Package ‘saeME’

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Title Small Area Estimation with Measurement Error

Type Package

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Description A set of functions and datasets implementation of small area estimation when auxiliary variable is measured with error. These functions provide a empirical best linear unbiased prediction (EBLUP) estimator and mean squared error (MSE) estimator of the EBLUP. These models were developed by Ybarra and Lohr (2008) <doi:10.1093/biomet/asn048>.

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R topics documented:

dataME *dataME*

Description

This data generated by simulation based on Fay-Herriot with Measurement Error Model by following these steps:

1. Generate x_i from a UNIF(5, 10) distribution, ψ_i = 3, c_i = 0.25, and σ_v^2 = 2.
2. Generate u_i from a N(0, c_i) distribution, e_i from a N(0, ψ_i) distribution, and v_i from a N(0, σ_v^2) distribution.
3. Generate $\hat{x}_i$ = x_i + u_i.
4. Then for each iteration, we generated $Y_i = 2 + 0.5\hat{x}_i + v_i$ and $y_i = Y_i + e_i$.

Direct estimator `y`, auxiliary variable $\hat{x}$, sampling variance ψ, and c are arranged in a dataframe called `dataME`.

Usage

```
data(dataME)
```

Format

A data frame with 100 observations on the following 4 variables.

`small_area` areas of interest.

`y` direct estimator for each domain.

`x.hat` auxiliary variable for each domain.

`vardir` sampling variances for each domain.

`var.x` mean squared error of auxiliary variable and sorted as `x.hat`

datamix *datamix*

Description

This data generated by simulation based on Fay-Herriot with Measurement Error Model by following these steps:

1. Generate x_{1i} from a UNIF(5, 10) distribution, x_{2i} from a UNIF(9, 11) distribution, ψ_i = 3, c_{1i} = c_{2i} = 0.25, and σ_v^2 = 2.
2. Generate u_{1i} from a N(0, c_{1i}) distribution, u_{2i} from a N(0, c_{2i}) distribution, e_i from a N(0, ψ_i) distribution, and v_i from a N(0, σ_v^2) distribution.
3. Generate x_{3i} from a UNIF(1, 5) distribution and x_{4i} from a UNIF(10, 14) distribution.

4. Generate $\hat{x}_{1i} = x_{1i} + u_{1i}$ and $\hat{x}_{2i} = x_{2i} + u_{2i}$.
5. Then for each iteration, we generated $Y_i = 2 + 0.5\hat{x}_{1i} + 0.5\hat{x}_{2i} + 2x_{3i} + 0.5x_{4i} + v_i$ and $y_i = Y_i + e_i$.

This data contain combination between auxiliary variable measured with error and without error. Direct estimator `y`, auxiliary variable $\hat{x}_1$ $\hat{x}_2$ x_3 x_4, sampling variance ψ, and $c_1 c_2$ are arranged in a dataframe called `datamix`.

Usage

```
data(datamix)
```

Format

A data frame with 100 observations on the following 8 variables.

`small_area` areas of interest.

`y` direct estimator for each domain.

`x.hat1` auxiliary variable (measured with error) for each domain.

`x.hat2` auxiliary variable (measured with error) for each domain.

`x3` auxiliary variable (measured without error) for each domain.

`x4` auxiliary variable (measured without error) for each domain.

`vardir` sampling variances for each domain.

`var.x1` mean squared error of auxiliary variable and sorted as `x.hat1`

`var.x2` mean squared error of auxiliary variable and sorted as `x.hat2`

`FHme` *Fay-Herriot Model with Measurement Error*

Description

This function gives the EBLUP estimator based on Fay-Herriot model with measurement error.

