

Package ‘familial’

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Type Package

Title Familial Inference

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Description Provides functionality for testing familial hypotheses. Currently supports tests of the Huber family of centers. Testing is carried out using the Bayesian bootstrap. One- and two-sample tests are supported, as are directional tests. Methods for visualizing output are provided.

URL <https://github.com/ryan-thompson/familial>

BugReports <https://github.com/ryan-thompson/familial/issues>

License GPL-3

Encoding UTF-8

LazyData true

Depends R (>= 4.1.0)

Imports parallel, ggplot2, DepthProc

RoxygenNote 7.1.2

Suggests testthat, knitr, rmarkdown, MASS

VignetteBuilder knitr

Config/testthat/edition 3

R topics documented:

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|------------|---------------------------|
| bayes.boot | <i>Bayesian bootstrap</i> |
|------------|---------------------------|

Description

Performs a Bayesian bootstrap for a statistic defined via a suitable function.

Usage

```
bayes.boot(x, fun, nboot = 1000, cluster = NULL, ...)
```

Arguments

| | |
|---------|---|
| x | a numeric vector to be passed as the first argument to fun |
| fun | the function to bootstrap; must accept data x and weights w (in that order), and return a data frame |
| nboot | the number of bootstraps to perform |
| cluster | an optional cluster for running bootstraps in parallel; must be set up using <code>parallel::makeCluster</code> |
| ... | any other arguments for fun |

Value

An object of class `bayes.boot`; a data frame with the following columns:

| | |
|---------|-------------------------------|
| boot.id | the bootstrap iteration index |
| ... | any columns returned by fun |

Author(s)

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Examples

```
set.seed(1)

# Bootstrap
boot <- bayes.boot(MASS::galaxies, fun = fit.family, nboot = 100)
head(boot)
```

| | |
|-------------|--------------------|
| center.test | <i>Center test</i> |
|-------------|--------------------|

Description

Performs a one- or two-sample test for a family of centers.

Usage

```
center.test(
  x,
  y = NULL,
  family = "huber",
  alternative = c("two.sided", "less", "greater"),
  mu = 0,
  paired = FALSE,
  nboot = 1000,
  loss = NULL,
  cluster = NULL,
  ...
)
```

Arguments

| | |
|-------------|--|
| x | a numeric vector of data |
| y | an optional numeric vector of data |
| family | the family of centers; currently only allows 'huber' for Huber family |
| alternative | the form of the alternative hypothesis; must be one of 'two.sided' (default), 'greater', or 'less' |
| mu | the null value of the center for a one-sample test, or the null value of the center of differences for a paired two-sample test, or the null value of the difference in centers for an independent two-sample test; can be an interval |
| paired | a logical indicating whether to treat x and y as paired |
| nboot | the number of bootstraps to perform |
| loss | an optional c×2 matrix of losses incurred from an incorrect decision, where c is the number of candidate choices (typically c=3: H0, H1, or indeterminate) |
| cluster | an optional cluster for running bootstraps in parallel; must be set up using <code>parallel::makeCluster</code> |
| ... | any other arguments |

Details

Uses the Bayesian bootstrap to compute posterior probabilities for the hypotheses $H_0 : \mu(\lambda) = \mu_0$ for some $\lambda \in \Lambda$ vs. $H_1 : \mu(\lambda) \neq \mu_0$ for all $\lambda \in \Lambda$, where $\{\mu(\lambda) : \lambda \in \Lambda\}$ is a family of centers. The default loss matrix results in a decision whenever the posterior probability for one of the hypotheses is greater than 0.95 and otherwise is indeterminate.

