Package ‘MRTSampleSizeBinary’

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Type Package

Title Sample Size Calculator for MRT with Binary Outcomes

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Description Provides a sample size calculator for micro-randomized trials (MRTs) with binary outcomes based on methodology developed in Qian et al. (2020) <doi:10.1093/biomet/asaa070>. Also provides a power calculator when the sample size is input by the user.

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NeedsCompilation no

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R topics documented:

`alpha_1` *Vector that defines the success probability null curve.*

Description

Vector that defines the success probability null curve.

Usage

```
alpha_1
```

Format

a length 2 vector
: The matrix multiplication of this vector with g_t_1 defines the MEE under the null hypothesis.

`beta_1` *Vector that defines the MEE under the alternative hypothesis.*

Description

Vector that defines the MEE under the alternative hypothesis.

Usage

```
beta_1
```

Format

a length 2 vector
: The matrix multiplication of this vector with f_t_1 defines the MEE under the alternative hypothesis.

compute_m_sigma — *Computes "M" and "Sigma" matrices for the sandwich estimator of variance-covariance matrix.*

Description

A helper function for mrt_binary_power() and mrt_binary_ss().

Usage

```
compute_m_sigma(avail_pattern, f_t, g_t, beta, alpha, p_t)
```

Arguments

`avail_pattern`	A vector of length T that is the average availability at each time point
`f_t`	Defines marginal excursion effect MEE(t) under alternative together with beta. Assumed to be matrix of size T*p.
`g_t`	Defines success probability null curve together with alpha. Assumed to be matrix of size T*q.
`beta`	Length p vector that defines marginal excursion effect MEE(t) under alternative together with f_t.
`alpha`	Length q vector that defines success probability null curve together with g_t.
`p_t`	Length T vector of randomization probabilities at each time point

Value

List containing two matrices. The first is the M matrix and the second is the Sigma matrix.

Examples

```
compute_m_sigma(tau_t_1, f_t_1, g_t_1, beta_1, alpha_1,
                                p_t_1)
```

compute_ncp — *Computes the non-centrality parameter for an F distributed random variable in the context of a MRT with binary outcome.*

Description

A helper function for mrt_binary_power() and mrt_binary_ss().

Usage

```
compute_ncp(x, beta, m_matrix, sigma_matrix)
```

Arguments

`x`	Sample size
`beta`	Marginal excursion effect, assumed dimension p
`m_matrix`	"Bread" of sandwich estimator for variance
`sigma_matrix`	"Meat" of sandwich estimator for variance

Value

Returns non-centrality parameter for an F distributed random variable.

Examples

```
compute_ncp(300, beta_1, m_matrix_1, sigma_matrix_1)
```

`f_t_1` *A matrix defining the MEE under the alternative hypothesis.*

Description

A matrix defining the MEE under the alternative hypothesis.

Usage

```
f_t_1
```

Format

a 10 by 2 matrix
In this example it is a log-linear trend.

`g_t_1` *A matrix defining the success probability null curve.*

Description

A matrix defining the success probability null curve.

Usage

```
g_t_1
```

Format

a 10 by 2 matrix
In this example it is a log-linear trend.

is_full_column_rank — *Check if a matrix is full column rank.*

Description

Used in checking if p_t*f_t is in the linear span of g_t.

Usage

```
is_full_column_rank(mat)
```

Arguments

mat	A matrix.

Value

Boolean TRUE/FALSE for if matrix is full column rank.

Examples

```
is_full_column_rank(diag(4))
```

max_samp — *Returns default maximum sample size to end power_vs_n_plot().*

Description

Returns default maximum sample size to end power_vs_n_plot().

Usage

```
max_samp(min_samp)
```

Arguments

min_samp	The starting sample size of the plot.

Value

A default maximum sample size to end power_vs_n_plot().

Examples

```
max_samp(100)
```

min_samp *Compute minimum sample size.*

Description

Returns a default minimum sample size to start power_vs_n_plot() at.

Usage

```
min_samp(alph, bet)
```

Arguments

alph	Vector to describe the MEE under the alternative.
bet	Vector to describe the MEE under the null.

Value

A default minimum sample size to start power_vs_n_plot() at.

Examples

```
min_samp(alpha_1, beta_1)
```

mrt_binary_power *Calculate power for binary outcome MRT*

Description

Returns power of the hypothesis test of marginal excursion effect (see Details) given a specified sample size in the context of an MRT with binary outcomes with small sample correction using F-distribution. See the vignette for more details.

Usage

```
mrt_binary_power(avail_pattern, f_t, g_t, beta, alpha, p_t, gamma, n)
```

Arguments

avail_pattern	A vector of length m that is the average availability at each time point
f_t	Defines marginal excursion effect MEE(t) under alternative together with beta. Assumed to be matrix of size m*p.
g_t	Defines success probability null curve together with alpha. Assumed to be matrix of size m*q.

beta	Length p vector that defines marginal excursion effect MEE(t) under alternative together with f_t.
alpha	Length q vector that defines success probability null curve together with g_t.
p_t	Length m vector of Randomization probabilities at each time point.
gamma	Desired Type I error
n	Sample size

Value

Power of the test for fixed null/alternative and sample size.

Examples

```
mrt_binary_power(tau_t_1, f_t_1, g_t_1, beta_1,
                                      alpha_1, p_t_1, 0.05, 100)
```

---

mrt_binary_ss   *Calculate sample size for binary outcome MRT*

Description

Returns sample size needed to achieve a specified power for the hypothesis test of marginal excursion effect (see Details) in the context of an MRT with binary outcomes with small sample correction using F-distribution. See the vignette for more details.

