Package 'BayesPower'

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Title Sample Size and Power Calculation for Bayesian Testing with Bayes Factor

Version 1.0.2

Description The goal of 'BayesPower' is to provide tools for Bayesian sample size determination and power analysis across a range of common hypothesis testing scenarios using Bayes factors. The main function, BayesPower_BayesFactor(), launches an interactive 'shiny' application for performing these analyses. The application also provides command-line code for reproducibility. Details of the methods are described in the tutorial by Wong, Pawel, and Tendeiro (2025) <doi:10.31234/osf.io/pgdac_v2>.

BugReports https://github.com/tkWong3004/BayesPower/issues

License GPL (>= 3)

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Contents

`BayesPower_BayesFactor`

Launch the BayesPower Shiny Application

Description

This function starts the interactive Shiny application for Bayesian power analysis using Bayes factors. The app provides a graphical user interface built with **shiny**.

Usage

```
BayesPower_BayesFactor()
```

Details

The application includes both the UI and server components, which are defined internally in the package. When run, a browser window or RStudio viewer pane will open to display the interface.

Value

No return value, called for its side effects.

Examples

```
if (interactive()) {
  # Launch the Shiny application
  BayesPower_BayesFactor()
}
```

`BF10.bin.test` *Bayes Factor for a Bayesian One-Proportion Test*

Description

Calculate the Bayes factor (BF10) for a single-proportion test, either against a point null or an interval null hypothesis.

Usage

```
BF10.bin.test(
  x,
  n,
  alpha,
  beta,
  h0,
  scale,
  prior_analysis,
  alternative,
  ROPE = NULL
)
```

Arguments

`x`	Numeric integer. Observed number of successes (non-negative integer scalar, must be $\leq n$).
`n`	Numeric integer. Sample size (positive integer scalar).
`alpha`	Numeric scalar. Shape parameter of the analysis beta prior under the alternative hypothesis (required if `prior_analysis = "beta"`).
`beta`	Numeric scalar. Shape parameter of the analysis beta prior under the alternative hypothesis (required if `prior_analysis = "beta"`).
`h0`	Numeric scalar. Null proportion value (numeric scalar between 0.1 and 0.9).
`scale`	Numeric scalar. Scale parameter for the analysis prior (only used if `prior_analysis = "Moment"`).
`prior_analysis`	character. the analysis prior under the alternative hypothesis: `"beta"` (stretched beta) or `"Moment"` (normal-moment prior).
`alternative`	character. Hypothesis being tested: two-sided (`"two.sided"`), right-sided (`"greater"`), or left-sided (`"less"`).
`ROPE`	Numeric vector. Optional numeric vector specifying bounds for an interval null; used if interval BF is calculated.

Value

An object of class "BFvalue_bin" containing:

- bf10: Bayes factor in favor of the alternative hypothesis.
- type: Test type ("one-proportion").
- x: Number of successes.
- n: Sample size.
- h0: Null proportion value.
- analysis_h1: List describing the analysis prior, containing prior (prior distribution), alpha (alpha parameter), beta (beta parameter), and scale (scale parameter).
- alternative: the direction of the alternative hypothesis.
- ROPE: interval null bounds (if specified).
- p.value: p-value.

Examples

```
BF10.bin.test(
 x = 42,
 n = 52,
 h0 = 0.5,
 prior_analysis = "beta",
 alternative = "greater",
 alpha = 1,
 beta = 1)
```

BF10.cor *Bayes factor for a Bayesian correlation test*

Description

Calculate the Bayes factor (BF10) for a correlation coefficient, either against a point null or an interval null hypothesis. Supports default beta ("d_beta"), stretched beta ("beta"), and normal-moment ("Moment") priors for the alternative hypothesis.

Usage

```
BF10.cor(
  r,
  n,
  k,
  alpha,
  beta,
  h0,
  alternative,
```

```
  scale,
  prior_analysis,
  ROPE = NULL
)
```

Arguments

r	Numeric scalar. Observed correlation coefficient. Must be a numeric scalar between -1 and 1.
n	Numeric integer. Sample size. Must be a numeric scalar greater than 3.
k	Numeric scalar. Parameter for the analysis default beta prior ("d_beta") under the alternative hypothesis.
alpha	Numeric scalar. Parameter for the analysis beta prior ("beta") under the alternative hypothesis.
beta	Numeric scalar. Parameter for the analysis beta prior ("beta") under the alternative hypothesis.
h0	Numeric scalar. Null value of the correlation. Must be a numeric scalar between -0.8 and 0.8.
alternative	Character. The direction of the alternative hypothesis being tested: two-sided ("two.sided"), right-sided ("greater"), or left-sided ("less").
scale	Numeric scalar. Scale parameter for the analysis normal-moment prior ("Moment"). Must be > 0.
prior_analysis	Character. Analysis prior: default beta ("d_beta"), beta ("beta"), or normal-moment ("Moment").
ROPE	Numeric vector. Optional numeric vector specifying bounds for an interval null hypothesis. For "two.sided", must be two distinct finite values between -0.5 and 0.5. For "greater" or "less", must satisfy additional bounds relative to h0.

Value

A list with class "BFvalue_r" containing:

- type: "correlation"
- bf10: Calculated Bayes factor BF10
- h0: Null value of the correlation
- r: Observed correlation coefficient
- n: Sample size
- analysis_h1: List with the analysis prior parameters: prior_analysis, k, alpha, beta, and scale.
- alternative: the direction of the alternative hypothesis
- ROPE: Interval bounds if specified
- p.value: Numeric, p.value.

Examples

```
BF10.cor(
  r = 0.3930924,
  n = 46,
  prior_analysis = "d_beta",
  k = 1,
  h0 = 0,
  alternative = "two.sided")
```

`BF10.f.test` *Bayes Factor for a Bayesian F-Test*

Description

Computes the Bayes factor (BF10) for an F-test, comparing a full model to a reduced model under either an effect-size prior or a Moment prior. Optionally, an interval null hypothesis can be specified.

