

# Package ‘fbst’

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**Type** Package

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

**Version** 1.3

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**Author** Riko Kelter

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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

**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.

Package: fbst  
 Type: Package  
 Title: The Full Bayesian Significance Test and the e-Value  
 Version: 1.3  
 Date: 2020-09-11  
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 Maintainer: Riko Kelter <riko.kelter@uni-siegen.de>  
 Description: Provides access to a range of functions for computing and visualising the Full Bayesian Significance Test (FBST)  
 Imports: bayestestR, methods  
 Suggests: BayesFactor  
 License: GPL-3

Index of help topics:

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fbst-package	The Full Bayesian Significance Test and the e-Value
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plot.fbst	plot.fbst
show.fbst	show.fbst
summary.fbst	summary.fbst

**Author(s)**

Riko Kelter

Maintainer: Riko Kelter <riko.kelter@uni-siegen.de>

## References

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

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access-method	<i>Returns an object from an object of class fbst.</i>
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## Description

Returns an object from an object of class fbst

## Details

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## Value

-

## 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)

# Return the e-value from an fbst object
res$eValue
```

---

`fbst`*fbst*

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### 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

<code>posteriorDensityDraws</code>	Vector of MCMC posterior parameter draws
<code>nullHypothesisValue</code>	Parameter value belonging to the sharp null hypothesis
<code>FUN</code>	Reference function
<code>par</code>	Additional parameters of the reference function
<code>dimensionTheta</code>	Dimension of the parameter space
<code>dimensionNullset</code>	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**

**data:** Object of class "list" holding the results of the Full Bayesian Significance Test. `posteriorDensityDraws` holds the posterior MCMC parameter draws, `postEffSizeSorted` stores the sorted posterior MCMC parameter draws, `densZero` stores the surprise function value at the sharp null hypothesis parameter value, `postDensValues` stores the posterior density values, `indices` stores the indices for deciding which values are located inside the tangential set, `nullHypothesisValue` stores the sharp null hypothesis parameter value, `referenceFunction` holds the name of the reference function used, `dimensionTheta` holds the dimension of the parameter space, `dimensionNullset` holds the dimension of the null set corresponding to the null hypothesis, `eValue` holds the Bayesian evidence against the sharp null hypothesis, the e-value, `pValue` holds the p-value associated with the Bayesian e-value in favour of the sharp null hypothesis, `sev_H_0` holds the standardized e-value as a replacement of the frequentist p-value.

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`names.fbst``names.fbst`

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**Description**

Plots the names of the objects stored in the data object of a Full Bayesian Significance Test.

**Usage**

```
## S3 method for class 'fbst'  
names(x)
```

**Arguments**

`x` An Object of class "fbst".

**Details**

Plots the names of the objects stored in the data object of a Full Bayesian Significance Test.

**Value**

Returns a list of names.

**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)  
names(res)
```

---

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)
```

---

show.fbst

*show.fbst*

---

### Description

Prints the main results of a Full Bayesian Significance Test to the console.

### Usage

```
## S3 method for class 'fbst'
show(object)
```

### Arguments

object            An Object of class "fbst".

### Details

Shows the main results of a Full Bayesian Significance Test stored in an object of class fbst.

### 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)
show(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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