Package 'BFF'

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Title Bayes Factor Functions

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Author Rachael Shudde [aut, cre],
Saptati Datta [aut],
Riana Guha [aut],
Sandy Pramanik [aut],
Valen Johnson [aut]

Maintainer Rachael Shudde <rachael.shudde@gmail.com>

Description
Bayes factors represent the ratio of probabilities assigned to data by competing scientific hypotheses. However, one drawback of Bayes factors is their dependence on prior specifications that define null and alternative hypotheses. Additionally, there are challenges in their computation. To address these issues, we define Bayes factor functions (BFFs) directly from common test statistics. BFFs express Bayes factors as a function of the prior densities used to define the alternative hypotheses. These prior densities are centered on standardized effects, which serve as indices for the BFF. Therefore, BFFs offer a summary of evidence in favor of alternative hypotheses that correspond to a range of scientifically interesting effect sizes. Such summaries remove the need for arbitrary thresholds to determine ``statistical significance.'' BFFs are available in closed form and can be easily computed from z, t, chi-squared, and F statistics. They depend on hyperparameters ``r'' and ``tau^2'', which determine the shape and scale of the prior distributions defining the alternative hypotheses. For replicated designs, the ``r'' parameter in each function can be adjusted to be greater than 1. Plots of BFFs versus effect size provide informative summaries of hypothesis tests that can be easily aggregated across studies.

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Encoding UTF-8

Imports BSDA, grDevices, graphics, hypergeo, ggplot2, Matrix, gsl, stats

Suggests testthat (>= 2.1.0), knitr, rmarkdown

RoxygenNote 7.2.3

VignetteBuilder knitr

Depends R (>= 2.10)

NeedsCompilation no

Repository CRAN

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R topics documented:

`chi2_test_BFF` *chi2_test_BFF*

Description

chi2_test_BFF constructs BFFs based on the chi-squared test. BFFs depend on hyperparameters r and tau^2 which determine the shape and scale of the prior distributions which define the alternative hypotheses. By setting r > 1, we use higher-order moments for replicated studies. Fractional moments are set with r > 1 and r not an integer. All results are on the log scale. Plot saved to working directory unless a full path is specified in the 'savename' variable of the function.

Usage

```
chi2_test_BFF(
  chi2_stat,
  n = NULL,
  df = NULL,
  pearsons = TRUE,
  savename = NULL,
  maximize = FALSE,
  r = 1,
  tau2 = NULL,
  save = TRUE,
  xlab = NULL,
  ylab = NULL,
  main = NULL
)
```

Arguments

`chi2_stat`	chi^2 statistic
`n`	sample size
`df`	degrees of freedom
`pearsons`	Is this a test of Pearson's chi^2 test for goodness-of-fit? Default is TRUE. FALSE assumes a likelihood ratio test

savename	optional, filename for saving the pdf of the final plot
maximize	Should the value of r be maximized? Default is FALSE. Only set to TRUE if analyzing multiple studies
r	r value
tau2	tau2 values (can be a single entry or a vector of values)
save	should a copy of the plot be saved?
xlab	optional, x label for plot
ylab	optional, y label for plot
main	optional, main label for plot

Value

Returns Bayes factor function results

BFF	The log of the Bayes Factor Function values
effect_size	Effect sizes tested (seq(0, 1, by = 0.01))
BFF_max_RMSE	Maximum BFF value
max_RMSE	Effect size that maximizes BFF
tau2	tau^2 values tested

Examples

```
chi2BFF = chi2_test_BFF(chi2_stat = 2.5, n = 50, df = 49, save = FALSE)
chi2BFF = chi2_test_BFF(chi2_stat = 2.5, n = 50, df = 49, save = FALSE, tau2 = 0.5)
chi2BFF = chi2_test_BFF(chi2_stat = 2.5, n = 50, df = 49, save = FALSE, tau2 = c(0.5, 0.8))
chi2_test_BFF(chi2_stat = 2.5, n = 50, df = 49, pearsons = FALSE, save = FALSE)
chi2_test_BFF(chi2_stat = 2.5, n = 50, df = 49, r = 2, save = FALSE)
chi2_test_BFF(chi2_stat = 2.5, n = 50, df = 49, r = 2, pearsons = FALSE, save = FALSE)
chi2_test_BFF(chi2_stat = 2.5, n = 50, df = 49, r = 2.5, save = FALSE)
chi2_test_BFF(chi2_stat = 2.5, n = 50, df = 49, r = 2.5, pearsons = FALSE, save = FALSE)
chi2_test_BFF(chi2_stat=2.5, n = 50, df = 49, maximize = TRUE)
chi2_test_BFF(chi2_stat=2.5, n = 50,  df = 49, maximize = TRUE, tau2 = 0.5)
chi2_test_BFF(chi2_stat=2.5, n = 50,  df = 49, maximize = TRUE, tau2 = c(0.5, 0.8))
chi2BFF$BFF_max_RMSE  # maximum BFF value
chi2BFF$max_RMSE      # effect size which maximizes the BFF
```

