

Package ‘saeeb’

October 14, 2022

Type Package

Title Small Area Estimation for Count Data

Version 0.1.0

Depends R (>= 2.10)

Imports COUNT (>= 1.3.4), MASS, stats

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Description Provides small area estimation for count data type and gives option whether to use covariates in the estimation or not. By implementing Empirical Bayes (EB) Poisson-Gamma model, each function returns EB estimators and mean squared error (MSE) estimators for each area. The EB estimators without covariates are obtained using the model proposed by Clayton & Kaldor (1987) <[doi:10.2307/2532003](https://doi.org/10.2307/2532003)>, the EB estimators with covariates are obtained using the model proposed by Wakefield (2006) <[doi:10.1093/biostatistics/kx1008](https://doi.org/10.1093/biostatistics/kx1008)> and the MSE estimators are obtained using Jackknife method by Jiang et. al. (2002) <[doi:10.1214/aos/1043351257](https://doi.org/10.1214/aos/1043351257)>.

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Encoding UTF-8

LazyData true

RoxygenNote 7.1.0

NeedsCompilation no

Repository CRAN

Date/Publication 2020-04-28 09:50:03 UTC

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 ebcov

EB Poisson-Gamma with Covariates

Description

This function gives the area level EB and MSE estimator based on Wakefield (2006) model and the refinement model by Kismiantini (2007).

Usage

```
ebcov(formula, data, e)
```

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 details of model specification are given under 'Details'.
data	a mandatory data frame containing the variables in formula and e.
e	a variable that contains the expected numbers of cases in each area.

Details

A typical model has the form $\text{response} \sim \text{terms}$ where the response is a vector with numeric data type and terms is a set(s) of auxiliary variables.

A formula has an implied intercept term. To remove this use either $y \sim x - 1$ or $y \sim 0 + x$. See [formula](#) for more details of allowed formulae.

The formula only accomodates variables with count data type and will be modeled using binomial negatif linear regression.

Value

The function returns a list with the following objects:

EB data frame with number of rows equal to number of areas containing the EB estimator. For domains with zero sample size, the EB estimators are based on the synthetic regression.

Parameter • alpha: the scale parameter estimator in Gamma distribution

• v: the shape parameter estimator in Gamma distribution

fit • Estimate: maximum likelihood estimator of the model parameters

• SE: asymptotic estimate of the standard error of the the parameters

• Z: the Z statistic of the asymptotic hypothesis test that the population value for the parameter is 0

• LCL: lower 95% confidence interval for the parameter estimators

• UCL: upper 95% confidence interval for the parameter estimators

MSE.EB • method: Jackknife

• mse: the mean squared error estimator of the EB estimators

direct • est: direct estimators for the response variable

• mse: the mean squared error estimator of the direct estimators

See Also

[ml.nb2](#), [glm.nb](#),

Examples

```
#Load dataset
data(lip)

#Save output as an object
results <- ebncov(Y ~ AFF, lip, E)
results
```

 ebncov

EB Poisson-Gamma without Covariates

Description

This function gives the area level EB and MSE estimator based on Clayton & Kaldor (1987).

Usage

```
ebnocov(y, data, e)
```

Arguments

y	a response variable contains the numbers of cases in each area.
data	a mandatory data frame containing the y and e variables.
e	a variable that contains the expected numbers of cases in each area.

Details

This function only accomodates variables with count data type.

Value

The function returns a list with the following objects:

EB data frame with number of rows equal to number of areas containing the EB estimator. For domains with zero sample size, the EB estimators are based on the synthetic regression.

Parameters

- alpha: the scale estimator in Gamma distribution
- v: the shape parameter estimator in Gamma distribution

MSE.EB

- method: Jackknife
- mse: the mean squared error estimator of the EB estimators

direct

- est: direct estimators for the response variable
- mse: the mean squared error estimator of the direct estimators

Examples

```
#Load dataset
data(lip)

#Save output as an object
results <- ebnocov(Y, lip, E)
results
```

lip	<i>Lip Cancer in Scotland</i>
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Description

This dataset sets out observed and "expected" cases of lip cancer registered during the 6 years from 1975 to 1980 in each of the 56 counties of Scotland. These are the districts prior to the 1995 reorganization of local government. The dataset includes district names and identifying numbers and for district i with $i = 1, \dots, 56$: the number of observed cases Y_i ; the number of expected cases E_i ; and the value of a single covariate (percent of population employed in agriculture, fishing and forestry).

Usage

```
lip
```

Format

A data frame with 56 rows and 5 variables:

ID The district identifying number.

district.name The district name.

Y The number of observed lip cancer cases.

E The number of expected lip cancer cases.

AFF The percentage of population employed in agriculture, fishing and forestry.

Description

This package provides functions for small area estimation using Empirical Bayes (EB) Poisson-Gamma model. This model only accomodates count data type and gives option whether to use covariates in the estimation or not. Each function returns EB estimators and mean squared error (MSE) estimators for each area. The EB estimators are obtained using the model proposed by Wakefield (2006) and refined by Kismiantini (2007) and the MSE estimators are obtained using Jackknife method by Jiang et. al. (2002).

Functions

`ebcov` Gives the EB Poisson-Gamma with covariates and the Jackknife MSE estimators.

`ebnocov` Gives the EB Poisson-Gamma without covariates and the Jackknife MSE estimators.

Author(s)

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References

- Clayton, David & Kaldor, John. (1987). *Empirical Bayes Estimates of Age-Standardized Relative Risks for Use in Disease Mapping*. *Biometrics*, 43, 671-681.
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- Rao, J. N. K. & Molina, Isabel. (2015). *Small Area Estimation* (2nd ed.). New Jersey: John Wiley & Sons, Inc.
- Wakefield, Jon. (2006). *Disease Mapping and Spatial Regression with Count Data*. *Biostatistics*, 8, 2, 158–183. doi:10.1093/biostatistics/kxl008.

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