Package 'saeHB.ME'

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Type Package

Title Small Area Estimation with Measurement Error using Hierarchical Bayesian Method

Version 1.0

Description Implementation of small area estimation using Hierarchical Bayesian (HB) Method when auxiliary variable measured with error. The 'rjags' package is employed to obtain parameter estimates. For the references, see Rao and Molina (2015) <doi:10.1002/9781118735855>, Ybarra and Lohr (2008) <doi:10.1093/biomet/asn048>, a
zoufras (2009, ISBN-10: 1118210352).

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R topics documented:

dataHBME *Sample Data for Small Area Estimation with Measurement Error using Hierarchical Bayesian Method under Normal Distribution*

Description

This data generated by simulation based on Hierarchical Bayesian Method under Normal Distribution with Measurement Error by following these steps:

1. Generate x_1 ~ UNIF(0, 1), x_2 ~ UNIF(1,5), x_3 ~ UNIF(10,15), and x_4 ~ UNIF(10,20)
2. Generate $v.x_1$ ~ Gamma(1,1) and $v.x_2$ ~ Gamma(2,1)
3. Generate x_{1h} ~ N(x_1, sqrt($v.x_1$)) and x_{2h} ~ N(x_2, sqrt($v.x_2$))
4. Generate β_0, β_1, β_2, β_3, and β_4
5. Generate u ~ N(0,1) and v ~ 1/(Gamma(1,1))
6. Calculate $\mu = \beta_0 + \beta_1 * x_{1h} + \beta_2 * x_{2h} + \beta_3 * x_3 + \beta_4 * x_4 + u$
7. Generate Y ~ N(μ, sqrt(v))

Direct estimation `Y`, auxiliary variables `x1` `x2` `x3` `x4`, sampling variance `v`, and mean squared error of auxiliary variables `v.x1` `v.x2` are arranged in a dataframe called `dataHBME`.

Usage

```
data(dataHBME)
```

Format

A data frame with 30 observations on the following 8 variables.

`Y` direct estimation of Y.

`x1` auxiliary variable of x1.

`x2` auxiliary variable of x2.

`x3` auxiliary variable of x3.

`x4` auxiliary variable of x4.

`vardir` sampling variances of Y.

`v.x1` mean squared error of x1.

`v.x2` mean squared error of x2.

dataTMEHB *Sample Data for Small Area Estimation with Measurement Error using Hierarchical Bayesian Method under Student-t Distribution*

Description

This data generated by simulation based on Hierarchical Bayesian Method under Student-t Distribution with Measurement Error by following these steps:

1. Generate x_1 ~ UNIF(10, 20) and x_2 ~ UNIF(30,50)
2. Generate $v.x_1$ ~ 1/(Gamma(1,1))
3. Generate x_{1h} ~ N(x_1
4. Generate β_0 = β_1 = β_2 = 0.5
5. Generate u ~ N(0,1) and k ~ Gamma(10,1)
6. Calculate μ = $\beta_0 + \beta_1 * x_{1h} + \beta_2 * x_{2h} + u$
7. Generate Y ~ t(k, μ)) and $v = \sigma_y^2$

Direct estimation `Y`, auxiliary variables `x1` `x2` `x3` `x4`, sampling variance `v`, and mean squared error of auxiliary variables `v.x1` `v.x2` are arranged in a dataframe called `dataTMEHB`.

Usage

```
data(dataTMEHB)
```

Format

A data frame with 30 observations on the following 8 variables.

`Y` direct estimation of Y.

`x1` auxiliary variable of x1.

`x2` auxiliary variable of x2.

`vardir` sampling variances of Y.

`v.x1` mean squared error of x1.

`meHBNormal` *Small Area Estimation with Measurement Error using Hierarchical Bayesian Method under Normal Distribution*

Description

This function is implemented to variable of interest (y) that assumed to be a Normal Distribution when auxiliary variable is measured with error.

Usage

```
meHBNormal(
  formula,
  vardir,
  var.x,
  coef,
  var.coef,
  iter.update = 3,
  iter.mcmc = 10000,
  thin = 2,
  tau.u = 1,
  burn.in = 2000,
  data
)
```

Arguments

`formula`	an object of class `formula` (or one that can be coerced to that class): a symbolic description of the model to be fitted. The variables included `formula` must have a length equal to the number of domains `m`. This formula can provide auxiliary variable either measured with error or combination between measured with `error` and `without error`. If the auxiliary variable are combination between `error` and `without error`, input the `error` variable first followed by `without error` variable.
`vardir`	vector containing the `m` sampling variances of direct estimators for each domain. The values must be sorted as the `Y`.
`var.x`	vector containing mean squared error of `X`. The values must be sorted as the `X`.
`coef`	a vector contains prior initial value of Coefficient of Regression Model for fixed effect with default vector of `0` with the length of the number of regression coefficients.
`var.coef`	a vector contains prior initial value of variance of Coefficient of Regression Model with default vector of `1` with the length of the number of regression coefficients.
`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.
tau.u	prior initial value of inverse of Variance of area random effect with default 1.
burn.in	number of iterations to discard at the beginning with default 2000.
data	the data frame.

