Package ‘saeHB.zinb’

October 14, 2022

Type Package

Title Small Area Estimation using Hierarchical Bayesian under Zero Inflated Negative Binomial Distribution

Version 0.1.1

Author Azka Ubaidillah [aut], Hayun [aut, cre]

Maintainer Hayun <221810327@stis.ac.id>

Description We designed this package to provide a function for area level of small area estimation using Hierarchical Bayesian (HB) method under Zero Inflated Negative Binomial Distribution. This package provides model using Univariate Zero Inflated Negative Binomial Distribution for variable of 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, and the quantile. For the reference, see Rao,J.N.K & Molina (2015) <doi:10.1002/9781118735855>.

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 7.2.0

URL https://github.com/hayunbuto/saeHB.zinb

BugReports https://github.com/hayunbuto/saeHB.zinb/issues

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

Suggests saeHB, knitr, rmarkdown

VignetteBuilder knitr

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

Depends R (>= 2.10)

NeedsCompilation no

Repository CRAN

Date/Publication 2022-06-16 06:30:02 UTC

R topics documented:

`dataZINB` *Synthetics Data for Small Area Estimation using Hierarchical Bayesian Method under Zero Inflated Negative Binomial*

Description

Datasets to simulate Small Area Estimation using Hierarchical Bayesian Method under Zero Inflated Negative Binomial.

This data is generated by these following steps:

1. Generate sampling random area effect `u` and `v` with `u` ~ `N(0,1)` and `v` ~ `N(0,1)`.
2. The auxiliary variables are generated by uniform and bernoulli distribution with `x1` ~ `U(0,1)` and `x2` ~ `B(1,0.6)`.
3. The coefficient parameters $\beta_0, \beta_1, \beta_2, \gamma_0, \gamma_1, and \gamma_2$ are set with a certain values. For the reference, see Desjardins, C.D. (2013).
4. Calculate π = $exp(\gamma_0 + x_1\gamma_1 + x_2\gamma_2 + u)$ / $1 + exp(\gamma_0 + x_1\gamma_1 + x_2\gamma_2 + u)$
5. Calculate μ = $exp(\beta_0 + x_1\beta_1 + x_2\beta_2 + v)$
6. Generate direct estimate with `y` ~ `rzinegbin` (μ, π, r), we set r = 2. Using `library(VGAM)`
7. Calculate the variance of `y` with `var(y)` = μ * (1 - π) * (1 + (μ / r) + (μ * π))
8. Auxiliary variables `x1,x2`, direct estimation `y` and `vardir` are combined in a dataframe called `dataZINB`

Usage

```
data(dataZINB)
```

Format

A data frame with 50 rows and 4 variables::

y Direct Estimation of y

x1 Auxiliary variable of x1

x2 Auxiliary variable of x2

vardir Sampling Variance of y

dataZINBNS — *Synthetics Data for Small Area Estimation using Hierarchical Bayesian Method under Zero Inflated Negative Binomial Distribution with non-sampled areas*

Description

Dataset to simulate Small Area Estimation using Hierarchical Bayesian Method under Zero Inflated Negative Binomial Distribution with non-sampled areas

This data contains `NA` values that indicates no sampled at one or more small areas. It uses the `dataZINB` with the direct estimates and the related variances in 5 small areas are missing.

Usage

```
data(dataZINBNS)
```

Format

A data frame with 50 rows and 4 variables::

y Direct Estimation of y

x1 Auxiliary variable of x1

x2 Auxiliary variable of x2

vardir Sampling Variance of y

saeHB.zinb — *saeHB.zinb : Small Area Estimation under Zero Inflated Negative Binomial Model using Hierarchical Bayesian Method*

Description

Provides function and datasets for area level of Small Area Estimation under Zero Inflated Negative Binomial Model using Hierarchical Bayesian (HB) Method with Univariate Zero Inflated Negative Binomial Distribution for variable of interest. The 'rjags' package is employed to obtain parameter estimates. Model-based estimators involves the HB estimators which include the mean, the variation of mean, and the quantile of mean. For the reference, see Rao, J.N.K & Molina (2015).