Usage

```
BF10.f.test(fval, df1, df2, dff, rscale, f_m, prior_analysis, ROPE = NULL)
```

Arguments

`fval`	Numeric scalar. Observed F statistic (must be at least 0).
`df1`	Numeric scalar. Numerator degrees of freedom (must be > 0).
`df2`	Numeric scalar. Denominator degrees of freedom (must be > 0).
`dff`	Numeric scalar. Degrees of freedom for the analysis prior under the alternative hypothesis. For the Moment prior, this must be ≥ 3.
`rscale`	Numeric scalar. Scale parameter for the effect-size prior (only used when `prior_analysis = "effectsize"`).
`f_m`	Numeric scalar. Cohen's f effect-size parameter for the analysis prior.
`prior_analysis`	character. Analysis prior under the alternative hypothesis. Must be either `"effectsize"` or `"Moment"`.
`ROPE`	Numeric scaler. Optional numeric scalar specifying an upper bound for an interval null hypothesis. If provided, must be > 0.

Value

A list of class `"BFvalue_f"` containing:

`fval` Input F-value.

`df1`, `df2` Degrees of freedom.

`ROPE` Interval bound (if specified).

`analysis_h1` List containing the analysis prior specification, including the prior distribution, the scale `rscale`, f `f_m`, and degrees of freedom `dff`.

`bf10` The computed Bayes factor.

`p.value` p-value.

Examples

```
BF10.f.test(
  fval = 4.5,
  df1 = 2,
  df2 = 12,
  dff = 12,
  rscale = 0.707,
  f_m = 0.1,
  prior_analysis = "effectsize"
)
```

`BF10.props` *Bayes factor for comparing two proportions*

Description

Compute the Bayes factor (BF10) for a Bayesian test of two proportions.

Usage

```
BF10.props(a0, b0, a1, b1, a2, b2, n1, n2, x1, x2)
```

Arguments

`a0`	Numeric scalar. Alpha parameter of the Beta prior under the null hypothesis.
`b0`	Numeric scalar. Beta parameter of the Beta prior under the null hypothesis.
`a1`	Numeric scalar. Alpha parameter of the Beta prior for group 1 under the alternative hypothesis.
`b1`	Numeric scalar. Beta parameter of the Beta prior for group 1 under the alternative hypothesis.
`a2`	Numeric scalar. Alpha parameter of the Beta prior for group 2 under the alternative hypothesis.
`b2`	Numeric scalar. Beta parameter of the Beta prior for group 2 under the alternative hypothesis.
`n1`	Numeric integer. Sample size for group 1.
`n2`	Numeric integer. Sample size for group 2.
`x1`	Numeric integer. Number of successes observed in group 1.
`x2`	Numeric integer. Number of successes observed in group 2.

Value

A list of class `BFvalue_2p` containing:

- `type`: the string "Two-proportions".
- `analysis_h0`: list with `a` and `b` for the null prior.
- `analysis_h1_theta_1`: list with `a` and `b` for group 1 prior under H1.
- `analysis_h1_theta_2`: list with `a` and `b` for group 2 prior under H1.
- `bf10`: the computed Bayes factor (BF10).
- `n1`, `x1`, `n2`, `x2`: the input sample sizes and observed successes.
- `OddRatio`: observed odd ratio.
- `p.value`: p.value.

Examples

```
BF10.props(
a0 = 1,
b0 = 1,
a1 = 1,
b1 = 1,
a2 = 1,
b2 = 1,
n1 = 493,
n2 = 488,
x1 = 155,
x2 = 150)
```

`BF10.ttest.OneSample` *Bayes Factor for a One-Sample Bayesian t-Test*

Description

Computes the Bayes factor (BF10) for a one-sample t-test, comparing an observed t-value against either a point null hypothesis or an interval null hypothesis.

Usage

```
BF10.ttest.OneSample(
  tval,
  df,
  prior_analysis,
  location,
  scale,
  dff,
  alternative,
  ROPE = NULL
)
```

Arguments

`tval`	Numeric scalar. Observed t-value from the one-sample t-test.
`df`	Numeric scalar. Degrees of freedom of the t-test (must be >= 1).
`prior_analysis`	Character string. Statistical model for the analysis prior under the alternative hypothesis. Choices are: **"Normal"** Normal distribution. **"Moment"** Normal moment prior. **"t-distribution"** Scaled t-distribution.
`location`	Numeric scalar. Location parameter for the analysis prior under the alternative hypothesis.
`scale`	Numeric scalar. Scale parameter for the analysis prior under the alternative hypothesis (must be > 0).
`dff`	Numeric scalar. Degrees of freedom for the t-distribution prior (only required if `prior_analysis` = `"t-distribution"`; must be > 0). Ignored otherwise.
`alternative`	Character string. The direction of the alternative hypothesis. One of: **"!="** Two-sided (difference from 0). **">"** Right-sided (greater than 0). **"<"** Left-sided (less than 0).
`ROPE`	Optional numeric vector. Specifies bounds for an interval null hypothesis. For: **Two-sided** (`"two.sided"`) Must be a numeric vector of length 2 with two distinct finite values. **Right-sided** (`"greater"`) Must be a numeric scalar > 0. **Left-sided** (`"less"`) Must be a numeric scalar < 0.

Value

A list of class `BFvalue_t` containing:

type Character, indicating "One-sample t-test".

bf10 Numeric, the Bayes factor (BF10).

tval Observed t-value.

df Degrees of freedom.

analysis_h1 List with the analysis prior parameters: `prior_analysis`, `location`, `scale`, and optionally `dff`.

alternative Character, the direction of the alternative hypothesis.

ROPE Optional numeric vector of interval null bounds.

d Numeric, observed Cohen's d.

p.value Numeric, p.value.

Examples

```
BF10.ttest.OneSample(
tval = 2,
df = 50,
prior_analysis = "t-distribution",
location = 0,
scale = 0.707,
dff = 1,
alternative = "two.sided")
```

`BF10.ttest.TwoSample` *Bayes Factor for Two-Sample Bayesian t-Test*

Description

Compute the Bayes factor (BF10) for a two-sample independent-samples t-test. Supports both point-null and interval-null hypotheses.

