Package 'NSAE'

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Type Package

Title Nonstationary Small Area Estimation

Version 0.1.1

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Description Executes spatial nonstationary Fay-Herriot models for small area estimation.The empirical best linear unbiased predictor (EBLUP) under stationary and nonstationary Fay-Herriot models along with the mean squared error estimation are included. EBLUP for prediction of non-sample area is also included under both stationary and nonstationary Fay-Herriot models. This extension to the Fay-Herriot model that accounts for the presence of spatial nonstationarity was developed by Hukum Chandra, Nicola Salvati and Ray Chambers (2015) <doi:10.1093/jssam/smu026>. This package is dedicated to the memory of Dr. Hukum Chandra who passed away while the package creation was in progress.

License GPL-3

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R topics documented:

`eblupFH1` *EBLUP under stationary Fay-Herriot model for sample area*

Description

This function gives the EBLUP and the estimate of mean squared error (mse) based on a stationary Fay-Herriot model for sample area.

Usage

```
eblupFH1(formula, vardir, method = "REML", data)
```

Arguments

`formula`	an object of class list of formula, describe the model to be fitted
`vardir`	a vector of sampling variances of direct estimators for each small area
`method`	type of fitting method, default is "REML" method
`data`	a data frame comprising the variables named in formula and vardir

Value

The function returns a list with the following objects:

eblup a vector with the values of the estimators for each small area

mse a vector of the mean squared error estimates for each small area

sample a matrix consist of area code, eblup, mse, standard error (SE) and coefficient of variation (CV)

fit a list containing the following objects:

- estcoef : a data frame with the estimated model coefficients in the first column (beta), their asymptotic standard errors in the second column (std.error), the t statistics in the third column (tvalue) and the p-values of the significance of each coefficient in last column (pvalue)
- refvar : estimated random effects variance
- randomeffect : a data frame with the values of the random effect estimators

Examples

```
# Load data set
data(paddysample)
# Fit Fay-Herriot model using sample part of paddy data
result <- eblupFH1(y ~ x1+x2, var, method="REML", data = paddysample)
result
```

`eblupFH2` *EBLUP under stationary Fay-Herriot model for sample and non-sample area*

Description

This function gives the EBLUP and the estimate of mean squared error (mse) based on a stationary Fay-Herriot model for both sample and non-sample area.

Usage

```
eblupFH2(formula, vardir, indicator, method = "REML", data)
```

Arguments

`formula`	an object of class list of formula, describe the model to be fitted
`vardir`	a vector of sampling variances of direct estimators for each small area
`indicator`	a vector indicating the sample and non-sample area
`method`	type of fitting method, default is "REML" methods
`data`	a data frame comprising the variables named in formula and vardir

Value

The function returns a list with the following objects:

eblup a vector with the values of the estimators for each sample area

eblup.out a vector with the values of the estimators for each non-sample area

mse a vector of the mean squared error estimates for each sample area

mse.out a vector of the mean squared error estimates for each non-sample area

sample a matrix consist of area code, eblup, mse, SE and CV for sample area

nonsample a matrix consist of area code, eblup, mse, SE and CV for non-sample area

fit a list containing the following objects:

- estcoef : a data frame with the estimated model coefficients in the first column (beta),their asymptotic standard errors in the second column (std.error), the t statistics in the third column (tvalue) and the p-values of the significance of each coefficient in last column (pvalue)
- refvar : estimated random effects variance
- randomeffect : a data frame with the values of the random effect estimators

Examples

```
# Load data set
data(paddy)
# Fit Fay-Herriot model using sample and non-sample part of paddy data
result <- eblupFH2(y ~ x1+x2, var, indicator ,method="REML", data = paddy)
result
```

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eblupNSFH1 *EBLUP under nonstationary Fay-Herriot model for sample area*

Description

This function gives the EBLUP and the estimate of mean squared error (mse) based on a nonstationary Fay-Herriot model for sample area.

Usage

```
eblupNSFH1(formula, vardir, lat, long, method = "REML", data)
```

Arguments

formula	an object of class list of formula, describe the model to be fitted
vardir	a vector of sampling variances of direct estimators for each small area
lat	a vector of latitude for each small area
long	a vector of longitude for each small area
method	type of fitting method, default is "REML" methods
data	a data frame comprising the variables named in formula, vardir, lat and long

Value

The function returns a list with the following objects:

eblup a vector with the values of the estimators for each small area

mse a vector of the mean squared error estimates for each small area

sample a matrix consist of area code, eblup, mse, SE and CV

fit a list containing the following objects:

- estcoef : a data frame with the estimated model coefficients in the first column (beta),their asymptotic standard errors in the second column (std.error), the t statistics in the third column (tvalue) and the p-values of the significance of each coefficient in last column (pvalue)
- refvar : estimated random effects variance
- spatialcorr : spatial correlation parameter
- randomeffect : a data frame with the values of the random effect estimators

Examples

```
# Load data set
data(paddysample)
# Fit nonstationary Fay-Herriot model using sample part of paddy data
result <- eblupNSFH1(y ~ x1+x2, var, latitude, longitude, method="REML", data = paddysample)
result
```

`eblupNSFH2` *EBLUP under nonstationary Fay-Herriot model for sample and non-sample area*

Description

This function gives the EBLUP and the estimate of mean squared error (mse) based on a nonstationary Fay-Herriot model for both sample and non-sample area.

