Package ‘saeHB.panel’

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Type Package

Title Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model

Version 0.1.1

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Description We designed this package to provide several functions for area level of small area estimation using hierarchical Bayesian (HB) method. This package provides model using panel data for variable interest. This package also provides a dataset produced by a data generation. The 'rjags' package is employed to obtain parameter estimates. Model-based estimators involves the HB estimators which include the mean and the variation of mean. For the reference, see Rao and Molina (2015).

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 7.1.2

URL https://github.com/Veliatrimarliana/saeHB.panel

BugReports https://github.com/Veliatrimarliana/saeHB.panel/issues

Suggests knitr, rmarkdown

VignetteBuilder knitr

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

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

Depends R (>= 2.10)

NeedsCompilation no

Repository CRAN

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**R topics documented:**

- `dataAr1` .................................................. 2
- `dataAr1Ns` ................................................. 3
- `dataPanel` ................................................ 3
- `dataPanelNs` .............................................. 4
- `Panel` ..................................................... 5
- `RaoYuAr1` ................................................. 6

**Index**

| dataAr1 | Sample Data for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model |

**Description**

Dataset to simulate Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model

This data is generated by these following steps:

1. Generate random effect area \( v \), random effect for area \( i \) at time point \( j \) \( u \), epsilon \( \epsilon \), variance of \( y_{di} \) \( \text{vardir}_{ij} \), sampling error \( e \), auxiliary \( x_{di1} \) and \( x_{di2} \)

   - Set coefficient \( \beta_0 = \beta_1 = \beta_2 = 2 \) and \( \rho = -0.5 \)
   - Generate random effect area \( v_{(i)} \sim N(0,1) \)
   - Generate auxiliary variable \( x_{di1_{(ij)}} \sim U(1,2) \)
   - Generate auxiliary variable \( x_{di2_{(ij)}} \sim U(1,3) \)
   - Generate epsilon \( \epsilon_{ij} \sim N(0,1) \)
   - Calculate variance of \( y_{di} \) with \( \text{vardir}_{ij} \sim IG(10,6) \)
   - Generate sampling error \( e_{(ij)} \sim N(0,\text{vardir}_{ij}) \)
   - Calculate random effect for area \( i \) at time point \( j \) \( u_{ij} = \rho \times u_{ij-1} + \epsilon_{ij} \)
   - Calculate \( \mu_{ij} = \beta_0 + \beta_1 x_{di1_{ij}} + \beta_2 x_{di2_{ij}} + v_i + u_{ij} + \epsilon_{ij} \)
   - Set area=50 and period=10

2. Auxiliary variables \( x_{di1}, x_{di2} \), direct estimation \( y \), area, period, and \( \text{vardir} \) are combined in a dataframe called `dataAr1`

**Usage**

`dataAr1`

**Format**

A data frame with 100 rows and 6 variables:

- `ydi` Direct Estimation of \( y \)
- `area` Area (domain) of the data
- `period` Period (subdomain) of the data
**dataAr1Ns**

**vardir** Sampling Variance of y

**xdi1** Auxiliary variable of xdi1

**xdi2** Auxiliary variable of xdi2

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**Description**

1. A dataset to simulate Small Area Estimation using Hierarchical Bayesian method for Rao-Yu Model with Non-sampled Area
2. This data contains NA values that indicates no sampled in at least one area.

**Usage**

dataAr1Ns

**Format**

A data frame with 100 row and 6 column:

**ydi** Direct Estimation of y

**area** Area (domain) of the data

**period** Period (subdomain) of the data

**vardir** Sampling Variance of y

**xdi1** Auxiliary variable of xdi1

**xdi2** Auxiliary variable of xdi2

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**dataPanel**

**Sample Data for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model when \( \rho = 0 \)**

**Description**

Dataset to simulate Small Area Estimation using Hierarchical Bayesian Method for Rao-Yu Model with \( \rho = 0 \) This data is generated by these following steps:

1. Generate random effect area \( v \), random effect for area \( i \) at time point \( j \), epsilon \( \epsilon \), variance of \( y_{di} \) \( \text{vardir} \), sampling error \( e \), auxiliary \( x_{di1} \) and \( x_{di2} \)

   - Set coefficient \( \beta_0 = \beta_1 = \beta_2 = 2 \) and \( \rho = -0.5 \)
   - Generate random effect area \( v_{(i)} \sim N(0,1) \)
   - Generate auxiliary variable \( x_{di1_{(i)}} \sim U(1,2) \)
• Generate auxiliary variable $x_{di2_{ij}} \sim U(1,3)$
• Generate epsilon $\varepsilon_{ij} \sim N(0,1)$
• Calculate variance of $y_{di}$ with $\text{vardir}_{ij} \sim IG(10,6)$
• Generate sampling error $e_{ij} \sim N(0,\text{vardir}_{ij})$
• Calculate $\mu_{ij} = \beta_0 + \beta_1 x_{di1_{ij}} + \beta_2 x_{di2_{ij}} + v_i + \varepsilon_{ij} + e_{ij}$

2. Auxiliary variables $x_{di1}, x_{di2}$, direct estimation $y$, area, period, and vardir are combined in a dataframe called dataPanel

Usage

dataPanel

Format

A data frame with 100 rows and 6 variables:

- $y_{di}$: Direct Estimation of $y$
- area: Area (domain) of the data
- period: Period (subdomain) of the data
- vardir: Sampling Variance of $y$
- $x_{di1}$: Auxiliary variable of $x_{di1}$
- $x_{di2}$: Auxiliary variable of $x_{di2}$

---

dataPanelNs

Sample Data for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model when $\rho = 0$ with Non Sampled Area

Description

1. A dataset to simulate Small Area Estimation using Hierarchical Bayesian method for Rao-Yu Model with Non-sampled area
2. This data contains NA values that indicates no sampled in at least one area.

