Package 'OBPSAE'

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Title Observed best predictor for small area estimation

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Description OBP for SAE.

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R topics documented:

bpeFH *Best predictive estimator for Fay-Herriot model.*

Description

This function computes the best predictive estimators (BPE) of the unknown parameters for Fay-Herriot model.

Usage

```
bpeFH(formula, data, errorvar, randvar = NULL, maxiter = 100,
  precision = 1e-04)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
data	data frame containing the variable names in formula and errorvar.
errorvar	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.
randvar	varinace of the random effect. If not supplied, BPE is estimated.
maxiter	maximum number of iterations used in estimating randvar.
precision	covergence tolerance limit for estimating randvar.

Details

This function computes BPE of the regression coefficients of the fixed effect (beta). The variance of the random effect can be specified by the user in which case that will be used to calculate the BPE of beta. Otherwise the function will calculate BPE of the random effect variance component and use that to calculate the BPE of beta.

Value

The function will return a list consisting of the OBP of the small area mean, BPE of the regression coefficient of the fixed effect and BPE of variance of the random effect (if not specified by the user).

References

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

`fitSpline.cv` *Fitting the optimal spline by cross validation method.*

Description

This function fits an optimal spline function to the given data set after choosing optimal degree of the polynomial and optimal number of knots by cross-validation.

Usage

```
fitSpline.cv(x, y)
```

Arguments

`x`	independent variable values.
`y`	dependent variable values

Details

This function returns a list of elements for the fitted Spline function. f.hat returns the fitted values, p is optimal degree of the polynomial, q is the number of knots, beta is the fitted regression coefficients of the polynomial and gamma is the coeffcients of the knot terms and knots are the locations of corresponding knots.

Value

A list containing fitted values, optimal degree of the polynomial, number of knots and the coefficients.

`Hospital` *Hospital data*

Description

Morris and Christiansen (1995) presented a dataset involving 23 hospitals (out of a total of 219 hospitals) that had at least 50 kidney transplants during a 27-month period.

Usage

```
Hospital
```

Format

A data frame with 23 rows and 4 variables:

Sample Size Number of kidney transplants in each hospital during a 27 months period (at least 50)

Graft Failure Rate Graft failure rates for kidney transplant operations i.e. number of graft failures/sample size

Severity Index Severity index at each hospital which is measured by the average fraction of females, blacks, children, and extremely ill kidney recipients at that hospital

SE The standard error for the graft failure rate. The variance for the graft failure rate D_i, is approximated by $(0.2)(0.8)/n_i$, where 0.2 is the observed failure rate for all hospitals. Thus, D_i is assumed known.

`Income` *Income data*

Description

This dataset is regarding the median income of families with three, four and five people for the fifty states of the U.S. and the District of Columbia.

Usage

```
Income
```

Format

A data frame with 561 rows and 9 variables:

State code State code of each of the 50 states and District of Columbia

Year The year the data correspond to, generally ranging over 1969, 1979 to 1988 except 1980.

BEA Per-capita income estimates produced by the Bureau of Economic Analysis (BEA).

CPS/Census estimate-3persons Estimated median income of 3-persons families from Current Population Survey (CPS) OR Census of 1969 and 1979.

CPS SE estimate 3-person Standard Errors of the Estimated median income of 3-persons family from Current Population Survey (CPS) OR Census, for Census the SE is set to zero.

CPS/Census estimate 4persons Estimated median income of 3-persons families from Current Population Survey (CPS) OR Census of 1969 and 1979.

CPS SE estimate 4-person Standard Errors of the Estimated median income of 3-persons family from Current Population Survey (CPS) OR Census, for Census the SE is set to zero.

CPS/Census estimate-5persons Estimated median income of 3-persons families from Current Population Survey (CPS) OR Census of 1969 and 1979.

CPS SE estimate 5-person Standard Errors of the Estimated median income of 3-persons family from Current Population Survey (CPS) OR Census, for Census the SE is set to zero.

`MSPE_boot` *Bootstrap MSPE Estimator of OBP*

Description

This function computes the bootstrap MSPE estimator of OBP.

Usage

```
MSPE_boot(theta.OBP, D, x, L = 200)
```

Arguments

theta.OBP	A vector of OBPs.
D	Scalar, Vector (or diagonal matrix) of error variances.
L	is the number of bootstrap samples. the default is 200.

Value

This function will return the Bootstrap MSPE estimator of OBP.

References

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

MSPE_boot_adjusted *Bootstrap MSPE estimator of adjusted OBP*

Description

This function computes the bootstrap MSPE estimator of benchmarked adjusted OBP.

Usage