Usage

```
mrt_binary_ss(
  avail_pattern,
  f_t,
  g_t,
  beta,
  alpha,
  p_t,
  gamma,
  b,
  exact = FALSE,
  less_than_10_possible = FALSE
)
```

Arguments

avail_pattern	A vector of length m that is the average availability at each time point
f_t	Defines marginal excursion effect MEE(t) under alternative together with beta. Assumed to be matrix of size m*p.

g_t	Defines success probability null curve together with alpha. Assumed to be matrix of size m*q.
beta	Length p vector that defines marginal excursion effect MEE(t) under alternative together with f_t.
alpha	Length q vector that defines success probability null curve together with g_t.
p_t	Length m vector of Randomization probabilities at each time point.
gamma	Desired Type I error
b	Desired Type II error
exact	Determines if exact n or ceiling will be returned
less_than_10_possible	If TRUE, returns sample size (instead of error) even if the calculated sample size is <= 10. Setting to TRUE is not recommended. Defaults to FALSE.

Details

When the calculator finds out that a sample size less than or equal to 10 is sufficient to attain the desired power, the calculator does not output the exact sample size but produces an error message. This is because the sample size calculator is based on an asymptotic result, and in this situation the sample size result may not be as accurate. (A small sample correction is built in the calculator, but even with the correction the sample size result may still be inaccurate when it is <= 10.) In general, when the output sample size is small, one might reconsider the following: (1) whether you are correctly or conservatively guessing the average of expected availability, (2) whether the duration of study is too long, (3) whether the treatment effect is overestimated, and (4) whether the power is set too low.

Value

Sample size to achieve desired power.

Examples

```
mrt_binary_ss(tau_t_1, f_t_1, g_t_1,
                                    beta_1, alpha_1, p_t_1,
                                    0.05, .2, FALSE)
```

---

m_matrix_1 *An example matrix for "bread" of sandwich estimator of variance.*

Description

An example matrix for "bread" of sandwich estimator of variance.

Usage

```
m_matrix_1
```

Format

A 2 by 2 matrix
: Generated from a toy example.

---

power_summary — *Calculate sample size at a range of power levels.*

Description

Returns sample sizes needed to achieve a range of power levels for the hypothesis test of marginal excursion effect (see Details) in the context of an MRT with binary outcomes with small sample correction using F-distribution. See the vignette for more details.

Usage

```
power_summary(
  avail_pattern,
  f_t,
  g_t,
  beta,
  alpha,
  p_t,
  gamma,
  power_levels = seq(from = 0.6, to = 0.95, by = 0.05)
)
```

Arguments

avail_pattern	A vector of length T that is the average availability at each time point
f_t	Defines marginal excursion effect MEE(t) under alternative together with beta. Assumed to be matrix of size T*p.
g_t	Defines success probability null curve together with alpha. Assumed to be matrix of size T*q.
beta	Length p vector that defines marginal excursion effect MEE(t) under alternative together with f_t.
alpha	Length q vector that defines success probability null curve together with g_t.
p_t	Length T vector of Randomization probabilities at each time point.
gamma	Desired Type I error
power_levels	Vector of powers to find sample size for.

Details

The sample size calculator is based on an asymptotic result with a small sample correction. When the calculator finds out that a sample size less than or equal to 10 is sufficient to attain the desired power, the calculator does not output the exact sample size but produces an error message, because in this situation the sample size result may not be as accurate. In general, when the output sample size is small, one might reconsider the following: (1) whether you are correctly or conservatively guessing the average of expected availability, (2) whether the duration of study is too long, (3) whether the treatment effect is overestimated, and (4) whether the power is set too low.

Value

Dataframe containing needed sample size to achieve user-specified power values.

Examples

```
power_summary(tau_t_1, f_t_1, g_t_1,
                     beta_1, alpha_1, p_t_1, 0.05)
```

---

power_vs_n_plot

Returns a plot of power vs sample size in the context of a binary outcome MRT. See the vignette for more details.

Description

Returns a plot of power vs sample size in the context of a binary outcome MRT. See the vignette for more details.

Usage

```
power_vs_n_plot(
  avail_pattern,
  f_t,
  g_t,
  beta,
  alpha,
  p_t,
  gamma,
  min_n = max(min_samp(alpha, beta), 11),
  max_n = max_samp(min_n)
)
```

Arguments

avail_pattern	A vector of length T that is the average availability at each time point
f_t	Defines marginal excursion effect MEE(t) under alternative together with beta. Assumed to be matrix of size T*p.

g_t	Defines success probability null curve together with alpha. Assumed to be matrix of size T*q.
beta	Length p vector that defines marginal excursion effect MEE(t) under alternative together with f_t.
alpha	Length q vector that defines success probability null curve together with g_t.
p_t	Length T vector of Randomization probabilities at each time point.
gamma	Desired Type I error
min_n	Minimum of range of sample sizes to plot. Should be greater than the sum of the dimensions of alpha and beta.
max_n	Maximum of range of sample sizes to plot. Should be greater than min_n.

Value

Plot of power and sample size

Examples

```
power_vs_n_plot(tau_t_1, f_t_1, g_t_1, beta_1, alpha_1,
                p_t_1, 0.05, 15, 700)
```

---

p_t_1 — *A vector of randomization probabilities for each time point.*

Description

A vector of randomization probabilities for each time point.

Usage

```
p_t_1
```

Format

a length T vector

Vector of randomization probabilities.

`sigma_matrix_1` *An example matrix for "meat" of sandwich estimator of variance.*

Description

An example matrix for "meat" of sandwich estimator of variance.

Usage

```
sigma_matrix_1
```

Format

A 2 by 2 matrix
: Generated from a toy example.

`tau_t_1` *Vector that holds the average availability at each time point.*

Description

Vector that holds the average availability at each time point.

Usage

```
tau_t_1
```

Format

vector of length T
: A vector of length T that is the average availability at each decision point.

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