Description

f_test_BFF constructs BFFs based on the F test. BFFs depend on hyperparameters r and tau^2 which determine the shape and scale of the prior distributions which define the alternative hypotheses. By setting r > 1, we use higher-order moments for replicated studies. Fractional moments are set with r > 1 and r not an integer. All results are on the log scale. Plot saved to working directory unless a full path is specified in the 'savename' variable of the function.

Usage

```
f_test_BFF(
  f_stat,
  n,
  df1,
  df2,
  savename = NULL,
  maximize = FALSE,
  r = 1,
  tau2 = NULL,
  save = TRUE,
  xlab = NULL,
  ylab = NULL,
  main = NULL
)
```

Arguments

f_stat	F statistic
n	sample size
df1	first degree of freedom
df2	first degree of freedom
savename	optional, filename for saving the pdf of the final plot
maximize	should the function be maximzied over all possible r values? Default is FALSE. Only set to TRUE if analyzing multiple studies
r	r value
tau2	tau2 values (can be a single entry or a vector of values)
save	should a copy of the plot be saved?
xlab	optional, x label for plot
ylab	optional, y label for plot
main	optional, main label for plot

Value

Returns Bayes factor function results

BFF	The log of the Bayes Factor Function values

effect_size	Effect sizes tested (seq(0, 1, by = 0.01))
BFF_max_RMSE	Maximum BFF value
max_RMSE	Effect size that maximizes BFF
tau2	tau^2 values tested

Examples

```
fBFF = f_test_BFF(f_stat = 2.5, n = 50, df1 = 20, df2 = 48, save = FALSE)
f_test_BFF(f_stat = 2.5, n = 50, df1 = 20, df2 = 48, save = FALSE, tau2 = 0.5)
f_test_BFF(f_stat = 2.5, n = 50, df1 = 20, df2 = 48, save = FALSE, tau2 = c(0.5, 0.8))
f_test_BFF(f_stat = 2.5, n = 50, df1 = 20, df2 = 48, r = 2, save = FALSE)
f_test_BFF(f_stat = 2.5, n = 50, df1 = 20, df2 = 48, r = 2.5, save = FALSE)
f_test_BFF(f_stat=2.5, n = 50, df1 = 20, df2 = 48, maximize = TRUE)
f_test_BFF(f_stat=2.5, n = 50, df1 = 20, df2 = 48, maximize = TRUE, tau2 = 0.5)
f_test_BFF(f_stat=2.5, n = 50, df1 = 20, df2 = 48, maximize = TRUE, tau2 = c(0.5, 0.8))
fBFF$BFF_max_RMSE  # maximum BFF value
fBFF$max_RMSE      # effect size which maximizes the BFF value
```

---

t_test_BFF *t_test_BFF*

Description

t_test_BFF constructs BFFs based on the t test. BFFs depend on hyperparameters r and tau^2 which determine the shape and scale of the prior distributions which define the alternative hypotheses. By setting r > 1, we use higher-order moments for replicated studies. Fractional moments are set with r > 1 and r not an integer. All results are on the log scale. Plot saved to working directory unless a full path is specified in the 'savename' variable of the function.

Usage

```
t_test_BFF(
  t_stat,
  n = NULL,
  df = NULL,
  one_sample = TRUE,
  n1 = NULL,
  n2 = NULL,
  savename = NULL,
  maximize = FALSE,
  r = 1,
  tau2 = NULL,
```

```
  save = TRUE,
  xlab = NULL,
  ylab = NULL,
  main = NULL
)
```

Arguments

t_stat	T statistic
n	sample size (if one sample test)
df	degrees of freedom
one_sample	is test one sided? Default is TRUE
n1	sample size of group one for two sample test
n2	sample size of group two for two sample test
savename	optional, filename for saving the pdf of the final plot
maximize	should the function be maximzied over all possible r values? Default is FALSE. Only set to TRUE if analyzing multiple studies
r	r value
tau2	tau2 values (can be a single entry or a vector of values)
save	should a copy of the plot be saved?
xlab	optional, x label for plot
ylab	optional, y label for plot
main	optional, main label for plot

Value

Returns Bayes factor function results

BFF	The log of the Bayes Factor Function values
effect_size	Effect sizes tested (seq(0, 1, by = 0.01))
BFF_max_RMSE	Maximum BFF value
max_RMSE	Effect size that maximizes BFF
tau2	tau^2 values tested

