

Package ‘waspr’

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Type Package

Title Wasserstein Barycenters of Subset Posteriors

Version 1.0.1

Description Functions to compute Wasserstein barycenters of subset posteriors using the swapping algorithm developed by Puccetti, Rüschemdorf and Vanduffel (2020) <[doi:10.1016/j.jmaa.2017.02.003](https://doi.org/10.1016/j.jmaa.2017.02.003)>. The Wasserstein barycenter is a geometric approach for combining subset posteriors. It allows for parallel and distributed computation of the posterior in case of complex models and/or big datasets, thereby increasing computational speed tremendously.

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URL <https://github.com/joliencremers/waspr>

BugReports <https://github.com/joliencremers/waspr/issues>

Encoding UTF-8

LazyData true

Imports Rcpp (>= 1.0.4.6)

LinkingTo BH, Rcpp, RcppArmadillo,

RoxygenNote 7.2.3

Suggests knitr, rmarkdown, testthat, spelling

VignetteBuilder knitr

Language en-US

Biarch true

Depends R (>= 3.5.0)

NeedsCompilation yes

Author Jolien Cremers [aut, cre]

Maintainer Jolien Cremers <joliencremers@gmail.com>

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combine	<i>Combine output of the swapping algorithm</i>
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Description

This (non-exported) function combines the output from the swapping algorithm (Puccetti, Rüschen-dorf and Vanduffel, 2020).

Usage

```
combine(x)
```

Arguments

x a three dimensional array (rows = subsets, columns = par, slices = samples) containing posterior samples for all subsets

Value

A wasp object, which can be further analyzed using the associated function [summary.wasp](#).

Source

Puccetti, G., Rüschen-dorf, L. & Vanduffel, S. (2020). On the computation of Wasserstein barycenters, *Journal of Multivariate Analysis*, 176.

hpd_est	<i>Compute the 95 percent Highest Posterior Density interval</i>
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Description

Compute the 95 percent Highest Posterior Density interval

Usage

```
hpd_est(x)
```

Arguments

x a numeric vector

Value

A vector containing the lower and upper bound of the 96 Posterior Density interval of a numeric vector as computed by the methods from Venter (1967).

Source

Venter, J.H. (1967). On estimation of the mode, *Annals of Mathematical Statistics*, 38(5), 1446-1455.

Examples

```
library(waspr)
hpd_est(pois_logistic[1,1,])
```

mode_est	<i>Compute the mode</i>
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Description

Compute the mode

Usage

```
mode_est(x)
```

Arguments

x a numeric vector

Value

The mode of a numeric vector as computed by the methods from Venter (1967).

Source

Venter, J.H. (1967). On estimation of the mode, *Annals of Mathematical Statistics*, 38(5), 1446-1455.

Examples

```
library(waspr)
mode_est(pois_logistic[1,1,])
```

pois_logistic	<i>pois_logistic</i>
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Description

A set of mcmc samples from 8 subposteriors from the analysis of a joint model with a logistic and poisson outcome variable.

Usage

```
pois_logistic
```

Format

An array with 3 dimensions of which the first represents the subposteriors (size = 8), the second represents the parameters (size = 8) and the third represents the amount of mcmc samples (size = 450).

print.wasp	<i>Print posterior summaries for the Wasserstein barycenter of subset posteriors</i>
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Description

Prints selected output from a Bayesian circular mixed-effects model.

Usage

```
## S3 method for class 'wasp'
print(x, ...)
```

Arguments

x a wasp object obtained from the function wasp().
... further arguments passed to or from other methods.

Value

A print of posterior summaries for the Wasserstein barycenter of subset posteriors

Examples

```
library(waspr)
out <- wasp(pois_logistic,
            par.names = c("beta_s", "alpha_l", "beta_l",
                          "baseline_sigma", "baseline_mu",
                          "correlation", "sigma_s", "sigma_l"))
print(out)
```

summary	<i>Posterior summaries for the Wasserstein barycenter of subset posteriors</i>
---------	--

Description

summary gives a posterior summary (mean, mode, sd, HPD)

Usage

```
summary(x)
```

Arguments

x a wasp object.