Usage

```
BF10.ttest.TwoSample(
  tval,
  N1,
  N2,
  prior_analysis,
  location,
  scale,
  dff,
  alternative,
  ROPE = NULL
)
```

Arguments

`tval`	Numeric scalar. Observed t-value from the two-sample t-test.
`N1`	Numeric integer. Sample size of group 1 (must be > 2, will be rounded to nearest integer).
`N2`	Numeric integer. Sample size of group 2 (must be > 2, will be rounded to nearest integer).
`prior_analysis`	Character. Analysis prior under the alternative hypothesis: `"Normal"`, `"Moment"` (normal-moment prior), or `"t-distribution"`.
`location`	Numeric scalar. Location parameter of the analysis prior.
`scale`	Numeric scalar > 0. Scale parameter of the analysis prior.

`dff` Numeric scalar. Degrees of freedom for the analysis prior (required if prior_analysis = `"t-distribution"`; ignored otherwise).

`alternative` Character. The direction of the alternative hypothesis two-sided (`"two.sided"`), right-sided (`"greater"`), or left-sided (`"less"`).

`ROPE` Optional numeric. Bounds for an interval null:

- For `"two.sided"`, must be a numeric vector of length 2 with distinct finite values.
- For `"greater"`, must be a single numeric scalar > 0.
- For `"less"`, must be a single numeric scalar < 0.

Value

A list of class `BFvalue_t` containing:

type Character string describing the test type.

bf10 Computed Bayes factor BF10.

tval Observed t-value.

df Degrees of freedom (currently NA / not computed).

analysis_h1 List with the analysis prior parameters: `prior_analysis`, `location`, `scale`, and optionally `dff`.

alternative Hypothesis tested (`"two.sided"`, `"greater"`, or `"less"`).

ROPE Interval bounds used, if any.

N1 Sample size of group 1 .

N2 Sample size of group 2 .

d Numeric, observed Cohen's d.

p.value Numeric, p.value.

Examples

```
BF10.ttest.TwoSample(
 tval = -1.148,
 N1 = 53,
 N2 = 48,
 prior_analysis = "t-distribution",
 location = 0,
 scale = 0.707,
 dff = 1,
 alternative = "two.sided",
 ROPE = c(-0.36,0.36))
```

BFpower.bin *Sample Size Determination for the Bayesian one-proportion test*

Description

Perform sample size determination or the calculation of compelling and misleading evidence for a Bayesian test of a single proportion.

Usage

```
BFpower.bin(
  alternative,
  threshold,
  h0,
  true_rate,
  false_rate,
  prior_analysis,
  alpha,
  beta,
  scale,
  prior_design = NULL,
  alpha_d,
  beta_d,
  location_d,
  scale_d,
  N = NULL,
  ROPE = NULL,
  type_rate = "positive",
  plot_power = FALSE,
  plot_rel = FALSE
)
```

Arguments

alternative	Character. The direction of the alternative hypothesis : two-sided ("two.sided"), right-sided ("greater"), or left-sided ("less").
threshold	Numeric scalar. Threshold for compelling evidence (must be > 1).
h0	Numeric scalar. Null proportion value for the test (numeric scalar between 0.1 and 0.9).
true_rate	Numeric scalar. Targeted true positive rate or true negative rate .
false_rate	Numeric scalar. Targeted false positive rate or false negative rate .
prior_analysis	Character. Analysis prior under the alternative hypothesis: "beta" or "Moment".
alpha	Numeric scalar. Parameter for the analysis beta prior (used when prior_analysis = "beta").

beta	Numeric scalar. Parameter for the analysis beta prior (used when prior_analysis = "beta").
scale	Numeric scalar. Scale parameter for the analysis moment prior (used when prior_analysis = "Moment").
prior_design	Character. Design prior under the alternative hypothesis: "beta", "Moment", or "Point".
alpha_d	Numeric scalar. Parameter for the design beta prior (used when prior_design = "beta").
beta_d	Numeric scalar. Parameter for the design beta prior (used when prior_design = "beta").
location_d	Numeric scalar. Proportion value for the design point prior (prior_design = "Point"). Represents the true proportion under the alternative hypothesis.
scale_d	Numeric scalar. Scale parameter for the design moment prior (used when prior_design = "Moment").
N	Numeric integer. Sample size. If NULL, sample size determination is performed.
ROPE	Numeric vector. Numeric bounds for the interval null (used when computing interval Bayes factors). • For hypothesis = "two.sided", must be a numeric vector of length 2 with distinct finite values. • For "greater", must be a single numeric scalar > 0. • For "less", must be a single numeric scalar < 0.
type_rate	Character. Either "positive" (controls true/false positive rates) or "negative" (controls true/false negative rates).
plot_power	Logical. Whether to plot power curves when sample size determination is requested.
plot_rel	Logical. Whether to plot probability of misleading evidence.

Details

1. Sample size determination mode (when N = NULL):

If no sample size is provided, the function calculates the minimum sample size needed to achieve the desired configuration below. The user must provide:

- type_rate - either "positive" to control true/false positive rates or "negative" to control true/false negative rates.
- true_rate - the targeted true positive or true negative rate (between 0.6 and 0.999).
- false_rate - the acceptable false positive or false negative rate (between 0.001 and 0.1).
- threshold - the Bayes factor threshold for compelling evidence (must be > 1).

The function iteratively finds the smallest sample size for which the probability of obtaining compelling evidence meets or exceeds true_rate, while the probability of misleading evidence does not exceed false_rate.

2. Fixed-sample analysis mode (when N is supplied):

If a positive numeric sample size N is provided, the function computes the probabilities of obtaining compelling or misleading evidence for that fixed sample size. In this mode, type_rate, true_rate, and false_rate are ignored; only the Bayes factor threshold threshold is used.

Model specification:

The user must specify the analysis prior under the alternative hypothesis using prior_analysis:

- prior_analysis = "beta": requires alpha and beta parameters (shape parameters of the beta distribution).
- prior_analysis = "Moment": requires scale parameter (scale of the moment prior).

The design prior under the alternative hypothesis can optionally be specified using prior_design:

- "beta": requires alpha_d and beta_d.
- "Moment": requires scale_d.
- "Point": requires location_d, representing the true proportion under the alternative hypothesis.

If prior_design is NULL, no design prior is used.

interval null Hypothesis:

If ROPE is provided, the function evaluates the Bayes factor for an interval null. Otherwise, a point-null hypothesis is assumed.

Hypothesis:

The function supports one-sided ("greater" or "less") and two-sided ("two.sided") tests. Design prior and interval null bounds must be consistent with the directionality of the hypothesis.