Usage

dataPanelNs
Panel

Format

A data frame with 100 row and 6 column:

<table>
<thead>
<tr>
<th>ydi</th>
<th>Direct Estimation of y</th>
</tr>
</thead>
<tbody>
<tr>
<td>area</td>
<td>Area (domain) of the data</td>
</tr>
<tr>
<td>period</td>
<td>Period (subdomain) of the data</td>
</tr>
<tr>
<td>vardir</td>
<td>Sampling Variance of y</td>
</tr>
<tr>
<td>xdi1</td>
<td>Auxiliary variable of xdi1</td>
</tr>
<tr>
<td>xdi2</td>
<td>Auxiliary variable of xdi2</td>
</tr>
</tbody>
</table>

Panel

Small Area Estimation using Hierarchical Bayesian under Rao-Yu Model with \( \rho = 0 \)

Description

This function is implemented to variable of interest \( ydi \)

Usage

Panel(
  formula,
  area,
  period,
  vardir,
  iter.update = 3,
  iter.mcmc = 2000,
  thin = 2,
  burn.in = 1000,
  tau.e = 1,
  tau.v = 1,
  data
)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>formula</td>
<td>Formula that describe the fitted model</td>
</tr>
<tr>
<td>area</td>
<td>Number of areas (domain) of the data</td>
</tr>
<tr>
<td>period</td>
<td>Number of periods (subdomains) for each area of the data</td>
</tr>
<tr>
<td>vardir</td>
<td>Sampling variances of direct estimations</td>
</tr>
<tr>
<td>iter.update</td>
<td>Number of updates with default 3</td>
</tr>
<tr>
<td>iter.mcmc</td>
<td>Number of total iterations per chain with default 2000</td>
</tr>
<tr>
<td>thin</td>
<td>Thinning rate, must be a positive integer with default 1</td>
</tr>
</tbody>
</table>
burn.in  Number of iterations to discard at the beginning with default 1000
tau.e   Variance of area-by-time effect of variable interest with default 1
tau.v   Variance of random area effect of variable interest with default 1
data    The data frame

Value

This function returns a list of the following objects:

Est       A vector with the values of Small Area mean Estimates using Hierarchical bayesian method
refVar    Estimated random effect variances
coeff     A dataframe with the estimated model coefficient
plot      Trace, Density, Autocorrelation Function Plot of MCMC samples

Examples

```r
##For data without any non-sampled area
data(dataPanel)    # Load dataset
formula = ydi ~ xdi1 + xdi2
area = max(dataPanel[, "area"])
period = max(dataPanel[,"period"])
vardir = dataPanel[,"vardir"]
result <- Panel(formula, area, period, vardir, data = dataPanel)

result$Est
result$refVar
result$cocf
result$plot

## For data with non-sampled area use dataPanelNs
```

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**RaoYuAr1**

Small Area Estimation using Hierarchical Bayesian under Rao-Yu Model

**Description**

This function is implemented to variable of interest ydi
Usage

RaoYuAr1(
  formula, 
  area, 
  period, 
  vardir, 
  iter.update = 3, 
  iter.mcmc = 2000, 
  thin = 2, 
  burn.in = 1000, 
  tau.e = 1, 
  tau.v = 1, 
  data 
)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>formula</td>
<td>Formula that describe the fitted model</td>
</tr>
<tr>
<td>area</td>
<td>Number of areas (domain) of the data</td>
</tr>
<tr>
<td>period</td>
<td>Number of periods (subdomains) for each area of the data</td>
</tr>
<tr>
<td>vardir</td>
<td>Sampling variances of direct estimations</td>
</tr>
<tr>
<td>iter.update</td>
<td>Number of updates with default 3</td>
</tr>
<tr>
<td>iter.mcmc</td>
<td>Number of total iterations per chain with default 2000</td>
</tr>
<tr>
<td>thin</td>
<td>Thinning rate, must be a positive integer with default 1</td>
</tr>
<tr>
<td>burn.in</td>
<td>Number of iterations to discard at the beginning with default 1000</td>
</tr>
<tr>
<td>tau.e</td>
<td>Variance of area-by-time effect of variable interest with default 1</td>
</tr>
<tr>
<td>tau.v</td>
<td>Variance of random area effect of variable interest with default 1</td>
</tr>
<tr>
<td>data</td>
<td>The data frame</td>
</tr>
</tbody>
</table>

Value

This function returns a list of the following objects:

- **Est**: A vector with the values of Small Area mean Estimates using Hierarchical bayesian method
- **refVar**: Estimated random effect variances
- **coefficient**: A dataframe with the estimated model coefficient
- **alpha**: Parameter dispersion of Generalized Poisson distribution
- **plot**: Trace, Density, Autocorrelation Function Plot of MCMC samples
Examples

```r
## For data without any non-sampled area
data(dataAr1)  # Load dataset
formula = ydi ~ xdi1 + xdi2
area = max(dataAr1[, "area"])
period = max(dataAr1[, "period"])
vardir = dataAr1[, "vardir"]

result <- RaoYuAr1(formula, area, period, vardir, data = dataAr1)
result$Est
result$refVar
result$coefficient
result$plot
## For data with non-sampled area use dataAr1Ns
```
Index

* datasets
  dataAr1, 2
  dataAr1Ns, 3
  dataPanel, 3
  dataPanelNs, 4

dataAr1, 2
dataAr1Ns, 3
dataPanel, 3
dataPanelNs, 4

Panel, 5
RaoYuAr1, 6