Details

the method [summary.wasp](#) has its own help page.

Examples

```
library(waspr)
```

summary.wasp	<i>Posterior summaries for the Wasserstein barycenter of subset posteriors</i>
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Description

Outputs and prints posterior summary statistics (mean, mode, sd, 95 Posterior Density interval)

Usage

```
## S3 method for class 'wasp'
summary(x)
```

Arguments

x a wasp object obtained from the function wasp().

Value

Posterior summary statistics (mean, mode, sd, 95 all the Wasserstein barycenter of subset posteriors of all parameters in the model).

Examples

```
library(waspr)
out <- wasp(pois_logistic,
  par.names = c("beta_s", "alpha_l", "beta_l",
    "baseline_sigma", "baseline_mu",
    "correlation", "sigma_s", "sigma_l"))
summary(out)
```

swap_rcpp	<i>The swapping algorithm for computing Wasserstein barycenters</i>
-----------	---

Description

The swapping algorithm for computing Wasserstein barycenters

Usage

```
swap_rcpp(samples, acc = 0.001, iter = 10L, out = FALSE)
```

Arguments

<code>samples</code>	A cube containing samples for all subset posteriors (rows = subsets, columns = par, slices = samples)
<code>acc</code>	accuracy
<code>iter</code>	maximum number of iterations of the algorithm
<code>out</code>	boolean indicating whether output for each iteration should be displayed (default = false)

Value

a three dimensional array (rows = subsets, columns = par, slices = samples) containing output from the swapping algorithm.

wasp	<i>Compute Wasserstein barycenters of subset posteriors</i>
------	---

Description

This function computes Wasserstein Barycenters of subset posteriors and gives posterior summaries for the full posterior.

Usage

```
wasp(mcmc, par.names = NULL, acc = 0.001, iter = 10, out = FALSE)
```

Arguments

<code>mcmc</code>	a three dimensional array (rows = number of subset posteriors, columns = number of parameters of the posterior distribution, slices = samples number of samples for each subset posterior) containing posterior samples for all subsets
<code>par.names</code>	optional character vector with parameter names
<code>acc</code>	accuracy of the swapping algorithm (default = 0.001)
<code>iter</code>	maximum number of iterations of the swapping algorithm (default = 10)
<code>out</code>	boolean indicating whether output for each iteration of the swapping algorithm should be displayed (default = false)

Details

The swapping algorithm developed by Puccetti, Rüschendorf and Vanduffel (2020) is used to compute Wasserstein barycenters of subset posteriors.

Value

A wasp object, which can be further analyzed using the associated function `summary.wasp`.

A wasp object contains the following elements (some elements are not returned if not applicable)

`barycenter` A matrix of posterior samples (rows) for all parameters (columns) of the full posterior obtained by the swapping algorithm.

`raw` An array (`dim = c(subsets, parameters, samples)`) containing the raw output from the swapping algorithm.

`call` The call to the `wasp()` function.

`subsets` The amount of subset posteriors in mcmc.

`parameters` The amount of parameters in mcmc.

`samples` The amount of posterior samples for each subset posterior in mcmc.

`acc` Accuracy of the swapping algorithm, default = 0.001.

`iter` Maximum amount of iterations for the swapping algorithm, default = 10.

Source

Puccetti, G., Rüschemdorf, L. & Vanduffel, S. (2020). On the computation of Wasserstein barycenters, *Journal of Multivariate Analysis*, 176.

Examples

```
library(waspr)
out <- wasp(pois_logistic,
            par.names = c("beta_s", "alpha_l", "beta_l",
                          "baseline_sigma", "baseline_mu",
                          "correlation", "sigma_s", "sigma_l"))
summary(out)
```

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