Plotting:

If plot_power = TRUE, the function plots the probability of compelling evidence as a function of sample size. If plot_rel = TRUE, the relationship between the Bayes factor and the number of successes (proportion) is plotted.

Value

A list of class "BFpower_bin" containing:

- type: Test type ("One proportion").
- alternative: alternative hypothesis.
- h0: The proportion under the null hypothesis.
- analysis_h1: List describing the analysis prior, containing prior (prior distribution), alpha (alpha parameter), beta (beta parameter), and scale (scale parameter).
- design_h1: List describing the design prior (if provided), containing prior (prior distribution), alpha (alpha parameter), beta (beta parameter), and scale (scale parameter).
- results: Data frame of probabilities of compelling/misleading evidence and the required or supplied sample size.
- threshold: Compelling-evidence threshold.
- plot_power: Logical, whether power curves are plotted.
- plot_rel: Logical, whether the relationship between the BF and data is plotted.

If sample size determination fails, the function returns NaN and prints a message.

Examples

```
BFpower.bin(
  alternative = "greater",
  threshold = 3,
  true_rate = 0.8,
  false_rate = 0.05,
  h0 = 0.5,
  prior_analysis = "beta",
  alpha = 1,
  beta = 1,
  plot_rel = TRUE,
  plot_power = TRUE)
```

BFpower.cor *Sample Size Determination for the Bayesian correlation test*

Description

Perform sample size determination or the probability of obtaining compelling or misleading evidence for a Bayesian correlation test. Can handle both point-null and interval-null hypothesis, and allows specifying analysis and design priors.

Usage

```
BFpower.cor(
  alternative,
  h0,
  ROPE = NULL,
  threshold,
  true_rate,
  false_rate,
  prior_analysis,
  k,
  alpha,
  beta,
  scale,
  prior_design = NULL,
  alpha_d,
  beta_d,
  location_d,
  k_d,
  scale_d,
  N = NULL,
  type_rate = "positive",
  plot_power = FALSE,
  plot_rel = FALSE
)
```

Arguments

alternative	character. The direction of the alternative hypothesis being tested: two-sided ("two.sided"), right-sided ("greater"), or left-sided ("less").
h0	Numeric scalar. Null rho correlation value. Must be between -0.8 and 0.8.
ROPE	Optional numeric vector or scalar specifying bounds for an interval null; used if interval Bayes factor is calculated. • For alternative = "two.sided", must be a numeric vector of length 2 with distinct finite values. • For alternative = "greater", must be a single numeric scalar > 0. • For alternative = "less", must be a single numeric scalar < 0.
threshold	Numeric scalar. Threshold of compelling evidence (numeric scalar > 1).
true_rate	Numeric scalar. Targeted true positive rate (if positive = "positive") or true negative rate (if positive = "negative").
false_rate	Numeric scalar. Targeted false positive rate (if positive = "positive") or false negative rate (if positive = "negative").
prior_analysis	character. Analysis prior under the alternative hypothesis: default beta ("d_beta"), beta ("beta"), or normal moment ("Moment").
k	Numeric scalar. Parameter for the default beta prior ("d_beta").
alpha	Numeric scalar. Parameter for the beta prior ("beta").
beta	Numeric scalar. Parameter for the beta prior ("beta").
scale	Numeric scalar. Scale parameter for the normal moment prior ("Moment").
prior_design	character. Design prior under the alternative hypothesis: default beta ("d_beta"), beta ("beta"), normal moment ("Moment"), or point ("Point").
alpha_d	Numeric scalar. Parameter for the design beta prior ("beta").
beta_d	Numeric scalar. Parameter for the design beta prior ("beta").
location_d	Numeric scalar. Location parameter for the design point prior ("Point").
k_d	Numeric scalar. Parameter for the design default beta prior ("d_beta").
scale_d	Numeric scalar. Scale parameter for the design normal moment prior ("Moment").
N	Numeric integer. Sample size. Only required if the goal is not sample size determination, but rather to calculate the probability of obtaining compelling or misleading evidence for a given sample size.
type_rate	character. Character indicating which rate to control: "positive" (true/false positive rates) or "negative" (true/false negative rates).
plot_power	Logical; if TRUE, plots power curves.
plot_rel	Logical; if TRUE, plots the relationship between the BF and data.

Details

1. Sample size determination mode (when N = NULL):

If no sample size is provided, the function determines the minimum sample size required to meet the desired requirements. In this mode, the user must supply the following arguments:

- type_rate - either "positive" to control true/false positive rates, or "negative" to control true/false negative rates.
- true_rate - the targeted true positive or true negative rate (between 0.6 and 0.999).
- false_rate - the acceptable false positive or false negative rate (between 0.001 and 0.1).
- threshold - the Bayes factor threshold for compelling evidence (must be > 1).

The function iteratively finds the smallest sample size for which the probability of obtaining compelling evidence meets or exceeds true_rate, while the probability of misleading evidence does not exceed false_rate.

2. Fixed-sample analysis mode (when N is supplied):

If a positive numeric sample size N is provided, the function computes the probabilities of obtaining compelling or misleading evidence for that fixed sample size. In this mode, the arguments type_rate, true_rate, and false_rate are ignored; only the Bayes factor threshold threshold is used.

Hypothesis specification:

The alternative argument defines the direction of the alternative hypothesis : "two.sided" for two-sided, "greater" for right-sided, or "less" for left-sided tests. The optional ROPE argument specifies bounds for an interval null hypothesis. If ROPE = NULL, a point-null test is assumed.

Analysis Priors:

The analysis prior specifies the prior distribution of the correlation under the alternative hypothesis. Depending on prior_analysis, the user must supply:

- d_beta (default beta): k > 0.
- beta (stretched beta): alpha and beta > 0.
- Moment (normal-moment prior): scale > 0.

Design Priors (optional):

A design prior can be supplied to reflect uncertainty about the correlation during study planning. If provided, prior_design must be one of "d_beta", "beta", "Moment", or "Point", and the corresponding parameters must be supplied:

- d_beta: k_d > 0.
- beta: alpha_d and beta_d > 0.
- Moment: scale_d > 0.
- Point: location_d numeric scalar.

interval null Hypothesis:

If ROPE is provided, the function evaluates the Bayes factor for an interval null. Otherwise, a point-null hypothesis is assumed.

