# Package 'waspr'

July 24, 2020

**Type** Package

**Title** Wasserstein Barycenters of Subset Posteriors

**Version** 1.0.0

**Description** Functions to compute Wasserstein barycenters of subset posteriors using the swapping algorithm developed by Puccetti, Rüschendorf and Vanduffel (2020) <doi: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.

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**Imports** Rcpp (>= 1.0.4.6), methods

**LinkingTo** BH, Rcpp, RcppArmadillo,

**RoxygenNote** 7.1.0

**Suggests** knitr, rmarkdown, testthat, spelling

**VignetteBuilder** knitr

**Language** en-US

**Biarch** true

**Depends** R (>= 3.5.0)

**NeedsCompilation** yes

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**Repository** CRAN

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# R topics documented:



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`combine` *Combine output of the swapping algorithm*

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## Description

This (non-exported) function combines the output from the swapping algorithm (Puccetti, Rüschendorf 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., Rüschendorf, L. & Vanduffel, S. (2020). On the computation of Wasserstein barycenters, Journal of Multivariate Analysis, 176.

## hpd_est *Compute the 95 percent Highest Posterior Density interval*

### 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 *Compute the mode*

### 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,])
```

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`pois_logistic` *pois_logistic*

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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 paramters (size = 8) and the third represents the amount of mcmc samples (size = 450).

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`print.wasp` *Print posterior summaries for the Wasserstein barycenter of subset posteriors*

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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 *Posterior summaries for the Wasserstein barycenter of subset posteriors*

---

### 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 — *Posterior summaries for the Wasserstein barycenter of subset posteriors*

### 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 — *The swapping algorithm for computing Wasserstein barycenters*

### Description

The swapping algorithm for computing Wasserstein barycenters

### Usage

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

### Arguments

| | |
|---|---|
| samples | A cube containing samples for all subset posteriors (rows = subsets, columns = par, slices = samples) |
| acc | accuracy |
| iter | maximum number of iterations of the algorithm |
| out | 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.

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## wasp *Compute Wasserstein barycenters of subset posteriors*

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### 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

| | |
|---|---|
| mcmc | 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 |
| par.names | optional character vector with parameter names |
| acc | accuracy of the swapping algorithm (default = 0.001) |
| iter | maximum number of iterations of the swapping algorithm (default = 10) |
| out | 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., Rüschendorf, 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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waspr *waspr: an R package for computing Wasserstein barycenters of subset posteriors*

---

## Description

This package contains functions to compute Wasserstein barycenters of subset posteriors using the swapping algorithm developed by Puccetti, Rüschendorf and Vanduffel (2020). 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.

## Functions

The main function of the package is:

`wasp`, which runs the swapping algorithm developed by Puccetti, Rüschendorf and Vanduffel (2020), combines the output from the swapping algorithm and computes the Wasserstein barycenter. It returns an S3 object of type `wasp`.

## Source

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

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