Value

An object of class `center.test`; a list with the following components:

| | |
|----------------------------|--|
| <code>expected.loss</code> | the expected loss, calculated by post-multiplying loss with prob |
| <code>decision</code> | the optimal decision given the expected loss |
| <code>loss</code> | the loss matrix |
| <code>prob</code> | the posterior probabilities of the null and alternative |
| <code>boot</code> | the bootstrap output from <code>bayes.boot</code> |
| <code>x</code> | the x that was supplied |
| <code>y</code> | the y that was supplied |
| <code>mu</code> | the mu that was supplied |
| <code>family</code> | the family that was supplied |

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Examples

```
set.seed(1)

# Familial test using Huber family with point null
test <- center.test(MASS::galaxies, mu = 21000, nboot = 100)
print(test)
plot(test)

# Familial test using Huber family with interval null
test <- center.test(MASS::galaxies, mu = c(20500, 21500), nboot = 100)
print(test)

# Familial test in parallel
cl <- parallel::makeCluster(2)
test <- center.test(MASS::galaxies, mu = c(20500, 21500), nboot = 100, cluster = cl)
parallel::stopCluster(cl)
print(test)
```

fit.family

Fit family

Description

Fits a family of centers.

Usage

```
fit.family(
  x,
  w = rep(1, length(x)),
  family = "huber",
  spread.fun = weighted.mad,
  eps = .Machine$double.eps
)
```

Arguments

| | |
|------------|---|
| x | a numeric vector of data |
| w | a numeric vector of weights |
| family | the location family; currently only allows 'huber' for Huber family |
| spread.fun | a function used for the spread of x in the Huber family; ensures that the results are comparable across variables |
| eps | a numerical tolerance parameter |

Value

An object of class `fit.family`; a data frame with the following columns:

| | |
|--------|----------------------------|
| mu.hat | the fitted values |
| lambda | the thresholding parameter |

Author(s)

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Examples

```
fit <- fit.family(MASS::galaxies)
plot(fit)
```

| | |
|------------------|---|
| plot.center.test | <i>Plot function for center.test object</i> |
|------------------|---|

Description

Plot the posterior distribution for the family of centers using a functional box plot.

Usage

```
## S3 method for class 'center.test'
plot(x, band = c(0.5, 0.75, 0.95), ninterp = 25, ...)
```

Arguments

| | |
|---------|---|
| x | an object of class center.test |
| band | a vector of band limits for the functional box plot |
| ninterp | the number of interpolation points for the functional box plot; more points lead to finer resolution of the plot at the expense of additional computation |
| ... | any other arguments |

Value

A plot of the posterior distribution.

Author(s)

Ryan Thompson <ryan.thompson@monash.edu>

| | |
|-----------------|--|
| plot.fit.family | <i>Plot function for fit.family object</i> |
|-----------------|--|

Description

Plot a fitted family.

Usage

```
## S3 method for class 'fit.family'  
plot(x, y = NULL, ...)
```

Arguments

| | |
|-----|-------------------------------|
| x | an object of class fit.family |
| y | an object of class fit.family |
| ... | any other arguments |

Value

A plot of the fitted family.

Author(s)

Ryan Thompson <ryan.thompson@monash.edu>

| | |
|-------------------|--|
| print.center.test | <i>Print function for center.test object</i> |
|-------------------|--|

Description

Print objects of class center.test.

Usage

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

Arguments

| | |
|-----|--------------------------------|
| x | an object of class center.test |
| ... | any other arguments |

Value

The argument x.

Author(s)

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| | |
|-------------|---------------------------------------|
| rudirichlet | <i>Uniform Dirichlet distribution</i> |
|-------------|---------------------------------------|

Description

Random number generation for the uniform Dirichlet distribution (having all concentration parameters set to one).

Usage

```
rudirichlet(n, d)
```

Arguments

| | |
|---|----------------------------|
| n | the number of observations |
| d | the number of dimensions |

Value

A matrix; each row is a random draw and each column is a dimension.

Author(s)

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weighted

Weighted statistics

Description

Assorted weighted statistics unavailable in base R

Usage

`weighted.median(x, w)`

`weighted.mad(x, w)`

Arguments

| | |
|---|-----------------------------|
| x | a numeric vector of data |
| w | a numeric vector of weights |

Value

A length-one numeric vector.

Author(s)

Ryan Thompson <ryan.thompson@monash.edu>

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