Plotting:

If plot_power = TRUE, the function plots the probability of compelling evidence as a function of sample size. If plot_rel = TRUE, the relationship between the BF and correlation is plotted.

Value

A list of class BFpower_r containing:

- type: Test type (always "Correlation").
- alternative: the direction of the alternative hypothesis.
- h0: the value of correlation under the null hypothesis.
- ROPE: Bounds for interval null (if used).
- analysis_h1: List with the analysis prior parameters: prior_analysis, k, alpha, beta, and scale.
- design_h1: List with the design prior parameters: prior_design, k, alpha, beta, scale, and location.
- results: Data frame with the probabilities of compelling/misleading evidence, and with the required sample size.
- threshold: Threshold of compelling evidence.
- plot_power: Logical, whether power curves are plotted.
- plot_rel: Logical, whether the relationship between the BF and the correlation is plotted.

Examples

```
BFpower.cor(
 alternative = "greater",
   h0 = 0,
   threshold = 3,
   true_rate = 0.8,
   false_rate = 0.05,
   prior_analysis = "d_beta",
   k = 1,
   prior_design = "Point",
   location_d = 0.3,
   plot_power = TRUE,
   plot_rel = TRUE
 )
```

BFpower.f.test *Sample Size Determination for the Bayesian F-test*

Description

This function performs sample size determination (when N = NULL) or calculates the probability of compelling/misleading evidence for a fixed sample size.

Usage

```
BFpower.f.test(
  threshold,
  true_rate,
  false_rate,
  p,
  k,
  prior_analysis,
  dff,
  rscale,
  f_m,
  prior_design = NULL,
  dff_d,
  rscale_d,
  f_m_d,
  N = NULL,
  type_rate = "positive",
  ROPE = NULL,
  plot_power = FALSE,
  plot_rel = FALSE
)
```

Arguments

`threshold`	Numeric scalar. Threshold for compelling evidence (must be > 1).
`true_rate`	Numeric scalar. Targeted true positive or true negative rate (used only when sample size determination is requested; `N = NULL`).
`false_rate`	Numeric scalar. Targeted false positive or false negative rate (used only when sample size determination is requested; `N = NULL`).
`p`	Numeric integer. Number of predictors in the reduced model.
`k`	Numeric integer. Number of predictors in the full model (must satisfy `k > p`).
`prior_analysis`	Character. Analysis prior model under the alternative hypothesis: `"effectsize"` or `"Moment"`.
`dff`	Numeric scalar. Degrees of freedom for the analysis prior under the alternative hypothesis. Must be a positive scalar, and must be at least 3 if `prior_analysis = "Moment"`.
`rscale`	Numeric scalar. Scale parameter for the analysis effect-size prior (only used when `prior_analysis = "effectsize"`).
`f_m`	Numeric scalar. Cohen's f effect-size parameter for the analysis prior (must be > 0).
`prior_design`	Character. Design prior model under the alternative hypothesis: `"effectsize"`, `"Moment"`, or `"Point"`.
`dff_d`	Numeric scalar. Degrees of freedom for the design prior. Must be a positive scalar, and at least 3 if `prior_design = "Moment"`.

rscale_d	Numeric scalar. Scale parameter for the design effect-size prior (only used when prior_design = "effectsize").
f_m_d	Numeric scalar. Cohen's f value for the design prior or the effect-size of the point design prior.
N	Numeric integer. Sample size. If NULL, sample size determination is performed.
type_rate	Character. Either "positive" (control true/false positive rates) or "negative" (control true/false negative rates).
ROPE	Numeric vector. Numeric bounds for the interval null (only used when interval Bayes factors are required).
plot_power	Logical. Whether to plot power curves when sample size determination is requested.
plot_rel	Logical. Whether to plot the relationship between the BF and data.

Details

Computes required sample size or probabilities of compelling or misleading evidence for a fixed sample size.

1. Sample size determination mode (when N = NULL):

If no sample size is provided, the function calculates the minimum sample size to achieve the desired configuration below. The user must provide:

- type_rate - either "positive" to control true/false positive rates, or "negative" to control true/false negative rates.
- true_rate - the targeted true positive or true negative rate (between 0.6 and 0.999).
- false_rate - the acceptable false positive or false negative rate (between 0.001 and 0.1).
- threshold - the Bayes factor threshold for compelling evidence (must be > 1).

The function iteratively finds the smallest sample size for which the probability of obtaining compelling evidence meets or exceeds true_rate, while the probability of misleading evidence does not exceed false_rate.

2. Fixed-sample analysis mode (when N is supplied):

If a positive numeric sample size N is provided, the function computes the probabilities of obtaining compelling or misleading evidence for that fixed sample size. In this mode, the arguments type_rate, true_rate, and false_rate are ignored; only the Bayes factor threshold threshold is used.

Model specification:

The function requires the user to specify the full model (k predictors) and the reduced model (p predictors, k > p), and the analysis prior under the alternative hypothesis. Depending on the chosen prior_analysis, different arguments are required:

- prior_analysis = "effectsize": requires rscale (scale parameter) and f_m (Cohen's f effect-size), and dff (degrees of freedom).
- prior_analysis = "Moment": requires f_m (Cohen's f effect-size) and dff (degrees of freedom, must be >= 3); rscale is not used.

The design prior under the alternative hypothesis can optionally be specified using `prior_design`, which can be:

- `"effectsize"`: requires `rscale_d`, `f_m_d`, and `dff_d`.
- `"Moment"`: requires `f_m_d` and `dff_d` (>=3); `rscale_d` is not used.
- `"Point"`: requires `f_m_d` only; `rscale_d` and `dff_d` are not used.

interval null Hypothesis:

If `ROPE` is provided, the function evaluates the Bayes factor for an interval null. Otherwise, a point-null hypothesis is assumed.

Plotting:

If `plot_power = TRUE`, the function plots the probability of compelling evidence as a function of sample size. If `plot_rel = TRUE`, the relationship between the Bayes factor and Cohen's `f` is plotted.

Value

A list of class `BFpower_f` containing:

`type` Test type (always "Regression/ANOVA").

`k, p` Number of predictors in the full and reduced models.

`ROPE` Bounds for interval null (if used).