Usage

```
eblupNSFH2(formula, vardir, lat, long, indicator, method = "REML", data)
```

Arguments

`formula`	an object of class list of formula, describe the model to be fitted
`vardir`	a vector of sampling variances of direct estimators for each small area
`lat`	a vector of latitude for each small area
`long`	a vector of longitude for each small area
`indicator`	a vector indicating the sample and non-sample area
`method`	type of fitting method, default is "REML" methods
`data`	a data frame comprising the variables named in formula, vardir, lat and long

Value

The function returns a list with the following objects:

eblup a vector with the values of the estimators for each sample area

eblup.out a vector with the values of the estimators for each non-sample area

mse a vector of the mean squared error estimates for each sample area

mse.out a vector of the mean squared error estimates for each non-sample area

sample a matrix consist of area code, eblup, mse, SE and CV for sample area

nonsample a matrix consist of area code, eblup, mse, SE and CV for non-sample area

fit a list containing the following objects:

- estcoef : a data frame with the estimated model coefficients in the first column (beta),their asymptotic standard errors in the second column (std.error), the t statistics in the third column (tvalue) and the p-values of the significance of each coefficient in last column (pvalue)

- refvar : estimated random effects variance
- spatialcorr : estimated spatial correlation parameter
- randomeffect : a data frame with the values of the random effect estimators

Examples

```
# Load data set
data(paddy)
# Fit nonstationary Fay-Herriot model using sample and non-sample part of paddy data
result <- eblupNSFH2(y ~ x1+x2, var, latitude, longitude, indicator , method="REML", data = paddy)
result
```

NSAE *NSAE : Nonstationary Small Area Estimation*

Description

Executes nonstationary Fay-Herriot model for small area estimation. It produces empirical best linear unbiased predictor (EBLUP) under stationary and nonstationary Fay-Herriot models. This package includes Fay-Herriot model for sample and non-sample area, nonstationary Fay-Herriot model for sample and non-sample area. Functions give EBLUP estimators and mean squared error (MSE) estimator for each model. The nonstationary Fay-Herriot model was developed by Hukum Chandra, Nicola Salvati and Ray Chambers (2015) <doi:10.1093/jssam/smu026>

Author(s)

Hukum Chandra, Nicola Salvati, Ray Chambers, Saurav Guha

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Functions

`eblupFH1` Provides the EBLUPs and MSE under stationary Fay-Herriot model for sample area

`eblupFH2` Provides the EBLUPs and MSE under stationary Fay-Herriot model for sample and non-sample area

`eblupNSFH1` Provides the EBLUPs and MSE under nonstationary Fay-Herriot model for sample area

`eblupNSFH2` Provides the EBLUPs and MSE under nonstationary Fay-Herriot model for sample and non-sample area

Reference

- Chandra, H., Salvati, N., & Chambers, R. (2015). A spatially nonstationary fay-herriot model for small area estimation. Journal of survey statistics and methodology. 3. 109-135. DOI:10.1093/jssam/smu026.
- Fay, R. E. & Herriot, R. A. (1979). Estimates of Income for Small Places: An Application of James-Stein Procedures to Census Data. Journal of the American Statistical Association. 74. 269-277. DOI:10.2307/2286322.

- Rao, J.N.K & Molina. (2015). Small Area Estimation 2nd Edition. New York: John Wiley and Sons, Inc.

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paddy *Yield data of paddy*

Description

Dataset on paddy yield used by Chandra et al. (2016).

Usage

```
data(paddy)
```

Format

A data frame with 70 observations on the following 9 variables:

D Small area code

latitude Latitude of each small areas

longitude Longitude of each small areas

n Sample size of each small areas

y Average yield data of paddy crop for the year 2009-10 (direct estimates for the small areas)

var Estimated variance of y

x1 First covariate (average household size) used by Chandra et al. (2016)

x2 Second covariate (female population of marginal household) used by Chandra et al. (2016)

indicator Index for sample and non-sample area

Reference

Chandra, H., salvati, N., chambers, R. and Sud, U. C. (2016). A Spatially Nonstationary Fay-Herriot Model for Small Area Estimation - An Application to Crop Yield Estimation. Seventh International Conference on Agricultural Statistics. Rome. DOI:10.1481/icasVII.2016.f35.

Examples

```
data(paddy)
yield <- paddy$y
summary(yield)
```

paddysample *Yield data of paddy for sample area*

Description

Dataset on paddy yield for sample area used by Chandra et al. (2016).

Usage

```
data(paddysample)
```

Format

A data frame with 58 observations on the following 8 variables:

D Small area code

latitude Latitude of each small areas

longitude Longitude of each small areas

n Sample size of each small areas

y Average yield data of paddy crop for the year 2009-10 (direct estimates for the small areas)

var Estimated variance of y

x1 First covariate (average household size) used by Chandra et al. (2016)

x2 Second covariate (female population of marginal household) used by Chandra et al. (2016)

Reference

Chandra, H., salvati, N., chambers, R. and Sud, U. C. (2016). A Spatially Nonstationary Fay-Herriot Model for Small Area Estimation - An Application to Crop Yield Estimation. Seventh International Conference on Agricultural Statistics. Rome. DOI:10.1481/icasVII.2016.f35.

Examples

```
data(paddysample)
yield <- paddysample$y
summary(yield)
```

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