Value

This function returns a list with 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 data frame with the estimated model coefficient
plot	Trace, Dencity, Autocorrelation Function Plot of MCMC samples

Examples

```
## Load dataset
data(dataHBME)

## Auxiliary variables only contains variable with error
example <- meHBNormal(Y~x1+x2, vardir = "vardir",
                  var.x = c("v.x1","v.x2"), iter.update = 3, iter.mcmc = 10000,
                  thin = 5, burn.in = 1000, data = dataHBME)

## Auxiliary variables contains variable with error and without error
example_mix <- meHBNormal(Y~x1+x2+x3, vardir = "vardir",
                  var.x = c("v.x1","v.x2"), iter.update = 3, iter.mcmc = 10000,
                  thin = 5, burn.in = 1000, data = dataHBME)

## Create dataset with nonsampled area
dataHBMEns <- dataHBME
dataHBMEns[c(1,10,20,30),"Y"] <- NA

## For data with nonsampled area use dataHBMEns
```

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meHBt *Small Area Estimation with Measurement Error using Hierarchical Bayesian Method under Student-t Distribution*

Description

This function is implemented to variable of interest (y) that assumed to be a Normal Distribution when auxiliary variable is measured with error.

Usage

```
meHBt(
  formula,
  vardir,
  var.x,
  coef,
  var.coef,
  iter.update = 3,
  iter.mcmc = 10000,
  thin = 2,
  tau.u = 1,
  burn.in = 2000,
  data
)
```

Arguments

formula	an object of class formula (or one that can be coerced to that class): a symbolic description of the model to be fitted. The variables included formula must have a length equal to the number of domains m. This formula can provide auxiliary variable either measured with error or combination between measured with error and without error. If the auxiliary variable are combination between error and without error, input the error variable first followed by without error variable.
vardir	vector containing the m sampling variances of direct estimators for each domain. The values must be sorted as the Y.
var.x	vector containing mean squared error of X. The values must be sorted as the X.
coef	a vector contains prior initial value of Coefficient of Regression Model for fixed effect with default vector of 0 with the length of the number of regression coefficients.
var.coef	a vector contains prior initial value of variance of Coefficient of Regression Model with default vector of 1 with the length of the number of regression coefficients.
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.
tau.u	prior initial value of inverse of Variance of area random effect with default 1.
burn.in	number of iterations to discard at the beginning with default 2000.
data	the data frame.

Value

This function returns a list with 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 data frame with the estimated model coefficient
plot	Trace, Dencity, Autocorrelation Function Plot of MCMC samples

Examples

```
## Load dataset
data(dataTMEHB)


## Auxiliary variables only contains variable with error
example <- meHBt(Y~x1, vardir = "vardir",
                  var.x = c("v.x1"), iter.update = 3, iter.mcmc = 10000,
                  thin = 5, burn.in = 1000, data = dataTMEHB)

## Auxiliary variables contains variable with error and without error
example_mix <- meHBt(Y~x1+x2, vardir = "vardir",
                  var.x = c("v.x1"), iter.update = 3, iter.mcmc = 10000,
                  thin = 5, burn.in = 1000, data = dataTMEHB)

## Create dataset with nonsampled area
dataTMEHBns <- dataTMEHB
dataTMEHBns[c(1,10,20,30),"Y"] <- NA

## For data with nonsampled area use dataTMEHBns
```

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saeHB.ME *saeHB.ME: Small Area Estimation with Measurement Error using Hierarchical Bayesian Method*

Description

Implementation of small area estimation using Hierarchical Bayesian (HB) Method when auxiliary variable measured with error. The 'rjags' package is employed to obtain parameter estimates.

Authors

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Functions

meHBNormal Produces HB estimators, standard error, random effect variance, coefficient and plot under normal distribution.

meHBt Produces HB estimators, standard error, random effect variance, coefficient and plot under student-t distribution.

References

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

Ybarra, L.M. and Lohr, S. L. (2008). Small area estimation when auxiliary information is measured with error. Biometrika 95, 919-931 <doi:10.1093/biomet/asn048>.

Ntzoufras, I. (2009), Bayesian Modeling Using WinBUGS. 1st Edn., Wiley, New Jersey, ISBN-10: 1118210352.

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