`analysis_h1` List containing the analysis prior specification, including the prior distribution, the scale `rscale`, f `f_m`, and degrees of freedom `dff`.

`design_h1` List containing the design prior specification, including the prior distribution, the scale `rscale`, f `f_m`, and degrees of freedom `dff` (or `NULL` if not specified).

`results` Data frame of probabilities of compelling/misleading evidence and the required or supplied sample size.

`threshold` Threshold of compelling evidence.

`plot_power` Logical; whether power curves are plotted.

`plot_rel` Logical; whether the relationship between the Bayes factor and data is plotted.

If sample size determination fails, the function returns `NaN` and prints a message.

Examples

```
BFpower.f.test(
 threshold = 3,
 true_rate = 0.8,
 false_rate = 0.05,
 p = 3,
 k = 4,
 prior_analysis = "effectsize",
 dff = 3,
 rscale = 0.18,
 f_m = 0.1,
 prior_design = "Point",
 f_m_d = 0.1,
```

```
 plot_power = TRUE,
 plot_rel = TRUE)
```

BFpower.props *Sample Size Determination for the Bayesian test of two proportions*

Description

Perform sample size determination or calculate probabilities of compelling and misleading evidence for a Bayesian comparison of two proportions.

Usage

```
BFpower.props(
  threshold,
  true_rate,
  a0,
  b0,
  a1,
  b1,
  a2,
  b2,
  prior_design_1 = "same",
  a1d,
  b1d,
  dp1,
  prior_design_2 = "same",
  a2d,
  b2d,
  dp2,
  n1 = NULL,
  n2 = NULL,
  type_rate = "positive",
  plot_power = FALSE,
  plot_rel = FALSE
)
```

Arguments

threshold	Numeric scalar. Threshold of compelling evidence.
true_rate	Numeric scalar. Targeted true positive rate (if positive = "positive") or true negative rate (if positive = "negative").
a0	Numeric scalar. Alpha parameter of the Beta prior under the null hypothesis.
b0	Numeric scalar. Beta parameter of the Beta prior under the null hypothesis.
a1	Numeric scalar. Alpha parameter of the Beta analysis prior for group 1 under the alternative hypothesis.

b1	Numeric scalar. Beta parameter of the Beta analysis prior for group 1 under the alternative hypothesis.
a2	Numeric scalar. Alpha parameter of the Beta analysis prior for group 2 under the alternative hypothesis.
b2	Numeric scalar. Beta parameter of the Beta analysis prior for group 2 under the alternative hypothesis.
prior_design_1	Character. The design prior of group 1: "beta", "Point", or "same" (if "same", the design prior is identical to the analysis prior).
a1d	Numeric scalar. Alpha parameter of the design prior for group 1 (used if model1 = "beta").
b1d	Numeric scalar. Beta parameter of the design prior for group 1 (used if model1 = "beta").
dp1	Numeric scalar. True proportion for group 1 in the design prior (used if model1 = "Point").
prior_design_2	Character. The design prior of group 2: "beta", "Point", or "same" (if "same", the design prior is identical to the analysis prior).
a2d	Numeric scalar. Alpha parameter of the design prior for group 2 (used if model2 = "beta").
b2d	Numeric scalar. Beta parameter of the design prior for group 2 (used if model2 = "beta").
dp2	Numeric scalar. True proportion for group 2 in the design prior (used if model2 = "Point").
n1	Numeric integer. Sample size for group 1.
n2	Numeric integer. Sample size for group 2.
type_rate	Character. Choose "positive" to control true/false positive rates or "negative" to control true/false negative rates.
plot_power	Logical; if TRUE, plot the power curve.
plot_rel	Logical; if TRUE, plot the grid for the values of BF across all possible combination of x1 and x2.

Details

1. Sample size determination mode (when n1 = NULL and n2 = NULL):

If no sample sizes are provided for the two groups, the function calculates the minimum sample sizes needed to achieve the desired configuration. The user must provide:

- type_rate - either "positive" to control true/false positive rates or "negative" to control true/false negative rates.
- true_rate - the targeted true positive or true negative rate (between 0.6 and 0.999).
- threshold - the Bayes factor threshold for compelling evidence (must be > 1).

The function iteratively finds the smallest sample sizes for which the probability of obtaining compelling evidence meets or exceeds true_rate.

2. Fixed-sample analysis mode (when `n1` and `n2` are supplied):

If positive numeric sample sizes `n1` and `n2` are provided, the function computes the probabilities of obtaining compelling or misleading evidence for these fixed sample sizes. In this mode, `type_rate` and `true_rate` are ignored; only the Bayes factor threshold `threshold` is used.

Model specification:

The user must specify the analysis priors under the null and alternative hypotheses using Beta parameters:

- `a0`, `b0` - Beta parameters for the null hypothesis prior.
- `a1`, `b1` - Beta parameters for the analysis prior of group 1 under the alternative hypothesis.
- `a2`, `b2` - Beta parameters for the analysis prior of group 2 under the alternative hypothesis.

Design priors for the alternative hypothesis can optionally be specified:

- `prior_design_1`, `a1d`, `b1d`, `dp1` - design prior for group 1 (`"same"` uses the analysis prior, `"beta"` requires Beta parameters, `"Point"` uses a fixed proportion).
- `prior_design_2`, `a2d`, `b2d`, `dp2` - design prior for group 2.

Plotting:

If `plot_power = TRUE`, a power curve is plotted showing the probability of compelling evidence as a function of sample sizes. If `plot_rel = TRUE`, a grid of Bayes factors across possible outcomes is plotted.

Value

An object of class `BFpower_2p` (a list) containing:

`type` Character, always `"Two-proportions"`.

`analysis_h0` List of analysis prior parameters under the null, containing `a` and `b`.

`analysis_h1_theta_1` List of analysis prior parameters for group 1 under the alternative, containing `a` and `b`.

`analysis_h1_theta_2` List of analysis prior parameters for group 2 under the alternative, containing `a` and `b`.

`design_h1_theta_1` List of design prior parameters for group 1 under the alternative, containing `prior`, `a`, `b`, and `p`.

`design_h1_theta_2` List of design prior parameters for group 2 under the alternative, containing `prior`, `a`, `b`, and `p`.

`results` Data frame of probabilities of compelling and misleading evidence.

`grid` Grid used for computation.

