

# Package ‘saens’

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**Type** Package

**Title** Small Area Estimation with Cluster Information for Estimation of Non-Sampled Areas

**Version** 0.1.2

**Description** Implementation of small area estimation (Fay-Herriot model) with EBLUP (Empirical Best Linear Unbiased Prediction) Approach for non-sampled area estimation by adding cluster information and assuming that there are similarities among particular areas. See also Rao & Molina (2015, ISBN:978-1-118-73578-7) and Anisa et al. (2013) <[doi:10.9790/5728-10121519](https://doi.org/10.9790/5728-10121519)>.

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**URL** <https://github.com/Alfrzlp/sae-ns>

**BugReports** <https://github.com/Alfrzlp/sae-ns/issues>

**Encoding** UTF-8

**LazyData** true

**Depends** R (>= 4.00)

**RoxygenNote** 7.2.0

**Imports** cli, dplyr, ggplot2, methods, rlang, stats, tidyr

**NeedsCompilation** no

**Author** Ridson Al Farizal P [aut, cre, cph] (ORCID: <<https://orcid.org/0000-0003-0617-0214>>),  
Azka Ubaidillah [aut] (ORCID: <<https://orcid.org/0000-0002-3597-0459>>)

**Maintainer** Ridson Al Farizal P <[alfrzlp@gmail.com](mailto:alfrzlp@gmail.com)>

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AIC.eblupres	<i>Akaike's An Information Criterion.</i>
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## Description

Generic function calculating Akaike's "An Information Criterion" for EBLUP model

## Usage

```
## S3 method for class 'eblupres'
AIC(object, ...)

## S3 method for class 'eblupres'
BIC(object, ...)
```

## Arguments

object	EBLUP model.
...	further arguments passed to or from other methods.

## Value

AIC value.

## Examples

```
m1 <- eblupfh_cluster(y ~ x1 + x2 + x3, data = mys, vardir = "var", cluster = "clust")
AIC(m1)
```

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autoplot	<i>Create a complete ggplot appropriate to a particular data type</i>
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**Description**

autoplot() uses ggplot2 to draw a particular plot for an object of a particular class in a single command. This defines the S3 generic that other classes and packages can extend.

**Usage**

```
autoplot(object, ...)
```

**Arguments**

object	an object, whose class will determine the behaviour of autoplot
...	other arguments passed to specific methods

**Value**

a ggplot object

**See Also**

[autolayer\(\)](#), [ggplot\(\)](#) and [fortify\(\)](#)

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autoplot.eblupres	<i>Autoplot EBLUP results.</i>
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**Description**

Autoplot EBLUP results.

**Usage**

```
## S3 method for class 'eblupres'  
autoplot(object, variable = "RSE", ...)
```

**Arguments**

object	EBLUP model.
variable	variable to plot.
...	further arguments passed to or from other methods.

**Value**

plot.

**Examples**

```
library(saens)

m1 <- eblupfh_cluster(y ~ x1 + x2 + x3, data = mys, vardir = "var", cluster = "clust")
autoplot(m1)
```

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coef.eblupres	<i>Extract Model Coefficients.</i>
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**Description**

Extract Model Coefficients.

**Usage**

```
## S3 method for class 'eblupres'
coef(object, ...)
```

**Arguments**

object	EBLUP model.
...	further arguments passed to or from other methods.

**Value**

model coefficients

**Examples**

```
m1 <- eblupfh_cluster(y ~ x1 + x2 + x3, data = mys, vardir = "var", cluster = "clust")
coef(m1)
```

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eblupfh	<i>EBLUPs based on a Fay-Herriot Model.</i>
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**Description**

This function gives the Empirical Best Linear Unbiased Prediction (EBLUP) or Empirical Best (EB) predictor under normality based on a Fay-Herriot model.

**Usage**

```
eblupfh(  
  formula,  
  data,  
  vardir,  
  method = "REML",  
  maxiter = 100,  
  precision = 1e-04,  
  scale = FALSE,  
  print_result = TRUE  
)
```

**Arguments**

formula	an object of class formula that contains a description of the model to be fitted. The variables included in the formula must be contained in the data.
data	a data frame or a data frame extension (e.g. a tibble).
vardir	vector or column names from data that contain variance sampling from the direct estimator for each area.
method	Fitting method can be chosen between 'ML' and 'REML'.
maxiter	maximum number of iterations allowed in the Fisher-scoring algorithm. Default is 100 iterations.
precision	convergence tolerance limit for the Fisher-scoring algorithm. Default value is 0.0001.
scale	scaling auxiliary variable or not, default value is FALSE.
print_result	print coefficient or not, default value is TRUE.

