

# Package: saeHB.panel (via r-universe)

September 11, 2024

**Type** Package

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

**Version** 0.1.0

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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/Veliatrimarlina/saeHB.panel>

**BugReports** <https://github.com/Veliatrimarlina/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)

**Repository** <https://veliatrimarlina.r-universe.dev>

**RemoteUrl** <https://github.com/veliatrimarlina/saehb.panel>

**RemoteRef** HEAD

**RemoteSha** cc4e38b852855791e9b167760ae2f388b88f052c

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dataAr1	<i>Sample Data for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model</i>
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## 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  $y_{di}$   $\text{var}_{dir}$ , 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  $\text{var}_{dir}_{\{ij\}} \sim IG(10,6)$
  - Generate sampling error  $e_{\{ij\}} \sim N(0, \text{var}_{dir}_{\{ij\}})$
  - Calculate random effect for area  $i$  at time point  $j$   $u_{ij} = \rho * u_{ij-1} + \epsilon_{ij}$
  - Calculate  $\mu_{ij} = \beta_0 + \beta_1 x_{di1}_{ij} + \beta_2 x_{di2}_{ij} + v_i + u_{ij} + e_{ij}$
  - Set  $\text{area}=50$  and  $\text{period}=10$
2. Auxiliary variables  $x_{di1}$ ,  $x_{di2}$ , direct estimation  $y$ , area, period, and  $\text{var}_{dir}$  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

**vardir** Sampling Variance of y  
**xdi1** Auxiliary variable of xdi1  
**xdi2** Auxiliary variable of xdi2

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dataAr1Ns                      *Sample Data for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model with Non Sampled Area*

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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*

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### 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  $j$   $u$ , epsilon  $\epsilon$ , variance of  $y_{di}$   $vardir$ , 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  $x_{di1}_{\{ij\}} \sim U(1,2)$

- Generate auxiliary variable  $xdi2_{ij} \sim U(1, 3)$
  - Generate epsilon  $\epsilon_{ij} \sim N(0, 1)$
  - Calculate variance of ydi with  $vardir_{ij} \sim IG(10, 6)$
  - Generate sampling error  $e_{ij} \sim N(0, vardir_{ij})$
  - Calculate  $\mu_{ij} = \beta_0 + \beta_1 xdi1_{ij} + \beta_2 xdi2_{ij} + v_i + \epsilon_{ij} + e_{ij}$
  - Set  $area=50$  and  $period=10$
2. Auxiliary variables xdi1, xdi2, 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::

**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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dataPanelNs

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

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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

```
dataPanelNs
```

**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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Panel	<i>Small Area Estimation using Hierarchical Bayesian under Rao-Yu Model with <math>\rho=0</math></i>
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**Description**

This function is implemented to variable of interest ydi

**Usage**

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

**Arguments**

formula	Formula that describe the fitted model
area	Number of areas (domain) of the data
period	Number of periods (subdomains) for each area of the data
vardir	Sampling variances of direct estimations
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
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
coef	A dataframe with the estimated model coefficient
plot	Trace, Density, Autocorrelation Function Plot of MCMC samples

### Examples

```
##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$coef
result$plot

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

### Description

This function is implemented to variable of interest ydi

**Usage**

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

**Arguments**

formula	Formula that describe the fitted model
area	Number of areas (domain) of the data
period	Number of periods (subdomains) for each area of the data
vardir	Sampling variances of direct estimations
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
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
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**

```
##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
```



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