`threshold` Threshold of compelling evidence.

`mode_bf` Character string specifying the mode (sample size determination or power calculation).

`plot_power` Logical; whether the power curve is plotted.

`plot_rel` Logical; whether the relationship between the Bayes factor and observed proportion differences is plotted.

Examples

```
BFpower.props(
threshold = 3,
true_rate = 0.8,
a0 = 1,
b0 = 1,
a1 = 156,
b1 = 339,
a2 = 151,
b2 = 339,
plot_power = TRUE,
plot_rel = TRUE)
```

BFpower.ttest.OneSample

Sample Size Determination for the One-Sample Bayesian t-Test

Description

Perform sample size determination or calculate the probability of obtaining compelling or misleading evidence for a one-sample Bayesian t-test. Can handle both point-null and interval-null hypothesis, and allows specifying analysis and design priors.

Usage

```
BFpower.ttest.OneSample(
  alternative,
  ROPE = NULL,
  prior_analysis,
  location,
  scale,
  dff,
  prior_design = NULL,
  location_d,
  scale_d,
  dff_d,
  N = NULL,
  type_rate = "positive",
  true_rate,
  false_rate,
  threshold,
  plot_power = FALSE,
  plot_rel = FALSE
)
```

Arguments

alternative	Character. The direction of the alternative hypothesis : two-sided ("two.sided"), right-sided ("greater"), or left-sided ("less").
ROPE	Optional numeric vector. Bounds for an interval null hypothesis. • For hypothesis = "two.sided", must be a numeric vector of length 2 with distinct finite values. • For "greater", must be a single numeric scalar > 0. • For "less", must be a single numeric scalar < 0.
prior_analysis	Character. The analysis prior under the alternative hypothesis: "Normal", "Moment" (normal-moment prior), or "t-distribution".
location	Numeric scaler. Location parameter for the analysis prior under the alternative hypothesis.
scale	Numeric scaler. Scale parameter for the analysis prior under the alternative hypothesis (must be > 0).
dff	Numeric scaler. Degrees of freedom for the analysis prior under the alternative hypothesis (required if prior_analysis = "t-distribution").
prior_design	Optional character. The design prior under the alternative hypothesis: "Normal", "Moment", "t-distribution", or "Point".
location_d	Numeric scaler. Location parameter for the design prior under the alternative hypothesis.
scale_d	Numeric scaler. Scale parameter for the design prior under the alternative hypothesis.
dff_d	Numeric scaler. Degrees of freedom for the design prior under the alternative hypothesis (required if prior_design = "t-distribution").
N	Numeric integer. Sample size.
type_rate	Character. Either "positive" (controls true/false positive rates) or "negative" (controls true/false negative rates).
true_rate	Numeric scaler. Target true positive or negative rate (between 0.6 and 0.999).
false_rate	Numeric scaler. Target false positive or false negative rate (between 0.001 and 0.1).
threshold	Numeric scaler. Threshold of compelling evidence (must be > 1).
plot_power	Logical. If TRUE, plots power curve.
plot_rel	Logical. If TRUE, plots the relationship between the BF and data.

Details

1. Sample size determination mode (when N = NULL):

If no sample size is provided, the function determines the minimum sample size. In this mode, the user must supply the following arguments:

- type_rate - either "positive" to control true/false positive rates, or "negative" to control true/false negative rates.

- `true_rate` - the targeted true positive or true negative rate (between 0.6 and 0.999).
- `false_rate` - the acceptable false positive or false negative rate (between 0.001 and 0.1).
- `threshold` - the Bayes factor threshold for compelling evidence (must be > 1).

The function iteratively finds the smallest sample size for which the probability of obtaining compelling evidence meets or exceeds `true_rate`, while the probability of misleading evidence does not exceed `false_rate`.

2. Fixed-sample analysis mode (when `N` is supplied):

If a positive numeric sample size `N` is provided, the function computes the probabilities of obtaining compelling or misleading evidence for that fixed sample size. In this mode, the arguments `type_rate`, `true_rate`, and `false_rate` are ignored; only the Bayes factor threshold `threshold` is used.

Analysis Priors:

The analysis prior specifies the prior distribution of the effect under the alternative hypothesis. The user must provide:

- `prior_analysis` - the type of prior: `"Normal"`, `"Moment"` (normal-moment prior), or `"t-distribution"`.
- `location` - the mean or location of the prior.
- `scale` - the standard deviation or scale (must be positive).
- `dff` - degrees of freedom (required if `prior_analysis = "t-distribution"`).

Design Priors (optional):

A design prior can be supplied to reflect uncertainty about the effect size during study planning. If provided, the following must be supplied:

- `prior_design` - the type of design prior: `"Normal"`, `"Moment"`, `"t-distribution"`, or `"Point"`.
- `location_d` - the location of the design prior.
- `scale_d` - the scale parameter (positive for all models except `"Point"`).
- `dff_d` - degrees of freedom for `"t-distribution"` design priors.

interval null Hypothesis:

The argument `ROPE` specifies the bounds of an interval null hypothesis. If `ROPE` is provided, the function evaluates the Bayes factor for an interval null hypothesis. For a point-null hypothesis, `ROPE` should be left as `NULL`.

Plotting:

If `plot_power = TRUE`, the function plots the probability of compelling evidence as a function of sample size. If `plot_rel = TRUE`, the relationship betwwen the BF and data is plotted.

Value

An object of class `BFpower_t` (a list) containing:

type Character, always "One-sample t-test".

alternative Character, the direction of the alternative hypothesis.

ROPE Optional numeric vector for interval null bounds.

analysis_h1 List with the analysis prior parameters: `prior_analysis`, `location`, `scale`, and optionally `dff`.

design_h1 List with the design prior parameters: `prior_design`, `location`, `scale`, and optionally `dff` (or `NULL` if not provided).

results Data frame of probabilities: compelling/misleading evidence, or `NaN` if calculation fails.

threshold Numeric, threshold of compelling evidence.

plot_power Logical, whether to plot the power curve.

plot_rel Logical, whether the relationship between the BF and t-value is plotted.

