Package 'retrodesign'

March 28, 2024

Type Package

Title Tools for Type S (Sign) and Type M (Magnitude) Errors

Version 0.2.2

Description Provides tools for working with Type S (Sign) and
Type M (Magnitude) errors, as proposed in Gelman and Tuerlinckx (2000)
<doi:10.1007/s001800000040> and
Gelman & Carlin (2014) <doi:10.1177/1745691614551642>.
In addition to simply calculating the probability of
Type S/M error, the package includes functions for calculating these errors
across a variety of effect sizes for comparison, and recommended sample size
given ``tolerances" for Type S/M errors. To improve the speed of these
calculations, closed forms solutions for the probability of a Type S/M error
from Lu, Qiu, and Deng (2018) <doi:10.1111/bmsp.12132>
are implemented. As of 1.0.0, this includes
support only for simple research designs. See the
package vignette for a fuller exposition on how Type S/M errors arise in
research, and how to analyze them using the type of design analysis proposed
in the above papers.

Depends R (>= 3.1.0)

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URL https://github.com/andytimm/retrodesign

BugReports https://github.com/andytimm/retrodesign/issues

Encoding UTF-8

RoxygenNote 7.1.2

Imports graphics

Suggests ggplot2, knitr, rmarkdown, gridExtra, testthat

VignetteBuilder knitr

NeedsCompilation no

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R **topics documented:**

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retrodesign	*retrodesign: Calculates Power, Type S, and Type M error*

Description

Calculates Power, Type S, and Type M error and returns them in a list or df, depending on whether a single true effect size or range is provided. retro_design() is faster as it uses the closed form solution from Lu et al. (2018), but this function can be used for t distributions, whereas retro_design() cannot. Function originally provided in Gelman and Carlin (2014), modified with permission.

Usage

```
retrodesign(A, s, alpha = 0.05, df = Inf, n.sims = 10000)
```

Arguments

A	a numeric or list, an estimate of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold
df	a numeric, the degrees of freedom. df=Inf is equivalent to a normal distribution.
n.sims	a numeric, how many times to simulate when calculating Type M error.

Value

either a list of length 3 containing the power, type s, and type M error, or if A is a list, a df that is 4 by length(A), with an effect size and it's corresponding power, type s, and type m errors in each row.

Examples

```
retrodesign(1,3.28)
retrodesign(list(.2,2,20),8.1)
retrodesign(.5,1,df=10)
```

---

retrodesign.list   *List retrodesign*

Description

retrodesign.list is the S3 method of the generic retrodesign() function, used when a list is passed for A.

Usage

```
## S3 method for class 'list'
retrodesign(A, s, alpha = 0.05, df = Inf, n.sims = 10000)
```

Arguments

A	a list, estimates of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold
df	a numeric, the degrees of freedom. df=Inf is equivalent to a normal distribution.
n.sims	a numeric, how many times to simulate when calculating Type M error

Value

A df that is 4 by length(A), with an effect size and it's corresponding power, type s, and type m errors in each row.

Examples

```
retrodesign(list(.2,2,20), 8.1)
retrodesign(list(.2,2,20), 8.1,df = 10)
```

---

retrodesign.numeric   *Numeric retrodesign*

Description

retrodesign.numeric is the S3 method of the generic retrodesign() function, used when a single numeric is passed for A. Martijn Weterings kindly provided code to slightly improve this in the very low N case using the non-central t-distribution.

Usage

```
## S3 method for class 'numeric'
retrodesign(A, s, alpha = 0.05, df = Inf, n.sims = 10000)
```

Arguments

A	a numeric, an estimate of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold
df	a numeric, the degrees of freedom. df=Inf is equivalent to a normal distribution.
n.sims	a numeric, how many times to simulate when calculating Type M error

Value

A list of length 3 containing the power, type s, and type M error.

Examples

```
retrodesign(1,3.28)
retrodesign(2,8.1)
retrodesign(.5,1,df=10)
```

---

retro_design   *retro_design: Calculates Power, Type S, and Type M error*

Description

This function name is deprecated in favor of the more clearly named retro_design_closed_form; it won't be removed in any hurry, just trying to move the naming conventions to be clearer and easier to use.

Usage

```
retro_design(A, s, alpha = 0.05)
```

Arguments

A	a numeric or list, an estimate of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold

Details

Calculates Power, Type S, and Type M error and returns them in a list or df, depending on whether a single true effect size or range is provided. Uses the closed form solution found for the Type-M error found by Lu et al. (2018), and thus is faster than retrodesign. For t distributions, use retrodesign() instead; the closed form solution only applies in the normal case.

Value

either a list of length 3 containing the power, type s, and type M error, or if A is a list, a df that is 4 by length(A), with an effect size and it's corresponding power, type s, and type m errors in each row.

Examples

```
retrodesign(1,3.28)
retrodesign(list(.2,2,20),8.1)
```

---

retro_design_closed_form

retro_design_closed_form: Calculates Power, Type S, and Type M error

---

Description

Calculates Power, Type S, and Type M error and returns them in a list or df, depending on whether a single true effect size or range is provided. Uses the closed form solution found for the Type-M error found by Lu et al. (2018), and thus is faster than retrodesign. For t distributions, use retrodesign() instead; the closed form solution only applies in the normal case.

