

Package ‘msaeHB’

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Type Package

Title Multivariate Small Area Estimation using Hierarchical Bayesian Method

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Description Implements area level of multivariate small area estimation using Hierarchical Bayesian method under Normal and T distribution. The 'rjags' package is employed to obtain parameter estimates. For the reference, see Rao and Molina (2015) <[doi:10.1002/9781118735855](https://doi.org/10.1002/9781118735855)>.

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 datasaeNorm

Sample Data for Small Area Estimation using Hierarchical Bayesian Method under Multivariate Normal distribution

Description

Dataset to simulate Small Area Estimation using Hierarchical Bayesian Method under Multivariate Normal distribution

This data is generated by these following steps:

1. Generate sampling error e , random effect u , and auxiliary variables $X1$ $X2$.
 - For sampling error e , we set $e_d \sim N_3(0, V_{ed})$, where $V_{ed} = (\sigma_{dij})_{i,j=1,2,3}$, with $\sigma_{ii} \sim InvGamma(a, b)$ and $\rho_e = 0.5$.
 - For random effect u , we set $u \sim N_3(0, V_u)$.
 - For auxiliary variables $X1$ and $X2$, we set $X1 \sim UNIF(1, 2)$ and $X2 \sim UNIF(1, 10)$.
2. Calculate direct estimation $Y1$ $Y2$ and $Y3$, where $Y_i = X * \beta + u_i + e_i$. We take $\beta_1 = 1$ and $\beta_2 = 1$.

Auxiliary variables $X1$ $X2$, direct estimation $Y1$ $Y2$ $Y3$, and sampling variance-covariance $v1$ $v2$ $v3$ $v12$ $v13$ $v23$ are combined into a dataframe called `datasaeNorm`

Usage

`datasaeNorm`

Format

A data frame with 30 rows and 11 variables:

X1 Auxiliary variable of $X1$

X2 Auxiliary variable of $X2$

Y1 Direct Estimation of $Y1$

Y2 Direct Estimation of $Y2$

Y3 Direct Estimation of $Y3$

v1 Sampling Variance of $Y1$

v12 Sampling Covariance of $Y1$ and $Y2$

v13 Sampling Covariance of $Y1$ and $Y3$

v2 Sampling Variance of $Y2$

v23 Sampling Covariance of $Y2$ and $Y3$

v3 Sampling Variance of $Y3$

datasaeT

Sample Data for Small Area Estimation using Hierarchical Bayesian Method under Multivariate T distribution

Description

Dataset to simulate Small Area Estimation using Hierarchical Bayesian Method under Multivariate T distribution

This data is generated by these following steps:

1. Generate sampling error e , random effect u , and auxiliary variables $X1$ $X2$.
 - For sampling error e , we set e_d is multivariate T distributed where the vector of noncentrality parameters is zero, scale matrix $V_{ed} = (\sigma_{dij})_{i,j=1,2,3}$, with $\sigma_{ii} \sim InvGamma(a, b)$ and $\rho_e = 0.5$, and degree of freedom $df \sim InvGamma(a, b)$.
 - For random effect u , we set $u \sim N_3(0, V_u)$.
 - For auxiliary variables $X1$ and $X2$, we set $X1 \sim UNIF(1, 2)$ and $X2 \sim UNIF(1, 10)$.
2. Calculate direct estimation $Y1$ $Y2$ and $Y3$, where $Y_i = X * \beta + u_i + e_i$. We take $\beta_1 = 1$ and $\beta_2 = 1$.

Auxiliary variables $X1$ $X2$, direct estimation $Y1$ $Y2$ $Y3$, and sampling variance-covariance $v1$ $v2$ $v3$ $v12$ $v13$ $v23$ are combined into a dataframe called `datasaeT`

Usage

`datasaeT`

Format

A data frame with 30 rows and 11 variables:

X1 Auxiliary variable of $X1$

X2 Auxiliary variable of $X2$

Y1 Direct Estimation of $Y1$

Y2 Direct Estimation of $Y2$

Y3 Direct Estimation of $Y3$

v1 Sampling Variance of $Y1$

v12 Sampling Covariance of $Y1$ and $Y2$

v13 Sampling Covariance of $Y1$ and $Y3$

v2 Sampling Variance of $Y2$

v23 Sampling Covariance of $Y2$ and $Y3$

v3 Sampling Variance of $Y3$

df2R	<i>Transform Dataframe to Matrix R</i>
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Description

This function transforms dataframe contains sampling variance to a diagonal matrix R

Usage

```
df2R(R, r)
```

Arguments

R	dataframe of sampling variances of direct estimators.
r	number of variables

Value

Block diagonal matrix R

Examples

```
NULL
```

mHBNormal	<i>Multivariate Small Area Estimation using Hierarchical Bayesian under Normal Distribution</i>
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Description

This function implements small area estimation using hierarchical bayesian to variable of interest that assumed to be a multivariate normal distribution.

