# Package 'retrodesign'

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**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

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**VignetteBuilder** knitr

**NeedsCompilation** no

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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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