

Package ‘fbst’

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Type Package

Title The Full Bayesian Significance Test and the e-Value

Version 1.0

Date 2020-05-30

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Description Provides access to a range of functions for computing and visualising the Full Bayesian Significance Test (FBST) and the e-value for testing a sharp hypothesis against its alternative. The methods are widely applicable as long as a posterior MCMC sample is available. For details on the computation and theory of the FBST see <arXiv:2005.13181>.

Imports bayestestR, methods, coda, Matrix

Suggests BayesFactor

License GPL-3

NeedsCompilation no

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fbst-package

*The Full Bayesian Significance Test and the e-Value***Description**

Provides access to a range of functions for computing and visualising the Full Bayesian Significance Test (FBST) and the e-value for testing a sharp hypothesis against its alternative. The methods are widely applicable as long as a posterior MCMC sample is available. For details on the computation and theory of the FBST see <arXiv:2005.13181>.

Details

Package for conducting the Full Bayesian Significance Test (FBST) for testing a sharp hypothesis against its alternative by calculating the e-value, the Bayesian evidence against the null hypothesis. The e-value is based on the relative surprise function to a reference function and the tangential set corresponding to a sharp null hypothesis. Calculation of the e-value, the p-value associated with the Bayesian e-value in favour of a sharp null hypothesis and visualisations of the FBST are provided.

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 Imports: bayestestR, methods, coda, Matrix
 Suggests: BayesFactor
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| fbst-package | The Full Bayesian Significance Test and the e-Value |
| plot.fbst | plot.fbst |
| summary.fbst | summary.fbst |

Author(s)

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References

For a details, see: <https://arxiv.org/abs/2001.10577> and <https://arxiv.org/pdf/2001.10577.pdf>.

| | |
|------|-------------|
| fbst | <i>fbst</i> |
|------|-------------|

Description

The function computes the Full Bayesian Significance Test (FBST) and the e-value, which is the Bayesian evidence against a sharp null hypothesis. The function assumes posterior MCMC draws and constructs a posterior density based on a kernel density estimator subsequently.

Usage

```
fbst(posteriorDensityDraws, nullHypothesisValue, FUN, par,  
dimensionTheta, dimensionNullset)
```

Arguments

| | |
|-----------------------|--|
| posteriorDensityDraws | Vector of MCMC posterior parameter draws |
| nullHypothesisValue | Parameter value belonging to the sharp null hypothesis |
| FUN | Reference function |
| par | Additional parameters of the reference function |
| dimensionTheta | Dimension of the parameter space |
| dimensionNullset | Dimension of the null set corresponding to the null hypothesis |

Details

If no reference function is specified, a flat reference function is used as default reference function.

Value

Returns an object of class fbst.

Author(s)

Riko Kelter

References

For a details, see: <https://arxiv.org/abs/2001.10577>.

Examples

```

set.seed(57)
grp1=rnorm(50,0,1.5)
grp2=rnorm(50,0.8,3.2)

p = as.vector(BayesFactor::ttestBF(x=grp1,y=grp2,
  posterior = TRUE, iterations = 3000,
  rscale = "medium")[,4])

# flat reference function
res = fbst(posteriorDensityDraws = p, nullHypothesisValue = 0,
  dimensionTheta = 3, dimensionNullset = 2)
summary(res)
plot(res)

# medium Cauchy C(0,1) reference function
res_med = fbst(posteriorDensityDraws = p, nullHypothesisValue = 0, dimensionTheta = 3,
  dimensionNullset = 2, FUN = dcauchy, par = list(location = 0, scale = sqrt(2)/2))
summary(res_med)
plot(res_med)

```

fbst-class

Class "fbst-class"

Description

Class for modelling the results of a Full Bayesian Significance Test

Objects from the Class

Store the results of a FBST

Slots

posteriorDensityDraws: Object of class "numeric" holding the posterior MCMC parameter draws. ~~

postEffSizeSorted: Object of class "numeric" storing the sorted posterior MCMC parameter draws. ~~

densZero: Object of class "numeric" storing the surprise function value at the sharp null hypothesis parameter value. ~~

postDensValues: Object of class "numeric" storing the posterior density values. ~~

indices: Object of class "numeric" storing indices for deciding which values are located inside the tangential set. ~~

nullHypothesisValue: Object of class "numeric" storing the sharp null hypothesis parameter value. ~~

prior: Object of class "character" holding the name of the reference function used. ~~

dimensionTheta: Object of class "numeric" holding the dimension of the parameter space. ~~
 dimensionNullset: Object of class "numeric" holding the dimension of the null set corresponding to the null hypothesis. ~~
 eValue: Object of class "numeric" holding the Bayesian evidence against the sharp null hypothesis, the e-value. ~~
 pValue: Object of class "numeric" holding the p-value associated with the Bayesian e-value in favour of the sharp null hypothesis. ~~
 sev_H_0: Object of class "numeric" holding the standardized e-value as a replacement of the frequentist p-value. ~~

 plot.fbst

plot.fbst

Description

Plots the results of a Full Bayesian Significance Test.

Usage

```
## S3 method for class 'fbst'
plot(x, ..., leftBoundary = -100, rightBoundary = 100)
```

Arguments

| | |
|---------------|---|
| x | An Object of class "fbst". |
| ... | Additional parameters, see "plot(x, ...)". |
| leftBoundary | x-coordinate for the left boundary to which is used for visualising the evidence in support of the null hypothesis. Defaults to -100. |
| rightBoundary | x-coordinate for the right boundary to which is used for visualising the evidence in support of the null hypothesis. Defaults to 100. |

Details

Plots the surprise function, the supremum of the surprise function restricted to the null set (blue point) and visualises the Bayesian e-value against the sharp null hypothesis as the blue shaded area under the surprise function. The Bayesian e-value in favour of the sharp null hypothesis is visualised as the red shaded area under the surprise function.

Value

Returns a plot.

Author(s)

Riko Kelter

References

For a details, see: <https://arxiv.org/abs/2001.10577> and <https://arxiv.org/pdf/2001.10577.pdf>.

Examples

```
set.seed(57)
grp1=rnorm(50,0,1.5)
grp2=rnorm(50,0.8,3.2)

p = as.vector(BayesFactor::ttestBF(x=grp1,y=grp2,
  posterior = TRUE, iterations = 3000,
  rscale = "medium")[,4])

# flat reference function
res = fbst(posteriorDensityDraws = p, nullHypothesisValue = 0,
  dimensionTheta = 3, dimensionNullset = 2)
plot(res)
```

summary.fbst

summary.fbst

Description

Prints the results of a Full Bayesian Significance Test.

Usage

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

Arguments

object An Object of class "fbst".
... Additional parameters, see "summary(object,...)".

Details

Summarises the results of a Full Bayesian Significance Test.

Value

Prints the results onto the console.

Author(s)

Riko Kelter

References

For a details, see: <https://arxiv.org/abs/2001.10577> and <https://arxiv.org/pdf/2001.10577.pdf>.

Examples

```
set.seed(57)
grp1=rnorm(50,0,1.5)
grp2=rnorm(50,0.8,3.2)

p = as.vector(BayesFactor::ttestBF(x=grp1,y=grp2,
  posterior = TRUE, iterations = 3000,
  rscale = "medium")[,4])

# flat reference function
res = fbst(posteriorDensityDraws = p, nullHypothesisValue = 0,
  dimensionTheta = 3, dimensionNullset = 2)
summary(res)
```

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