Examples

```
BFpower.ttest.OneSample(
 alternative = "two.sided",
 threshold = 3,
 true_rate = 0.8,
 false_rate = 0.05,
 prior_analysis = "t-distribution",
 location = 0,
 scale = 0.707,
 dff = 1
)
```

BFpower.ttest.TwoSample

Sample Size Determination for the Two-Sample Bayesian t-Test

Description

Perform sample size determination or calculate the probabilities of obtaining compelling or misleading evidence for a two-sample Bayesian t-test. Supports point-null and interval-null hypotheses, and allows specifying analysis and design priors.

Usage

```
BFpower.ttest.TwoSample(
  alternative,
  ROPE = NULL,
  threshold,
  true_rate,
  false_rate,
  prior_analysis,
  location,
  scale,
  dff,
  prior_design = NULL,
  location_d,
```

```
  scale_d,
  dff_d,
  N1 = NULL,
  N2 = NULL,
  r = NULL,
  type_rate = "positive",
  plot_power = FALSE,
  plot_rel = FALSE
)
```

Arguments

alternative	Character. The direction of the alternative hypothesis: two-sided ("two.sided"), right-sided ("greater"), or left-sided ("less").
ROPE	Optional numeric. Bounds for an interval null: • For hypothesis = "two.sided", must be a numeric vector of length 2 with distinct finite values. • For "greater", must be a single numeric scalar > 0. • For "less", must be a single numeric scalar < 0.
threshold	Numeric scalar. Threshold for compelling evidence (must be > 1).
true_rate	Numeric scalar. Target true positive or negative rate .
false_rate	Numeric scalar. Target false positive or negative rate .
prior_analysis	Character. Analysis prior under the alternative hypothesis: "Normal", "Moment", or "t-distribution".
location	Numeric scalar. Location parameter for the analysis prior.
scale	Numeric scalar > 0. Scale parameter for the analysis prior.
dff	Numeric scalar. Degrees of freedom for the analysis prior (required if prior_analysis = "t-distribution"; ignored otherwise).
prior_design	Optional character. Design prior under the alternative: "Normal", "Moment", "t-distribution", or "Point".
location_d	Numeric scalar. Location parameter for the design prior.
scale_d	Numeric scalar > 0. Scale parameter for the design prior.
dff_d	Numeric scalar. Degrees of freedom for the design prior (required if prior_design = "t-distribution"; ignored otherwise).
N1	Numeric integer. Sample size for group 1 (used if r = NULL).
N2	Numeric integer. Sample size for group 2 (used if r = NULL).
r	Optional numeric scalar. Ratio of sample size N2 / N1 (used if N1 and N2 are NULL).
type_rate	Character, either "positive" or "negative"; determines whether to control true/false positive or true/false negative rates .
plot_power	Logical. If TRUE, a plot of the power or probability of compelling evidence is generated.
plot_rel	Logical. Whether the relationship between the BF and data is plotted..

Details

1. Sample size determination mode (when `N1 = NULL` and `N2 = NULL`, but `r` is provided):

If no sample sizes are provided, the function calculates the minimum required sample sizes for both groups. In this mode, the user must supply:

- `type_rate` - either `"positive"` to control true/false positive rates, or `"negative"` to control true/false negative rates.
- `true_rate` - the targeted true positive or true negative rate (between 0.6 and 0.999).
- `false_rate` - the acceptable false positive or false negative rate (between 0.001 and 0.1).
- `threshold` - the Bayes factor threshold for compelling evidence (must be > 1).
- `r` - the allocation ratio of group 2 to group 1 sample sizes (`N2/N1`).

The function iteratively finds the smallest sample sizes `N1` and `N2 = r * N1` for which the probability of obtaining compelling evidence meets or exceeds `true_rate`, while the probability of misleading evidence does not exceed `false_rate`.

2. Fixed-sample analysis mode (when `N1` and `N2` are supplied):

If positive numeric sample sizes `N1` and `N2` are provided, the function computes the probabilities of obtaining compelling or misleading evidence for those fixed sample sizes. In this mode, the arguments `type_rate`, `true_rate`, and `false_rate` are ignored; only the Bayes factor threshold `threshold` is used.

Analysis Priors:

The analysis prior specifies the prior distribution of the effect under the alternative hypothesis. The user must provide:

- `prior_analysis` - the type of prior: `"Normal"`, `"Moment"` (normal-moment prior), or `"t-distribution"`.
- `location` - the mean or location of the prior.
- `scale` - the standard deviation or scale (must be positive).
- `dff` - degrees of freedom (required if `prior_analysis = "t-distribution"`).

Design Priors (optional):

A design prior can be supplied to reflect uncertainty about the effect size during study planning. If provided, the following must be supplied:

- `prior_design` - the type of design prior: `"Normal"`, `"Moment"`, `"t-distribution"`, or `"Point"`.
- `location_d` - the location of the design prior.
- `scale_d` - the scale parameter (positive for all models except `"Point"`).
- `dff_d` - degrees of freedom for `"t-distribution"` design priors.

interval null Hypothesis:

The argument `ROPE` specifies the bounds of an interval null hypothesis. If `ROPE` is provided, the function evaluates the Bayes factor for an interval null hypothesis. For a point-null hypothesis, `ROPE` should be left as `NULL`.

Plotting:

If `plot_power = TRUE`, the function plots the probability of compelling evidence as a function of the sample sizes. If `plot_rel = TRUE`, the relationship between BF and data is plotted.

Value

An object of class `BFpower_t` containing:

type Character string describing the test type.

alternative alternative hypothesis (`"two.sided"`, `"greater"`, or `"less"`).

ROPE Interval bounds under the null used, if any.

analysis_h1 List with the analysis prior parameters: `prior_analysis`, `location`, `scale`, and optionally `dff`.

design_h1 List with the design prior parameters: `prior_design`, `location`, `scale`, and optionally `dff` (or `NULL` if not provided).

results Data frame with probabilities of compelling/misleading evidence.

threshold Threshold of compelling evidence.

plot_power Logical flag for plotting power.

plot_rel Logical flag for plotting the relationship between BF and t-value.

Examples

```
BFpower.ttest.TwoSample(
 alternative = "two.sided",
 ROPE = c(-0.36, 0.36),
 threshold = 3,
 true_rate = 0.8,
 false_rate = 0.05,
 prior_analysis = "Normal",
 location = -0.23,
 scale = 0.2,
 dff = 1,
 type_rate = "negative",
 r = 1)
```

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