Usage

```
retro_design_closed_form(A, s, alpha = 0.05)
```

Arguments

A	a numeric or list, an estimate of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold

Value

either a list of length 3 containing the power, type s, and type M error, or if A is a list, a df that is 4 by length(A), with an effect size and it's corresponding power, type s, and type m errors in each row.

Examples

```
retrodesign(1,3.28)
retrodesign(list(.2,2,20),8.1)
```

---

retro_design_closed_form.list

List retro_design_closed_form

Description

retro_design_closed_form.list is the S3 method of the generic retro_design_closed_form() function, used when a list is passed for A.

Usage

```
## S3 method for class 'list'
retro_design_closed_form(A, s, alpha = 0.05)
```

Arguments

A	a list, estimates of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold

Value

A df that is 4 by length(A), with an effect size and it's corresponding power, type s, and type m errors in each row.

Examples

```
retro_design(list(.2,2,20),8.1)
```

---

retro_design_closed_form.numeric
Numeric retro_design_closed_form

Description

retro_design_closed_form.numeric is the S3 method of the generic retro_design_closed_form()
function, used when a single numeric is passed for A.

Usage

```
## S3 method for class 'numeric'
retro_design_closed_form(A, s, alpha = 0.05)
```

Arguments

A	a numeric, an estimate of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold

Value

A list of length 3 containing the power, type s, and type M error.

Examples

```
retrodesign(1,3.28)
retrodesign(2,8.1)
```

---

sim_plot   *sim_plot: visualize type S/M errors*

Description

Graphs type S/M errors resulting from a simulation using the provided parameters (using the same
simulation method as retrodesign()). Can optionally display using ggplot.

Usage

```
sim_plot(A, s, alpha = 0.05, df = Inf, n.sims = 5000, gg = TRUE)
```

Arguments

A	a numeric, an estimate of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold
df	a numeric, the degrees of freedom
n.sims	a numeric, how many times to simulate when calculating Type M error
gg	If TRUE and ggplot2 is installed, uses ggplot2 for graphic

Value

A list of length 3 containing the power, type s, and type M error.

Examples

```
sim_plot(1,3.28)
sim_plot(.5,1)
```

---

type_m	*type_m*

Description

Calculates type m error. Is calculated using simulation, and thus supports t distributions through the df parameter.

Usage

```
type_m(A, s, alpha = 0.05, df = Inf, n.sims = 10000)
```

Arguments

A	a numeric or list, estimate(s) of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold
df	a numeric, the number of degrees of freedom. df=Inf is equivalent to a normal distribution.
n.sims	a numeric, how many times to simulate when calculating Type M error

Value

either the type m error, a numeric if a single A is provided, or a df of length 2 by A, with the effect size and corresponding type m error in each row.

Examples

```
type_m(1,3.28)
type_m(list(.2,2,20),8.1)
```

---

type_m.list *List type_m*

Description

type_m.list is the S3 method of the generic type_m() function, used when a list is passed for A.

Usage

```
## S3 method for class 'list'
type_m(A, s, alpha = 0.05, df = Inf, n.sims = 10000)
```

Arguments

A	a list, estimates of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold
df	a numeric, the number of degrees of freedom. df=Inf is equivalent to a normal distribution.
n.sims	a numeric, how many times to simulate when calculating Type M error

Value

A df that is 2 by length(A), with an effect size and it's corresponding type m errors in each row.

Examples

```
type_s(list(.2,2,20),8.1)
```

---

type_m.numeric *Numeric type_m*

Description

this is the S3 method of the generic type_m() function, used when a numeric is passed for A.

Usage

```
## S3 method for class 'numeric'
type_m(A, s, alpha = 0.05, df = Inf, n.sims = 1e+05)
```

Arguments

A	a numeric, estimate of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold
df	a numeric, the number of degrees of freedom. df=Inf is equivalent to a normal distribution.
n.sims	a numeric, how many times to simulate when calculating Type M error

Value

either the type m, a numeric if a single A is provided, or a df of length 2 by A, with the effect size and corresponding type m error in each row.

Examples

```
type_m(1,3.28)
```

---

type_s	*type_s*

Description

Calculates type s error.

Usage

```
type_s(A, s, alpha = 0.05)
```

Arguments

A	a numeric or list, estimate(s) of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold

Value

either the type S, a numeric if a single A is provided, or a df of length 2 by A, with the effect size and corresponding type S error in each row.

Examples

```
type_s(1,3.28)
type_s(list(.2,2,20),8.1)
```

`type_s.list`	*List type_s*

Description

type_s.list is the S3 method of the generic type_s() function, used when a list is passed for A.

Usage

```
## S3 method for class 'list'
type_s(A, s, alpha = 0.05)
```

Arguments

A	a list, estimates of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold

Value

A df that is 2 by length(A), with an effect size and it's corresponding type s errors in each row.

Examples

```
type_s(list(.2,2,20),8.1)
```

`type_s.numeric`	*Numeric type_s*

Description

this is the S3 method of the generic type_s() function, used when a numeric is passed for A.

Usage

```
## S3 method for class 'numeric'
type_s(A, s, alpha = 0.05)
```

Arguments

A	a numeric, estimate of the true effect size
s	a numeric, standard error of the estimate
alpha	a numeric, the statistical significance threshold

Value

either the type S, a numeric if a single A is provided, or a df of length 2 by A, with the effect size and corresponding type S error in each row.

Examples

```
type_s(1,3.28)
```

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