

# Package ‘saeHB.ME.beta’

July 23, 2025

**Title** SAE with Measurement Error using HB under Beta Distribution

**Version** 1.1.0

**Description** Implementation of Small Area Estimation (SAE) using Hierarchical Bayesian (HB) Method when auxiliary variable measured with error under Beta Distribution. The 'rjags' package is employed to obtain parameter estimates. For the references, see J.N.K & Molina (2015) <doi:10.1002/9781118735855>, Ybarra and Sharon (2008) <doi:10.1093/biomet/asn048>, zoufras (2009, ISBN-10: 1118210352).

**License** GPL-3

**Encoding** UTF-8

**RoxygenNote** 7.2.3

**URL** <https://github.com/ratihrodliyah/saeHB.ME.beta>

**BugReports** <https://github.com/ratihrodliyah/saeHB.ME.beta/issues>

**NeedsCompilation** no

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

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

**Config/testthat/edition** 3

**Depends** R (>= 3.5.0)

**LazyData** true

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**VignetteBuilder** R.rsp, knitr

**Repository** CRAN

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dataHBMEbeta	<i>Sample Data for Small Area Estimation with Measurement Error using Hierarchical Bayesian Method under Beta Distribution</i>
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**Description**

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

1. Generate  $x_1 \sim \text{UNIF}(0, 1)$ ,  $x_2 \sim \text{UNIF}(0, 1)$ ,  $x_3 \sim \text{UNIF}(0, 1)$ , and  $x_4 \sim \text{UNIF}(0, 1)$
2. Generate  $v.x_1 \sim \text{Gamma}(2,1)$  and  $v.x_2 \sim \text{Gamma}(2,5)$
3. Generate  $x_{1h} \sim \text{N}(x_1, \text{sqrt}(v.x_1))$  and  $x_{2h} \sim \text{N}(x_2, \text{sqrt}(v.x_2))$
4. Set Coefficient  $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0, 5$
5. Generate  $u \sim \text{N}(0,1)$  and  $\pi \sim \text{Gamma}(1,0.5)$

6. Calculate

$$\mu = \frac{\beta_0 + \beta_1 * x_{1h} + \beta_2 * x_{2h} + \beta_3 * x_3 + \beta_4 * x_4 + u}{\beta_0 + \beta_1 * x_{1h} + \beta_2 * x_{2h} + \beta_3 * x_3 + \beta_4 * x_4 + u}$$

7. Calculate  $A = \mu\pi$  and  $B = (1-\mu)\pi$
8. Generate  $Y \sim \text{UNIF}(A,B)$
9. Calculate Mean of Variable Y with

$$E(Y) = \frac{A}{A + B}$$

10. Calculate Variance of Variable Y with

$$\text{Var}(Y) = \frac{AB}{(A + B + 1)(A + B)^2}$$

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 dataHBMEbeta.

**Usage**

```
data(dataHBMEbeta)
```

**Format**

A data frame with 30 rows and 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.

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dataHBMEbetaNS	<i>Sample Data for Small Area Estimation with Measurement Error using Hierarchical Bayesian Method under Beta Distribution with Non-sampled Area</i>
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### Description

This data to simulate Small Area Estimation using Hierarchical Bayesian Method with Measurement Error under Beta Distribution with non-sampled areas

This data contains NA values that indicates no sampled at one or more small areas. It uses the [dataHBMEbeta](#) with the direct estimates and the related variances in 5 small areas are missing.

### Usage

```
data(dataHBMEbetaNS)
```

### Format

A data frame with 30 rows and 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.

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meHBbeta	<i>Small Area Estimation with Measurement Error using Hierarchical Bayesian Method under Beta Distribution</i>
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### Description

This function is implemented to variable of interest ( $Y$ ) that assumed to be a Beta Distribution when auxiliary variable is measured with error. The range of data must be  $0 < Y < 1$ . The data proportion is supposed to be implemented with this function.

**Usage**

```
meHBbeta(
  formula,
  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 <code>formula</code> (or one that can be coerced to that class): a symbolic description of the model to be fitted. The variables included in <code>formula</code> must have a length equal to the number of domains <code>m</code> . 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.
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	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

```
## it may take time
## Load dataset
data(dataHBMEbeta)

## Auxiliary variables only contains variable with error in aux variable
example <- meHBbeta(Y~x1+x2, var.x = c("v.x1", "v.x2"),
                    iter.update = 3, iter.mcmc = 1010,
                    thin = 1, burn.in = 1000, data = dataHBMEbeta)

## you can use dataHBMEbetaNS for using dataset with non-sampled area
## and you can use this function for aux variables contains variable with error and without error
```

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saeHB.ME.beta	<i>saeHB.ME.beta: Small Area Estimation with Measurement Error using Hierarchical Bayesian Method under Beta Distribution</i>
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## Description

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

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## Functions

`meHBbeta` Produces HB estimators, standard error, random effect variance, coefficient and plot under beta distribution.

## References

- Rao, J.N.K & Molina. (2015). Small Area Estimation 2nd Edition. New York: John Wiley and Sons, Inc [doi:10.1002/9781118735855](https://doi.org/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](https://doi.org/10.1093/biomet/asn048).
- Ntzoufras, I. (2009), *Bayesian Modeling Using WinBUGS*. 1st Edn., Wiley, New Jersey, ISBN-10: 1118210352.

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