Author(s)

Hayun, Azka Ubaidillah

Maintaner: Hayun `<221810327@stis.ac.id>`

Functions

`ZinbHB` This function gives small area estimator under Zero Inflated Negative Binomial Model and is implemented to variable of interest (y) that assumed to be a Zero Inflated Negative Binomial Distribution. The range of data is $(y >= 0)$

Reference

- Desjardins, C. D. (2013). Evaluating the performance of two competing models of school suspension under simulation the zero-inflated negative binomial and the negative binomial hurdle (thesis). Minnesota (US): Minnesota University. <purl.umn.edu/152995>
- Emille E. O. Ishida, Joseph M. Hilbe, and Rafael S. de Souza (2017). Bayesian Models for Astrophysical Data: Using R, JAGS, Python, and Stan. Cambridge : Cambridge University Press. <bayesianmodelsforastrophysicaldata.com>
- Garray, A. M., Hashimoto, E. M., Ortega, E. M. M., dan Lachos, V. H. (2011). On Estimation and Influence Diagnostics For Zero Inflated Negative Binomial Regression Models. Computational Statistics and Data Analysis, 55 (3), p.1304-1318. <doi.org/10.1016/j.csda.2010.09.019>
- Hilbe, J. M. (2011). Negative Binomial Regression 2nd Edition. New York : Cambridge University Press. <doi.org/10.1017/CBO9780511973420>
- Nadhiroh, I. M. (2009). Zero-Inflated Negative Binomial Models in Small Area Estimation. Bogor: Bogor Agricultural University.
- Ntzoufras, I. (2009). Bayesian Modelling Using WinBUGS. New Jersey : John Wiley & Sons, Inc. <doi.org/10.1002/9780470434567>
- Rao, J.N.K & Molina. (2015). Small Area Estimation 2nd Edition. New York: John Wiley and Sons, Inc. <doi.org/10.1002/9781118735855>
- S. Krieg, H. J. Boonstra, and M. Smeets. (2016). Small-area estimation with zero-inflated data – a simulation study. J. Off. Stat., vol. 32, no. 4, pp. 963–986, 2016. <doi.org/10.1515/jos-2016-0051>

`ZinbHB` *Small Area Estimation using Hierarchical Bayesian under Zero Inflated Negative Binomial Distribution*

Description

This function is implemented to variable of interest (y) that assumed to be a Zero Inflated Negative Binomial Distribution. The range of data is $(y >= 0)$. This model can be used to handle overdispersion and excess zero in data.

Usage

```
ZinbHB(
  formula,
  iter.update = 3,
  iter.mcmc = 1100,
```

```
  coef.nonzero,
  coef.zero,
  var.coef.nonzero,
  var.coef.zero,
  thin = 1,
  burn.in = 600,
  tau.u = 1,
  tau.v = 1,
  data
)
```

Arguments

`formula` Formula that describe the fitted model

`iter.update` Number of updates with default `3`

`iter.mcmc` Number of total iterations per chain with default `1100`

`coef.nonzero` Optional vector containing initial values `mu.b` for the mean of the prior distribution of the log model coefficients (β) with default `rep(0,nvar)`

`coef.zero` Optional vector containing initial values `mu.g` for the mean of the prior distribution of the logit model coefficients (γ) with default `rep(0,nvar)`

`var.coef.nonzero` Optional vector containing initial values `tau.b` for the variance of the prior distribution on the log model coefficients (β) with default `rep(1,nvar)`

`var.coef.zero` Optional vector containing initial values `tau.g` for the variance of the prior distribution of the logit model coefficients (γ) with default `rep(1,nvar)`

`thin` Thinning rate, must be a positive integer with default `1`

`burn.in` Number of iterations to discard at the beginning with default `600`

`tau.u` Variance of random effect area for non-zero count of variable interest with default `1`

`tau.v` Variance of random effect area for zero count of variable interest with default `1`

`data` The data frame

Value

This function returns a list of the following objects:

`Est` A dataframe that contains the values, standar deviation, and quantile of Small Area mean Estimates using Hierarchical bayesian method

`refVar` Estimated random effect variances

`coefficient` A data frame with the estimated model coefficient consist of `beta` (coefficient in the log model) and `gamma` (coefficient in the logit model)

`plot.beta` Trace, Density, Autocorrelation Function Plot of MCMC samples `beta`

`plot.gamma` Trace, Density, Autocorrelation Function Plot of MCMC samples `gamma`

Examples

```
## Compute Fitted Model
## y ~ x1 +x2, nvar = 3

## For data without any nonsampled area
## Load Dataset
data(dataZINB)
result <- ZinbHB(formula = y ~ x1 + x2, data = dataZINB)

## Result
result$Est                             # Small Area mean Estimates
result$refVar                          # refVar
result$coefficient                     # coefficient


# Load library 'coda' to execute the plot
# autocorr.plot(result$plot.beta[[3]])  # Generate ACF Plot beta
# plot(result$plot.beta[[3]])           # Generate Dencity and Trace plot beta
# autocorr.plot(result$plot.gamma[[3]]) # Generate ACF Plot gamma
# plot(result$plot.gamma[[3]])          # Generate Dencity and trace plot gamma


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

Index