Usage

```
FHme(
  formula,
  vardir,
  var.x,
  type.x = "witherror",
  MAXITER = 1000,
  PRECISION = 1e-04,
  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 without error or combination between them. If the auxiliary variable are combination between noerror and witherror variable, input all witherror variable first then noerror 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. if you use optional data, input this parameter use c(""), example: var.x = c("c1") or var.x = c("c1","c2").

type.x
: type of auxiliary variable used in the model. Either source measured with noerror, witherror and mix. Default value is witherror.

MAXITER
: maximum number of iterations allowed. Default value is 1000 iterations.

PRECISION
: convergence tolerance limit. Default value is 0.0001.

data
: optional data frame containing the variables named in formula, vardir, and var.x.

Details

A formula has an implied intercept term. To remove this use either y ~ x - 1 or y ~ 0 + x. See formula for more details of allowed formulae.

Value

The function returns a list with the following objects:

eblup vector with the values of the estimators for the domains.

fit a list containing the following objects:

- method : type of fitting method.
- convergence : a logical value of convergence when calculating estimated beta and estimated random effects.
- iterations : number of iterations when calculating estimated beta and estimated random effects.
- estcoef : a data frame with the estimated model coefficient (beta) in the first column, their standard error (std.error) in the second column, the t-statistics (t.statistics) in the third column, and the p-values of the significance of each coefficient (pvalue) in the last column.
- refvar : a value of estimated random effects.
- gamma : vector with values of the estimated gamma for each domains.

See Also

mse_FHme

Examples

```
data(dataME)
data(datamix)
sae.me <- FHme(formula = y ~ x.hat, vardir = vardir, var.x = c("var.x"), data = dataME)
sae.mix <- FHme(formula = y ~ x.hat1 + x.hat2 + x3 + x4,
         vardir = vardir, var.x = c("var.x1", "var.x2"), type.x = "mix", data = datamix)
```

`mse_FHme` *Mean Squared Error Estimator of the EBLUP under a Fay-Herriot Model with Measurement Error*

Description

This function gives the mean squared error estimator of the EBLUP based on Fay-Herriot model with measurement error using jackknife method.

Usage

```
mse_FHme(
  formula,
  vardir,
  var.x,
  type.x = "witherror",
  MAXITER = 1000,
  PRECISION = 1e-04,
  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 without error or combination between them. If the auxiliary variable are combination between `noerror` and `witherror` variable, input all `witherror` variable first then `noerror` 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`. if you use optional `data`, input this parameter use `c("")`, example: `var.x = c("c1")` or `var.x = c("c1","c2")`.
`type.x`	type of auxiliary variable used in the model. Either source measured with `noerror`, `witherror` and `mix`. Default value is `witherror`.
`MAXITER`	maximum number of iterations allowed. Default value is `1000` iterations.
`PRECISION`	convergence tolerance limit. Default value is `0.0001`.
`data`	optional data frame containing the variables named in formula, vardir, and var.x.

Details

A formula has an implied intercept term. To remove this use either y ~ x - 1 or y ~ 0 + x. See `formula` for more details of allowed formulae.

Value

The function returns a list with the following objects:

`mse` vector with the values of the mean squared errors of the EBLUPs for each domain.

Examples

```
data(dataME)
data(datamix)

mse.sae.me <- mse_FHme(formula = y ~ x.hat, vardir = vardir, var.x = c("var.x"), data = dataME)
mse.sae.mix <- mse_FHme(formula = y ~ x.hat1 + x.hat2 + x3 + x4,
              vardir = vardir, var.x = c("var.x1", "var.x2"), type.x = "mix", data = datamix)
```

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saeME *saeME: Small Area Estimation with Measurement Error*

Description

The sae with measurement error provides function for small area estimation when auxiliary variable is measured with error, and function for mean squared error estimation using jackknife method. This package implement model of Fay Herriot with Measurement Error developed by Ybarra and Lohr (2008).

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Functions

`FHme` Gives the EBLUP for each domain based on Fay-Herriot with measurement error model.

`mse_FHme` Gives the MSE for each domain using the jackknife method.

References

Ybarra, L.M. and Lohr, S. L. (2008). Small area estimation when auxiliary information is measured with error. Biometrika 95, 919-931.

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