.gal.nb)
res<-spreg(CRIME~HOVAL + INC, data=columbus , listw= listw,  model = "sarar", het = TRUE)
summary(res)
```

---

stslshac *Spatial two stages least square with HAC standard errors*

Description

Non-parametric heteroskedasticity and autocorrelation consistent (HAC) estimator of the variance-covariance (VC) for a vector of sample moments within a spatial context. The disturbance vector is generated as follows:

$$u = R\epsilon$$

where R is a non-stochastic matrix.

Usage

```
stslshac(formula, data=list(),listw,na.action=na.fail,zero.policy=NULL, HAC=TRUE,
distance=NULL,type=c("Epanechnikov","Triangular","Bisquare","Parzen", "QS","TH"),
bandwidth="variable",W2X=TRUE)
```

Arguments

formula	a description of the model to be fit
data	an object of class data.frame. An optional data frame containing the variables in the model.
listw	an object of class listw created for example by nb2listw
distance	an object of class distance created for example by read.gwt2dist The object contains the specification of the distance measure to be employed in the estimation of the VC matrix. See Details.
type	One of c("Epanechnikov","Triangular","Bisquare","Parzen", "QS","TH"). The type of Kernel to be used. See Details.
na.action	a function which indicates what should happen when the data contains missing values. See lm for details.
zero.policy	See lagsarlm for details
bandwidth	"variable" (default) - or numeric when a fixed bandwidth is specified by the user.
HAC	if FALSE traditional standard errors are provided.
W2X	default TRUE. if FALSE only WX are used as instruments in the spatial two stage least squares.

Details

The default sets the bandwith for each observation to the maximum distance for that observation (i.e. the max of each element of the list of distances).

Six different kernel functions are implemented:

- `'Epanechnikov'`: $K(z) = 1 - z^2$
- `'Triangular'`: $K(z) = 1 - z$
- `'Bisquare'`: $K(z) = (1 - z^2)^2$
- `'Parzen'`: $K(z) = 1 - 6z^2 + 6|z|^3$ if $z \leq 0.5$ and $K(z) = 2(1 - |z|)^3$ if $0.5 < z \leq 1$
- `'TH'` (Tukey - Hanning): $K(z) = \frac{1+\cos(\pi z)}{2}$
- `'QS'` (Quadratic Spectral): $K(z) = \frac{25}{12\pi^2 z^2}(\frac{\sin(6\pi z)/5)}{6\pi z/5} - \cos(6\pi z)/5))$.

If the kernel type is not one of the six implemented, the function will terminate with an error message. The spatial two stage least square estimator is based on the matrix of instruments $H = [X, WX, W^2X^2]$.

Value

A list object of class `sphet`

`coefficients`	Spatial two stage least squares coefficient estimates
`vcmat`	variance-covariance matrix of the estimated coefficients
`s2`	S2sls residulas variance
`residuals`	S2sls residuals
`yhat`	difference between residuals and response variable
`call`	the call used to create this object
`model`	the model matrix of data
`type`	the kernel employed in the estimation
`bandwidth`	the type of bandwidth
`method`	`'s2slshac'`

Author(s)

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References

Kelejian, H.H. and Prucha, I.R. (2007) HAC estimation in a spatial framework, *Journal of Econometrics*, **140**, pages 131–154.

Kelejian, H.H. and Prucha, I.R. (1999) A Generalized Moments Estimator for the Autoregressive Parameter in a Spatial Model, *International Economic Review*, **40**, pages 509–533.

Kelejian, H.H. and Prucha, I.R. (1998) A Generalized Spatial Two Stage Least Square Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances, *Journal of Real Estate Finance and Economics*, **17**, pages 99–121.

See Also

gstslshet, distance, distance

Examples

```
library(spdep)
data(columbus)
listw<-nb2listw(col.gal.nb)
data(coldis)
res<-stslshac(CRIME~HOVAL + INC, data=columbus,listw=listw,  distance=coldis, type='Triangular')
summary(res)
```

---

summary.sphet *print method for class sphet*

Description

Method used to print objects of class 'summary.sphet' and 'sphet'

Usage

```
## S3 method for class 'sphet'
summary(object,width=getOption("width"), digits=getOption("digits"),obsinfo=FALSE,...)
```

Arguments

object	an object of class 'sphet'
width	controls the maximum number of columns on a line used in printing
digits	minimal number of significant digits, see print.default
obsinfo	for objects of class distance: if TRUE prints observation-wise information
...	additional arguments to be passed

Details

The summary function summary.sphet returns an objects of class 'sphet' organized in a coefficient matrix.

Author(s)

Gianfranco Piras<gpiras@mac.com>

See Also

gstslshet, stslshac

Examples

```
library(spdep)
data(columbus)
listw<-nb2listw(col.gal.nb)
res<-gstslshet(CRIME~HOVAL + INC, data=columbus, listw=listw)
summary(res)
```

`utilities` *Functions used by gstslshet.*

Description

- `arg` and `arg1` are the objective functions of the non-linear estimators in the GMM procedure.
- `Omega` and `Omegabis` generates the variance-covariance matrices of the Original and Transformed models (See Arraiz et al., 2007 for details.)
- `Ggfastfast` calculates G and g.
- All other functions perform calculations to estimates various objects defined in Appendix B2 and B3 in Arraiz et al., 2007.

Author(s)

Gianfranco Piras <gpiras@mac.com>

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