Package ‘saeHB.ZIB’

Type Package
Title Small Area Estimation using Hierarchical Bayesian under Zero Inflated Binomial Distribution
Version 0.1.1
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Description Provides function for area level of small area estimation using hierarchical Bayesian (HB) method with Zero-Inflated Binomial distribution for variables of interest. Some dataset produced by a data generation are also provided. 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.
License GPL-3
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LazyData true
RoxygenNote 7.1.2
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VignetteBuilder knitr
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R topics documented:

dataZIB ................................................................. 2
dataZIBns .............................................................. 3
ziBinomial .............................................................. 3

Index 6
Sample Data for Small Area Estimation using Hierarchical Bayesian Method under Zero-Inflated Binomial Distribution

Description

Dataset to simulate Small Area Estimation using Hierarchical Bayesian Method under Zero-Inflated Binomial distribution

This data is generated by these following steps:

1. Generate sampling random area effect u.Z and u.nZ with \((u.Z \sim N(0, 1))\) and \((u.nZ \sim N(0, 1))\).
   The auxiliary variables are generated by Uniform distribution with \((x1 \sim U(0, 1))\) and \((x2 \sim U(1, 5))\).
   The coefficient parameters \(\alpha_0, \alpha_1, \alpha_2, \beta_0, \beta_1, \beta_2\) are set as 0.
2. Calculate \(\logit(p) = \alpha_0 + \alpha_1 * x1 + \alpha_2 * x2 + u.Z\) and \(\logit(\pi) = \beta_0 + \beta_1 * x1 + \beta_2 * x2 + u.nZ\)
3. Generate number of sample with \(n.samp \sim U(10, 30)\)
4. Generate \(delta \sim \text{Bernoulli}(p)\) and \(y\_tar \sim \text{Binomial}(s, \pi)\)
5. calculate \(y = delta * y\_tar\)
6. Calculate variance of direct estimates (vardir) with \(\text{var}(y) = (1 - p) * s * pi * (1 - \pi * (1 - p * s))\)
7. Auxiliary variables x1, x2, direct estimation (y), vardir, and s are combined in a dataframe called dataZIB

Usage

data(dataZIB)

Format

A data frame with 64 observations on the following 4 variables:

- y Direct Estimation of y
- X1 Auxiliary variable of x1
- X2 Auxiliary variable of x2
- vardir sampling variance of y
- s number of sample
**dataZIBns**

Sample Data for Small Area Estimation using Hierarchical Bayesian Method under Zero-Inflated Binomial Distribution

**Description**

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

This data contains NA values that indicates no sampled at one or more small areas. It uses the dataZIB.ns with the direct estimates and the related variances in 3 small areas are missing.

**Usage**

data(dataZIBns)

**Format**

A data frame with 30 rows and 4 variables:

- **y** Direct Estimation of y
- **X1** Auxiliary variable of x1
- **X2** Auxiliary variable of x2
- **vardir** sampling variance of y
- **s** number of sample

**ziBinomial**

Small Area Estimation using Hierarchical Bayesian under Zero Inflated Binomial Distribution

**Description**

This function is implemented to variable of interest (y) that assumed to be a Zero Inflated Binomial Distribution. The range of data is \(0 < y < \infty\). This model can be used to handle overdispersion caused by excess zero in data.

**Usage**

ziBinomial(
    formula,
    n.samp,
    iter.update = 3,
    iter.mcmc = 10000,
    coef.nonzero,
    var.coef.nonzero,
)
ziBinomial(coef.zero, var.coef.zero, thin = 2, burn.in = 2000, tau.u.nZ = 1, data)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>formula</td>
<td>Formula that describe the fitted model</td>
</tr>
<tr>
<td>n.samp</td>
<td>Number of sample in each area</td>
</tr>
<tr>
<td>iter.update</td>
<td>Number of updates with default 3</td>
</tr>
<tr>
<td>iter.mcmc</td>
<td>Number of total iterations per chain with default 2000</td>
</tr>
<tr>
<td>coef.nonzero</td>
<td>Optional argument for mean on coefficient’s prior distribution or ( \beta )'s prior distribution which value is non-zero</td>
</tr>
<tr>
<td>var.coef.nonzero</td>
<td>Optional argument for the variances of the prior distribution of the model coefficients (( \beta ))</td>
</tr>
<tr>
<td>coef.zero</td>
<td>Optional argument for mean on coefficient’s prior distribution or ( \alpha )'s prior distribution which value is non-zero</td>
</tr>
<tr>
<td>var.coef.zero</td>
<td>Optional argument for the variances of the prior distribution of the model coefficients (( \alpha ))</td>
</tr>
<tr>
<td>thin</td>
<td>Thinning rate, must be a positive integer with default 1</td>
</tr>
<tr>
<td>burn.in</td>
<td>Number of iterations to discard at the beginning with default 1000</td>
</tr>
<tr>
<td>tau.u.nZ</td>
<td>Variance of random effect area for non-zero of variable interest (( y )) with default 1</td>
</tr>
<tr>
<td>data</td>
<td>The data frame</td>
</tr>
</tbody>
</table>

Value

This function returns a list of the following objects:

<table>
<thead>
<tr>
<th>Object</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Est</td>
<td>A vector with the values of Small Area mean Estimates using Hierarchical bayesian method</td>
</tr>
<tr>
<td>refVar</td>
<td>Estimated random effect variances</td>
</tr>
<tr>
<td>coefficient</td>
<td>A data frame with the estimated model coefficient</td>
</tr>
<tr>
<td>plot_alpha</td>
<td>Trace, Density, Autocorrelation Function Plot of MCMC samples</td>
</tr>
<tr>
<td>plot_beta</td>
<td>Trace, Density, Autocorrelation Function Plot of MCMC samples</td>
</tr>
</tbody>
</table>
Examples

# Compute fitted model

\[ y \sim X_1 + X_2 \]

# For data without any nonsampled area

# Load dataset

data(dataZIB)
saeHB.ZIB <- ziBinomial(formula = y~X1+X2, "s", iter.update=3, iter.mcmc = 1000, burn.in = 200, data = dataZIB)

# the setting of iter.update, iter.mcmc, and burn.in in this example
# is considered to make the example execution time be faster.

# Result
saeHB.ZIB$Est # Small Area mean Estimates
saeHB.ZIB$Est$SD # Standard deviation of Small Area Mean Estimates
saeHB.ZIB$refVar # refVar
saeHB.ZIB$coefficient # coefficient

# Load library 'coda' to execute the plot
# \texttt{autocorr.plot(saeHB.ZIB$plot\_alpha[[3]])} is used to \texttt{ACF Plot for alpha}
# \texttt{autocorr.plot(saeHB.ZIB$plot\_beta[[3]])} is used to \texttt{ACF Plot for beta}
# \texttt{plot(saeHB.ZIB$plot\_alpha[[3]])} is used to \texttt{Density and trace plot for alpha}
# \texttt{plot(saeHB.ZIB$plot\_beta[[3]])} is used to \texttt{Density and trace plot for beta}
Index

* datasets
  dataZIB, 2
  dataZIBns, 3

dataZIB, 2
dataZIBns, 3
ziBimonial, 3