**Details**

The model has a form that is response ~ auxiliary variables. where numeric type response variables can contain NA. When the response variable contains NA it will be estimated with cluster information.

**Value**

The function returns a list with the following objects (df\_res and fit): df\_res a data frame that contains the following columns:

- y variable response
- eblup estimated results for each area
- random\_effect random effect for each area

- vardir variance sampling from the direct estimator for each area
- mse Mean Square Error
- rse Relative Standard Error (%)

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)
- model\_formula model formula applied
- method type of fitting method applied (ML or REML)
- random\_effect\_var estimated random effect variance
- convergence logical value that indicates the Fisher-scoring algorithm has converged or not
- n\_iter number of iterations performed by the Fisher-scoring algorithm.
- goodness vector containing several goodness-of-fit measures: loglikelihood, AIC, and BIC

## References

1. Rao, J. N., & Molina, I. (2015). Small area estimation. John Wiley & Sons.

## Examples

```
library(saens)

m1 <- eblupfh(y ~ x1 + x2 + x3, data = na.omit(mys), vardir = "var")
m1 <- eblupfh(y ~ x1 + x2 + x3, data = na.omit(mys), vardir = ~var)
```

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eblupfh\_cluster

*EBLUPs based on a Fay-Herriot Model with Cluster Information.*

---

## Description

This function gives the Empirical Best Linear Unbiased Prediction (EBLUP) or Empirical Best (EB) predictor based on a Fay-Herriot model with cluster information for non-sampled areas.

**Usage**

```
eblupfh_cluster(
  formula,
  data,
  vardir,
  cluster,
  method = "REML",
  mse_method = "jackknife",
  maxiter = 100,
  precision = 1e-04,
  scale = FALSE,
  print_result = TRUE
)
```

**Arguments**

formula	an object of class formula that contains a description of the model to be fitted. The variables included in the formula must be contained in the data.
data	a data frame or a data frame extension (e.g. a tibble).
vardir	vector or column names from data that contain variance sampling from the direct estimator for each area.
cluster	vector or column name from data that contain cluster information.
method	Fitting method can be chosen between 'ML' and 'REML'
mse_method	MSE estimating method can be chosen between 'default' and 'jackknife'
maxiter	maximum number of iterations allowed in the Fisher-scoring algorithm. Default is 100 iterations.
precision	convergence tolerance limit for the Fisher-scoring algorithm. Default value is 0.0001.
scale	scaling auxiliary variable or not, default value is FALSE.
print_result	print coefficient or not, default value is TRUE.

**Details**

The model has a form that is response ~ auxiliary variables. where numeric type response variables can contain NA. When the response variable contains NA it will be estimated with cluster information.

**Value**

The function returns a list with the following objects `df_res` and `fit`: `df_res` a data frame that contains the following columns:

- y variable response

- eblup estimated results for each area
- random\_effect random effect for each area
- vardir variance sampling from the direct estimator for each area
- mse Mean Square Error
- cluster cluster information for each area
- rse Relative Standart Error (%)

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)
- model\_formula model formula applied
- method type of fitting method applied (ML or REML)
- random\_effect\_var estimated random effect variance
- convergence logical value that indicates the Fisher-scoring algorithm has converged or not
- n\_iter number of iterations performed by the Fisher-scoring algorithm.
- goodness vector containing several goodness-of-fit measures: loglikelihood, AIC, and BIC

## References

1. Rao, J. N., & Molina, I. (2015). Small area estimation. John Wiley & Sons.
2. Anisa, R., Kurnia, A., & Indahwati, I. (2013). Cluster information of non-sampled area in small area estimation. E-Prosiding Internasionall Departemen Statistika FMIPA Universitas Padjadjaran, 1(1), 69-76.

## Examples

```
library(saens)

m1 <- eblupfh_cluster(y ~ x1 + x2 + x3, data = mys, vardir = "var", cluster = "clust")
m1 <- eblupfh_cluster(y ~ x1 + x2 + x3, data = mys, vardir = ~var, cluster = ~clust)
```

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eblupfh\_ns

*Synthetic Estimator.*


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### Description

Synthetic estimator is one of the simple methods to obtain predicted values of mean specific area parameters, which the direct estimates are unknown. Based on estimated of parameter coefficient models using Empirical Best Unbiased Prediction (EBLUP), the synthetic estimator is obtained by calibrating the estimated parameter coefficient to the auxiliary variables.