```
MSPE_boot_adjusted(theta.OBP.adjusted, D, x, weight, L = 200)
```

Arguments

theta.OBP.adjusted	A vector of adjusted OBPs.
D	Scalar, Vector (or diagonal matrix) of error variances.
x	The independant variable values
weight	Weight of each small area for calculating the benchmarked OBP (generally sampling weights of each small area).
L	is the number of bootstrap samples. the default is 200.

Value

This function will return the Bootstrap MSPE estimator of Adjusted OBP.

References

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

MSPE_boot_augmented *Bootstrap MSPE estimator of augmented OBP*

Description

This function computes the bootstrap MSPE estimator of benchmarked augmented OBP.

Usage

```
MSPE_boot_augmented(theta.OBP.augmented, D, x, weight, L = 200)
```

Arguments

D	Scalar, Vector (or diagonal matrix) of error variances.
x	The independant variable values
weight	Weight of each small area for calculating the benchmarked OBP (generally sampling weights of each small area).
L	is the number of bootstrap samples. the default is 200.
theta.OBP.adjusted	A vector of augmented OBPs.

Value

This function will return the Bootstrap MSPE estimator of Augmented OBP.

References

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

MSPE_JNR *JNR MSPE Estimator of OBP*

Description

This function computes the JNR MSPE estimator of OBP.

Usage

```
MSPE_JNR(formula, data, errorvar, theta.OBP, A.BPE, beta.BPE)
```

Arguments

theta.OBP	A vector of OBP values
A.BPE	BPE estimate of variance of random effects.
y	A vector of the response variable.
D	Scalar, Vector (or diagonal matrix) of error variances.

Value

This function will return the Naive MSPE estimator of the OBP.

References

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

`MSPE_McJack` *Mc Jack MSPE estimator*

Description

This function computes the McJack MSPE estimator of Observed Best Predictor(OBP).

Usage

```
MSPE_McJack(formula, data, errorvar, A.BPE, K = 1000, returnMcSpline = TRUE)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
`data`	data frame containing the variable names in formula and errorvar.
`errorvar`	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.
`A.BPE`	BPE estimator of random error variance component. Recomputes if missing.
`K`	number of Monte Carlo simulations. Default is 1000.
`returnMcSpline`	logical. Returns McSpline estimator with McJack (default).

Value

The function will return a list with the McJack and McSpline (if returnMcSpline is TRUE) MSPE estimator.

References

Bandyopadhyay R, Jiang J (2017) "Benchmarking of Observed Best Predictor"

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

MSPE_McJack_Benchmark *McJack MSPE estimator of benchmarked OBP*

Description

This function computes the McJack MSPE benchmark estimator.

Usage

```
MSPE_McJack_Benchmark(formula, data, errorvar, weight, A.BPE, K = 1000,
  returnMcSpline = TRUE)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
data	data frame containing the variable names in formula and errorvar.
errorvar	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.
weight	vector of weights.
A.BPE	BPE estimator of random error variance component. Recomputes if missing.
K	number of Monte Carlo simulations. Default is 1000.
returnMcSpline	logical. Returns McSpline MSPE benchmark estimators with McJack (default).

Value

The function will return a list with the McJack and McSpline (if returnMcSpline is TRUE) MSPE estimators of both adjusted and augmented methods.

References

Bandyopadhyay R, Jiang J (2017) "Benchmarking of Observed Best Predictor"

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

MSPE_McSpline *Mc Spline MSPE estimator*

Description

This function computes the McSPline MSPE estimator of Observed Best Predictor(OBP).

Usage

```
MSPE_McSpline(formula, data, errorvar, A.BPE, K = 1000)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
data	data frame containing the variable names in formula and errorvar.
errorvar	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.
A.BPE	BPE estimator of random error variance component. Recomputes if missing.
K	number of Monte Carlo simulations. Default is 1000.

Value

The function will return a list with the McSpline MSPE estimator.

References

Bandyopadhyay R, Jiang J (2017) "Benchmarking of Observed Best Predictor"

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

MSPE_McSpline_Benchmark

McSpline MSPE estimator of benchmarked OBP

Description

This function computes the McSpline MSPE estimator of benchmarked OBP.

Usage

```
MSPE_McSpline_Benchmark(formula, data, errorvar, weight, A.BPE, K = 1000)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
data	data frame containing the variable names in formula and errorvar.
errorvar	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.
weight	vector of weights.
A.BPE	BPE estimator of random error variance component. Recomputes if missing.
K	number of Monte Carlo simulations. Default is 1000.

Value

The function will return a list with the McSpline MSPE estimator of both adjusted and augmented OBP's.

References

Bandyopadhyay R, Jiang J (2017) "Benchmarking of Observed Best Predictor"

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

`MSPE_naive` *Naive MSPE Estimator of OBP*

Description

This function computes the naive MSPE estimator of OBP.

Usage