Examples

```
tBFF = t_test_BFF(t_stat = 2.5, n = 50, df = 49, save = FALSE)
t_test_BFF(t_stat = 2.5, n = 50, df = 49, save = FALSE, tau2 = 0.5)
t_test_BFF(t_stat = 2.5, n = 50, df = 49, save = FALSE, tau2 = c(0.5, 0.2))
t_test_BFF(t_stat = 2.5, n1 = 50, n2 = 40, df = 88, save = FALSE, one_sample = FALSE)
```

```
t_test_BFF(t_stat = 2.5, n = 50, r = 2, df = 49, save = FALSE)
t_test_BFF(t_stat = 2.5, r = 2, n1 = 50, n2 = 30, df = 78, one_sample = FALSE, save = FALSE)
t_test_BFF(t_stat = 2.5, n = 50, r = 2.5, df = 49, save = FALSE)
t_test_BFF(t_stat=2.5, r = 2.5, n1 = 50, n2 = 30, df = 78, one_sample = FALSE, save=FALSE)
t_test_BFF(t_stat = 2.5, n = 50, df = 49, save = FALSE, maximize = TRUE)
t_test_BFF(t_stat = 2.5, n = 50, df = 49, save = FALSE, maximize = TRUE, tau2 = 0.5)
t_test_BFF(t_stat = 2.5, n = 50, df = 49, save = FALSE, maximize = TRUE, tau2 = c(0.5, 0.8))
tBFF$BFF_max_RMSE   # maximum BFF value
tBFF$max_RMSE       # effect size which maximizes the BFF value
```

---

z_test_BFF *z_test_BFF*

Description

z_test_BFF constructs BFFs based on the z test. BFFs depend on hyperparameters r and tau^2 which determine the shape and scale of the prior distributions which define the alternative hypotheses. By setting r > 1, we use higher-order moments for replicated studies. Fractional moments are set with r > 1 and r not an integer. All results are on the log scale. Plot saved to working directory unless a full path is specified in the 'savename' variable of the function.

Usage

```
z_test_BFF(
  z_stat,
  n = NULL,
  one_sample = TRUE,
  n1 = NULL,
  n2 = NULL,
  savename = NULL,
  maximize = FALSE,
  r = 1,
  tau2 = NULL,
  save = TRUE,
  xlab = NULL,
  ylab = NULL,
  main = NULL
)
```

Arguments

z_stat	z statistic
n	sample size (if one sample test)
one_sample	is test one sided? Default is TRUE
n1	sample size of group one for two sample test
n2	sample size of group two for two sample test

savename	optional, filename for saving the pdf of the final plot
maximize	Should the value of r be maximized? Default is FALSE. Only set to TRUE if analyzing multiple studies
r	r value
tau2	tau2 values (can be a single entry or a vector of values)
save	should a copy of the plot be saved?
xlab	optional, x label for plot
ylab	optional, y label for plot
main	optional, main label for plot

Value

Returns Bayes factor function results

BFF	The log of the Bayes Factor Function values
effect_size	Effect sizes tested (seq(0, 1, by = 0.01))
BFF_max_RMSE	Maximum BFF value
max_RMSE	Effect size that maximizes BFF
tau2	tau^2 values tested

Examples

```
zBFF = z_test_BFF(z_stat = 2.5, n = 50, save = FALSE)
z_test_BFF(z_stat = 2.5, n = 50, save = FALSE, tau2 = 0.5)
z_test_BFF(z_stat = 2.5, n = 50, save = FALSE, tau2 = c(0.5, 0.8))
z_test_BFF(z_stat = 2.5, n1 = 50, n2 = 35, one_sample = FALSE, save = FALSE) ##
z_test_BFF(z_stat = 2.5, n = 50, r = 2, save = FALSE)
z_test_BFF(z_stat = 2.5, r = 2, n1 = 50, n2 = 30, one_sample = FALSE, save = FALSE) ##
z_test_BFF(z_stat = 2.5, n = 50, r = 2.5, save = FALSE)
z_test_BFF(z_stat = 2.5, r = 2.5, n1 = 50, n2 = 30, one_sample = FALSE, save = FALSE) ##
z_test_BFF(z_stat=2.5, n = 50, maximize = TRUE)
z_test_BFF(z_stat=2.5, n = 50,  maximize = TRUE, tau2 = 0.5)
z_test_BFF(z_stat=2.5, n = 50,  maximize = TRUE, tau2 = c(0.5, 0.8))
zBFF$BFF_max_RMSE   # maximum BFF value
zBFF$max_RMSE       # effect size which maximizes the BFF value
```

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