

Package ‘saeHB.panel.beta’

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Type Package

Title Small Area Estimation using HB for Rao Yu Model under Beta Distribution

Version 0.1.5

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Description Several functions are provided for small area estimation at the area level using the hierarchical bayesian (HB) method with panel data under beta distribution for variable interest. This package also provides a dataset produced by data generation. The 'rjags' package is employed to obtain parameter estimates. Model-based estimators involve the HB estimators, which include the mean and the variation of the mean. For the reference, see Rao and Molina (2015, ISBN: 978-1-118-73578-7).

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URL <https://github.com/DianRahmawatiSalis/saeHB.panel.beta>

BugReports <https://github.com/DianRahmawatiSalis/saeHB.panel.beta/issues>

Depends R(>= 2.10)

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

Suggests knitr, R.rsp, rmarkdown, testthat (>= 3.0.0)

VignetteBuilder knitr, R.rsp

Config/testthat/edition 3

Encoding UTF-8

LazyData true

NeedsCompilation no

RoxygenNote 7.3.1

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

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Repository CRAN

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dataBetaAr1	<i>Sample Data under Beta Distribution for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model</i>
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Description

Dataset under Beta Distribution 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 ϵ , variance of y_{di} 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 $x_{di1_{\{ij\}}} \sim U(0, 1)$
 - Generate auxiliary variable $x_{di2_{\{ij\}}} \sim U(0, 1)$
 - Generate epsilon $\epsilon_{ij} \sim N(0, 1)$
 - Generate sampling error $e_{\{ij\}} \sim N(0, var_{dir}_{\{ij\}})$
 - Generate $\phi_{ij} \sim \text{Gamma}(1, 0.5)$
 - Calculate random effect for area i at time point j $u_{ij} = \rho * u_{ij-1} + \epsilon_{ij}$
 - Calculate $\mu_{ij} = \frac{(\exp \beta_0 + \beta_1 x_{di1_{ij}} + \beta_2 x_{di2_{ij}} + v_i + \epsilon_{ij})}{(1 + \exp \beta_0 + \beta_1 x_{di1_{ij}} + \beta_2 x_{di2_{ij}} + v_i + \epsilon_{ij})}$
 - Calculate $A_{ij} = \mu_{ij} * \phi_{ij}$
 - Calculate $B_{ij} = (1 - \mu_{ij}) * \phi_{ij}$
 - Generate y_{di} $y_{\{ij\}} \sim \text{Beta}(A_{\{ij\}}, B_{\{ij\}})$
 - Calculate variance of y_{di} with $var_{dir}_{ij} = \frac{(A_{ij})(B_{ij})}{(A_{ij} + B_{ij})^2 (A_{ij} + B_{ij} + 1)}$
 - Set area=20 and period=5
2. Auxiliary variables x_{di1} , x_{di2} , direct estimation y , area, period, and var_{dir} are combined in a dataframe called dataAr1

Usage

dataBetaAr1

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

dataBetaAr1Ns	<i>Sample Data under Beta Distribution for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model with Non Sampled Area</i>
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Description

1. A dataset under Beta Distribution 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

```
dataBetaAr1Ns
```

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

dataPanelbeta

Sample Data under Beta Distribution for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model when $\rho = 0$

Description

Dataset under Beta Distribution 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 ϵ , variance of ydi var_{dir} , sampling error e , auxiliary x_{di1} and x_{di2}
 - Set coefficient $\beta_0 = \beta_1 = \beta_2 = 2$
 - Generate random effect area $v_{\{i\}} \sim N(0, 1)$
 - Generate auxiliary variable $x_{di1}_{\{ij\}} \sim U(0, 1)$
 - Generate auxiliary variable $x_{di2}_{\{ij\}} \sim U(0, 1)$
 - Generate epsilon $\epsilon_{ij} \sim N(0, 1)$
 - Generate $\phi_{ij} \sim \text{Gamma}(1, 0.5)$
 - Calculate $\mu_{ij} = \frac{\exp \beta_0 + \beta_1 x_{di1}_{ij} + \beta_2 x_{di2}_{ij} + v_i + \epsilon_{ij}}{(1 + \exp \beta_0 + \beta_1 x_{di1}_{ij} + \beta_2 x_{di2}_{ij} + v_i + \epsilon_{ij})}$
 - Calculate $A_{ij} = \mu_{ij} * \phi_{ij}$
 - Calculate $B_{ij} = (1 - \mu_{ij}) * \phi_{ij}$
 - Generate ydi $y_{\{ij\}} \sim \text{Beta}(A_{\{ij\}}, B_{\{ij\}})$
 - Calculate variance of ydi with $var_{dir}_{ij} = \frac{(A_{ij})(B_{ij})}{(A_{ij} + B_{ij})^2 (A_{ij} + B_{ij} + 1)}$
 - Set area=20 and period=5
2. Auxiliary variables x_{di1} , x_{di2} , direct estimation y , area, period, and var_{dir} are combined in a dataframe called dataPanel

Usage

```
dataPanelbeta
```

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

var_{dir} Sampling Variance of y

x_{di1} Auxiliary variable of x_{di1}

x_{di2} Auxiliary variable of x_{di2}

dataPanelbetaNs	<i>Sample Data under Beta Distribution for Small Area Estimation using Hierarchical Bayesian Method for Rao Yu Model when $\rho = 0$ with Non Sampled Area</i>
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Description

1. A dataset under Beta Distribution 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

```
dataPanelbetaNs
```

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

Panel.beta	<i>Small Area Estimation using Hierarchical Bayesian for Rao-Yu Model under Beta Distribution with $\rho=0$</i>
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Description

This function is implemented to variable of interest ydi

Usage

```
Panel.beta(
  formula,
  area,
  period,
  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
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
convergence.test	Convergence diagnostic for Markov chains based on Geweke test

Examples

```

##For data without any non-sampled area
data(dataPanelbeta) # Load dataset
dataPanelbeta = dataPanelbeta[1:25,] #for the example only use part of the dataset
formula = ydi ~ xdi1 + xdi2
area = max(dataPanelbeta[, "area"])
period = max(dataPanelbeta[, "period"])

result <- Panel.beta(formula, area, period, data = dataPanelbeta)

result$Est
result$refVar
result$coef
result$plot

## For data with non-sampled area use dataPanelbetaNs

```

RaoYuAr1.beta	<i>Small Area Estimation using Hierarchical Bayesian for Rao-Yu Model under Beta Distribution</i>
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Description

This function is implemented to variable of interest ydi

Usage

```
RaoYuAr1.beta(
  formula,
  area,
  period,
  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
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

<code>alpha</code>	Parameter dispersion of Generalized Poisson distribution
<code>plot</code>	Trace, Density, Autocorrelation Function Plot of MCMC samples
<code>convergence.test</code>	Convergence diagnostic for Markov chains based on Geweke test

Examples

```
##For data without any non-sampled area
data(dataBetaAr1)      # Load dataset
dataBetaAr1 = dataBetaAr1[1:25,] #for the example only use part of the dataset
formula = ydi ~ xdi1 + xdi2
area = max(dataBetaAr1[, "area"])
period = max(dataBetaAr1[, "period"])

result <- RaoYuAr1.beta(formula, area, period, data = dataBetaAr1)
result$Est
result$refVar
result$coefficient
result$plot
## For data with non-sampled area use dataBetaAr1Ns
```

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