Package 'saeHB.spatial'

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Type Package

Title Small Area Estimation Hierarchical Bayes For Spatial Model

Version 0.1.1

Description Provides several functions and datasets for area level of Small Area Estimation under Spatial Model using Hierarchical Bayesian (HB) Method. Model-based estimators include the HB estimators based on a Spatial Fay-Herriot model with univariate normal distribution for variable of interest.The 'rjags' package is employed to obtain parameter estimates. For the reference, see Rao and Molina (2015) <doi:10.1002/9781118735855>.

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 7.2.3

URL https://github.com/arinams/saeHB.spatial

BugReports https://github.com/arinams/saeHB.spatial/issues

Imports stringr, coda, rjags, stats, grDevices, graphics

SystemRequirements JAGS (http://mcmc-jags.sourceforge.net)

Suggests rmarkdown, knitr

VignetteBuilder knitr

Depends R (>= 2.10)

NeedsCompilation no

Author Arina Mana Sikana [aut, cre],
Azka Ubaidillah [aut]

Maintainer Arina Mana Sikana <sikanaradrianan@gmail.com>

Repository CRAN

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Contents

`prox.mat` *Proximity Matrix for Small Area Estimation under Spatial Simultaneous Autoregressive (SAR) Model*

Description

A data frame containing the proximity values for the 64 regions to simulate Small Area Estimation under Spatial SAR Model using Hierarchical Bayesian Method

Usage

```
data(prox.mat)
```

Format

The values are numbers in the interval [0,1] containing the proximity of the row and column domains. The sum of the values of each row is equal to 1.

`saeHB.spatial` *saeHB.spatial : Small Area Estimation Hierarchical Bayes For Spatial Model*

Description

Provides several functions and datasets for area level of Small Area Estimation under Spatial Model using Hierarchical Bayesian (HB) Method. Model-based estimators include the HB estimators based on a Spatial Fay-Herriot model with univariate normal distribution for variable of interest.The 'rjags' package is employed to obtain parameter estimates. For the reference, see Rao and Molina (2015) <doi:10.1002/9781118735855>.

Author(s)

Arina Mana Sikana, Azka Ubaidillah

Maintaner: Arina Mana Sikana <sikanaradrianan@gmail.com>

Functions

`sar.normal` This function gives small area estimator under Spatial SAR Model and is implemented to variable of interest (y) that assumed to be a Normal Distribution. The range of data is $(-\infty < y < \infty)$.

Reference

- Rao, J.N.K & Molina. (2015). Small Area Estimation 2nd Edition. New Jersey: John Wiley and Sons, Inc. <doi:10.1002/9781118735855>.
- J. Kubacki and A. Jedrzejczak. (2016). Small Area Estimation of Income Under Spatial SAR Model. Statistics in Transition New Series, Vol. 17, No. 3, pp. 365–390. <doi: 10.21307/stattrans-2016-028>.
- H. C. Chung and G. S. Datta. (2020). Bayesian Hierarchical Spatial Models for Small Area Estimation. Research Report Series. Washington, D.C.: U.S. Census Bureau.

`sar.normal` *Small Area Estimation under Spatial Simultaneous Autoregressive (SAR) Model and Normal Distribution using Hierarchical Bayesian Method*

Description

This function gives small area estimator under Spatial SAR Model and is implemented to variable of interest (y) that assumed to be a Normal Distribution. The range of data is $(-\infty < y < \infty)$.

Usage

```
sar.normal(
  formula,
  vardir,
  proxmat,
  iter.update = 3,
  iter.mcmc = 2000,
  thin = 1,
  burn.in = 1000,
  coef,
  var.coef,
  data
)
```

Arguments

`formula`	formula that describe the fitted model.
`vardir`	sampling variances of direct estimations.
`proxmat`	`D*D` proximity matrix with values in the interval `[0,1]` containing the proximities between the row and column domains. The rows add up to `1`.

iter.update	number of updates with default 3.
iter.mcmc	number of total iterations per chain with default 2000.
thin	thinning rate, must be a positive integer with default 1.
burn.in	number of iterations to discard at the beginning with default 1000.
coef	optional vector containing the mean of the prior distribution of the regression model coefficients.
var.coef	optional vector containing the variances of the prior distribution of the regression model coefficients.
data	the data frame.

Value

This function returns a list of the following objects:

Est	A data frame of Small Area mean Estimates using Hierarchical Bayesian Method
refVar	Estimated random effect variances
coefficient	A data frame with estimated model coefficient
plot	Trace, Density, and Autocorrelation Function Plot of MCMC samples

Examples

```
## For data without any non-sampled area
data(sp.norm)       # Load dataset
data(prox.mat)      # Load proximity Matrix

result <- sar.normal(y ~ x1 + x2, "vardir", prox.mat, data = sp.norm)

result$Est          # Small Area mean Estimates
result$refVar       # Estimated random effect variances
result$coefficient  # Estimated model coefficient


# Load library 'coda' to execute the plot
# autocorr.plot(result$plot[[3]])    # Generate ACF Plot
# plot(result$plot[[3]])             # Generate Density and Trace plot



## For data with non-sampled area use sp.normNs
```

`sp.norm` *Synthetic Data for Small Area Estimation under Spatial Simultaneous Autoregressive (SAR) Model and Normal Distribution*

Description

Synthetic data of 64 regions to simulate Small Area Estimation under Spatial SAR Model and Normal Distribution using Hierarchical Bayesian Method

This data is generated by these following steps:

1. Generate sampling random area effect $v = (I - \rho W)^{-1}u$ with u $N(0, I)$, I is an identity matrix, and W is proximity matrix. The auxiliary variables are generated by $x1$ $U(0, 1)$ and $x2$ $N(10, 1)$. The parameters $\beta_0, \beta_1, \beta_2$ are set as 1 and ρ as 0.7
2. Generate variance of the direct estimators σ_e^2 with σ_e^2 $InvGamma(a, b)$. Sampling error e is generated by e $N(0, \sigma_e^2)$
3. Calculate $\mu = \beta_0 + \beta_1 x1 + \beta_2 x2 + u$. Calculate the direct estimators of μ, i.e $y = \mu + e$
4. Direct estimators y, auxiliary variables $x1, x2$, and variance of the direct estimators are combined in a data frame called `sp.norm`

Usage

```
data(sp.norm)
```

Format

A data frame with 64 observations on the following 4 variables:

y Direct estimators for each region

x1 Auxiliary variable of x1

x2 Auxiliary variable of x2

vardir Sampling variance of the direct estimators for each region

`sp.normNs` *Synthetic Data for Small Area Estimation under Spatial Simultaneous Autoregressive (SAR) Model and Normal Distribution with non-sampled area*

Description

Synthetic data of 64 regions to simulate Small Area Estimation under Spatial SAR Model and Normal Distribution with non-sampled area using Hierarchical Bayesian Method

This data contains `NA` values that indicates no sampled at one or more regions. It uses the `sp.norm` dataset with the direct estimators and the related variances of 5 regions are missing.

Usage

```
data(sp.normNs)
```

Format

A data frame with 64 observations on the following 4 variables:

y Direct estimators for each region

x1 Auxiliary variable of x1

x2 Auxiliary variable of x2

vardir Sampling variance of the direct estimators for each region

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