Usage

```
mHBNormal(
  formula,
  vardir,
  iter.update = 3,
  iter.mcmc = 10000,
  thin = 2,
  burn.in = 2000,
  data
)
```

Arguments

<code>formula</code>	an object of class list of formula, describe the model to be fitted
<code>vardir</code>	vector containing name of sampling variances of direct estimators in the following order: <code>var1</code> , <code>var2</code> , . . . , <code>var(k)</code> , <code>cov12</code> , . . . <code>cov1k</code> , <code>cov23</code> , . . . , <code>cov(k-1)(k)</code>
<code>iter.update</code>	number of updates with default 3
<code>iter.mcmc</code>	number of total iterations per chain with default 10000
<code>thin</code>	thinning rate, must be a positive integer with default 2
<code>burn.in</code>	number of iterations to discard at the beginning with default 2000
<code>data</code>	dataframe containing the variables named in <code>formula</code> and <code>vardir</code>

Value

The function returns a list with the following objects:

Est A vector with the values of Small Area mean Estimates using Hierarchical bayesian method

coefficient A dataframe with the estimated model coefficient

plot Trace, Density, Autocorrelation Function Plot of MCMC samples

Examples

```
## Load dataset
data(datasaeNorm)
## Using parameter 'data'
Fo <- list(f1=Y1~X1+X2,
           f2=Y2~X1+X2)
vardir <- c("v1", "v2", "v12")
m1 <- mHBNormal(formula=Fo, vardir=vardir,
                iter.update = 1, iter.mcmc = 1000,
                thin = 2, burn.in = 200, data=datasaeNorm)
```

mHBT

Multivariate Small Area Estimation using Hierarchical Bayesian under T Distribution

Description

This function implements small area estimation using hierarchical bayesian to variable of interest that assumed to be a multivariate T distribution.

Usage

```
mHBT(
  formula,
  vardir,
  iter.update = 3,
  iter.mcmc = 10000,
  thin = 2,
  burn.in = 2000,
  data
)
```

Arguments

formula	an object of class list of formula, describe the model to be fitted
vardir	vector containing name of sampling variances of direct estimators in the following order: var1, var2, . . . , var(k) , cov12, . . . cov1k, cov23, . . . , cov(k-1)(k)
iter.update	number of updates with default 3
iter.mcmc	number of total iterations per chain with default 10000
thin	thinning rate, must be a positive integer with default 2
burn.in	number of iterations to discard at the beginning with default 2000
data	dataframe containing the variables named in formula and vardir

Value

The function returns a list with the following objects:

Est A vector with the values of Small Area mean Estimates using Hierarchical bayesian method

coefficient A dataframe with the estimated model coefficient

plot Trace, Density, Autocorrelation Function Plot of MCMC samples

Examples

```
## Load dataset
data(datasaeT)
## Using parameter 'data'
Fo <- list(f1=Y1~X1+X2,
           f2=Y2~X1+X2)
vardir <- c("v1", "v2", "v12")
m1 <- mHBT(formula=Fo, vardir=vardir,
            iter.update = 1, iter.mcmc = 1000,
            thin = 2, burn.in = 200, data=datasaeT)
```

msaeHB

msaeHB : Multivariate Small Area Estimation using Hierarchical Bayesian Method

Description

Implements area level of multivariate small area estimation using hierarchical Bayesian (HB) method under Normal and T distribution. The 'rjags' package is employed to obtain parameter estimates. For the reference, see Rao and Molina (2015) <doi:10.1002/9781118735855>.

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Functions

mHBNormal Estimate multivariate small area estimation under normal distribution

mHBT Estimate multivariate small area estimation under normal distribution

Reference

- Rao, J.N.K & Molina. (2015). Small Area Estimation 2nd Edition. New York: John Wiley and Sons, Inc. <doi:10.1002/9781118735855>.

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