### Usage

```
eblupfh_ns(
  formula,
  data,
  vardir,
  method = "REML",
  maxiter = 100,
  precision = 1e-04,
  scale = FALSE,
  print_result = TRUE
)
```

### Arguments

formula	an object of class formula that contains a description of the model to be fitted. The variables included in the formula must be contained in the data.
data	a data frame or a data frame extension (e.g. a tibble).
vardir	vector or column names from data that contain variance sampling from the direct estimator for each area.
method	Fitting method can be chosen between 'ML' and 'REML'
maxiter	maximum number of iterations allowed in the Fisher-scoring algorithm. Default is 100 iterations.
precision	convergence tolerance limit for the Fisher-scoring algorithm. Default value is 0.0001.
scale	scaling auxiliary variable or not, default value is FALSE.
print_result	print coefficient or not, default value is TRUE.

### Details

The model is defined as response ~ auxiliary variables, where the response variable, of numeric type, may contain NA values. When the response variable contains NA, it will be estimated using a synthetic estimator.

**Value**

The function returns a list with the following objects `df_res` and `fit`: `df_res` a data frame that contains the following columns:

- `y` variable response
- `eb1up` estimated results for each area
- `random_effect` random effect for each area
- `vardir` variance sampling from the direct estimator for each area
- `mse` Mean Square Error
- `cluster` cluster information for each area
- `rse` Relative Standart Error (%)

`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`)
- `model_formula` model formula applied
- `method` type of fitting method applied (ML or REML)
- `random_effect_var` estimated random effect variance
- `convergence` logical value that indicates the Fisher-scoring algorithm has converged or not
- `n_iter` number of iterations performed by the Fisher-scoring algorithm.
- `goodness` vector containing several goodness-of-fit measures: loglikelihood, AIC, and BIC

**References**

1. Rao, J. N., & Molina, I. (2015). Small area estimation. John Wiley & Sons.

**Examples**

```
library(saens)

m1 <- eblupfh_ns(y ~ x1 + x2 + x3, data = mys, vardir = "var")
m1 <- eblupfh_ns(y ~ x1 + x2 + x3, data = mys, vardir = ~var)
```

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logLik.eblupres	<i>Extract Log-Likelihood.</i>
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---

**Description**

Extract Log-Likelihood.

**Usage**

```
## S3 method for class 'eblupres'
logLik(object, ...)
```

**Arguments**

object	EBLUP model.
...	further arguments passed to or from other methods.

**Value**

Log-Likelihood value

**Examples**

```
library(saens)

model1 <- eblupfh_cluster(y ~ x1 + x2 + x3, data = mys, vardir = "var", cluster = "clust")
logLik(model1)
```

**mys** *mys: mean years of schooling people with disabilities in Papua Island, Indonesia.*

---

### Description

A dataset containing the mean years of schooling people with disabilities in Papua Island, Indonesia in 2021.

### Usage

`mys`

### Format

A data frame with 42 rows and 7 variables with 10 domains are non-sampled areas.

**area** regency municipality

**y** mean years of schooling people with disabilities

**var** variance sampling from the direct estimator for each area

**rse** relative standard error (%)

**x1** Number of Elementary Schools

**x2** Number of Junior High Schools

**x3** Number of Senior High Schools

**clust** Cluster

**n** Number of eligible samples

**weight** Weight

### Source

<https://www.bps.go.id>

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`summary.eblupres` *Summarizing EBLUP Model Fits.*

---

### Description

‘summary’ method for class "eblupres".

### Usage

```
## S3 method for class 'eblupres'  
summary(object, ...)
```

### Arguments

object            EBLUP model.  
...                further arguments passed to or from other methods.

### Value

The function returns a data frame that contains the following columns:

- \* y variable response
- \* eblup estimated results for each area
- \* random\_effect random effect for each area
- \* vardir variance sampling from the direct estimator for each area
- \* mse Mean Square Error
- \* cluster cluster information for each area
- \* rse Relative Standart Error (

### Examples

```
library(saens)  
  
model1 <- eblupfh_cluster(y ~ x1 + x2 + x3, data = mys, vardir = "var", cluster = "clust")  
summary(model1)
```

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