```
MSPE_naive(y, D, theta.OBP, A.BPE)
```

Arguments

`y`	A vector of the response variable.
`D`	Scalar, Vector (or diagonal matrix) of error variances.
`theta.OBP`	A vector of OBP values
`A.BPE`	BPE estimate of variance of random effects.

Value

This function will return the Naive MSPE estimator of the OBP.

References

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

obpFH *Observed best predictor for Fay-Herriot model.*

Description

This function computes the observed best predictor (OBP) for Fay-Herriot model. The variance of the random error can be specified by the user. Otherwise the function will calculate its Best Predictive Estimator (BPE). In the process of of computing OBP it also calculates the BPE of the regression coefficients of the fixed effect

Usage

```
obpFH(formula, data, errorvar, randvar = NULL, maxiter = 100,
  precision = 1e-04)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
data	data frame containing the variable names in formula and errorvar.
errorvar	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.
randvar	varinace of the random effect. If not supplied, BPE is estimated.
maxiter	maximum number of iterations used in estimating randvar.
precision	covergence tolerance limit for estimating randvar.

Value

The function will return a list consisting of the OBP of the small area mean, BPE of the regression coefficient of the fixed effect and BPE of variance of the random effect (if not specified by the user).

References

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

obpFHbenchmark *Benchmarked observed best predictor for Fay-Herriot model.*

Description

This function computes the benchmarked observed best predictor (OBP) for Fay-Herriot model. The variance of the random error can be specified by the user. Otherwise the function will calculate its Best Predictive Estimator (BPE). In the process of of computing OBP it also calculates the BPE of the regression coefficients of the fixed effect

Usage

```
obpFHbenchmark(formula, data, errorvar, weight, method = c("adjusted",
  "augmented"), randvar = NULL, maxiter = 100, precision = 1e-04)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
data	data frame containing the variable names in formula and errorvar.
errorvar	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.
weight	vector containing the sampling weights of small areas. Default is uniform. If sum of the weights is not 1, the weights are normalized.
method	string specifying the benchmarking method. Options are "adjusted" and "augmented". Computes both if not specified. See references for details.
randvar	varinace of the random effect. If not supplied, BPE is estimated.
maxiter	maximum number of iterations used in estimating randvar.
precision	covergence tolerance limit for estimating randvar.

Value

The function will return a list of adjusted OBP or augmented OBP or both depending on the "method".

References

Bandyopadhyay R, Jiang J (2017) "Benchmarking of Observed Best Predictor"

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

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obpFH_adjusted *Adjusted observed best predictor for Fay-Herriot Model*

Description

This function computes the Adjusted observed best predictor (OBP) for Fay-Herriot model. The variance of the random error can be specified by the user. Otherwise the function will calculate its Best Predictive Estimator (BPE). In the process of of computing OBP it also calculates the BPE of the regression coefficients of the fixed effect

Usage

```
obpFH_adjusted(formula, data, errorvar, weight, randvar = NULL,
  maxiter = 100, precision = 1e-04)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
data	data frame containing the variable names in formula and errorvar.
errorvar	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.
weight	vector containing the sampling weights of small areas. Default is uniform. If sum of the weights is not 1, the weights are normalized.
randvar	varinace of the random effect. If not supplied, BPE is estimated.
maxiter	maximum number of iterations used in estimating randvar.
precision	covergence tolerance limit for estimating randvar.

Value

The function will return a list containing the Adjusted OBP.

References

Bandyopadhyay R, Jiang J (2017) "Benchmarking of Observed Best Predictor"

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

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obpFH_augmented *Augmented observed best predictor for Fay-Herriot model.*

Description

This function computes the Augmented observed best predictor (OBP) for Fay-Herriot model. The variance of the random error can be specified by the user. Otherwise the function will calculate its Best Predictive Estimator (BPE). In the process of of computing OBP it also calculates the BPE of the regression coefficients of the fixed effect

Usage

```
obpFH_augmented(formula, data, errorvar, weight, randvar = NULL,
  maxiter = 100, precision = 1e-04)
```

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 in formula must have a length equal to the number of domains D. Details of model specification are given under Details.
data	data frame containing the variable names in formula and errorvar.
errorvar	vector containing the D sampling variances of direct estimators for each domain. The values must be sorted as the variables in formula.

weight	vector containing the sampling weights of small areas. Default is uniform. If sum of the weights is not 1, the weights are normalized.
randvar	varinace of the random effect. If not supplied, BPE is estimated.
maxiter	maximum number of iterations used in estimating randvar.
precision	covergence tolerance limit for estimating randvar.

Value

The function will return a list containing the Augmented OBP.

References

Bandyopadhyay R, Jiang J (2017) "Benchmarking of Observed Best Predictor"

Jiang J, Nguyen T, and Rao J. S. (2011), "Best Predictive Small Area Estimation", Journal of the American Statistical Association.

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