

Package ‘gsMAMS’

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Title Group Sequential Designs of Multi-Arm Multi-Stage Trials

Version 0.7.2

Imports mvtnorm, stats, survival

Description

It provides functions to generate operating characteristics and to calculate Sequential Conditional Probability Ratio Tests(SCPRT) efficacy and futility boundary values along with sample/event size of Multi-Arm Multi-Stage(MAMS) trials for different outcomes. The package is based on Jianrong Wu, Yimei Li, Liang Zhu (2023) <doi:10.1002/sim.9682>, Jianrong Wu, Yimei Li (2023) ``Group Sequential Multi-Arm Multi-Stage Survival Trial Design with Treatment Selection"(Manuscript accepted for publication) and Jianrong Wu, Yimei Li, Shengping Yang (2023) ``Group Sequential Multi-Arm Multi-Stage Trial Design with Ordinal Endpoints"(In preparation).

License GPL-3

Encoding UTF-8

RoxygenNote 7.3.1

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

Config/testthat/edition 3

VignetteBuilder knitr

URL <https://github.com/Tpatni719/gSMAMS>

BugReports <https://github.com/Tpatni719/gSMAMS/issues>

NeedsCompilation no

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design_cont	<i>Design the clinical trial for continuous outcome</i>
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Description

This function generates the design parameters of a clinical trial for continuous outcome.

Usage

```
design_cont(delta0, delta1, alpha, beta, k, frac)
```

Arguments

delta0	numeric Standardized effect size in ineffective arm.
delta1	numeric Standardized effect size in effective arm.
alpha	numeric Type I error.
beta	numeric Type II error.
k	numeric Number of treatment arms.
frac	numeric Vector of fractions for information time at each look.

Value

List of cumulative sample size for each stage of treatment and control groups along with maximum total sample size of the trial. It also provides efficacy and futility boundaries of the trial.

Examples

```
design_cont(delta0 = 0.178, delta1 = 0.545, alpha = 0.05, beta = 0.1, k = 4, frac = c(1 / 2, 1))
```

design_ord	<i>Design the clinical trial for ordinal outcome</i>
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Description

This function generates the design parameters of a clinical trial for ordinal outcome.

Usage

```
design_ord(alpha, beta, k, prob, or0, or, frac)
```

Arguments

alpha	numeric Type I error.
beta	numeric Type II error.
k	numeric Number of treatment arms.
prob	numeric Probability of ordinal outcomes in control group.
or0	numeric Odds ratio of ineffective treatment group vs control.
or	numeric Odds ratio of effective treatment group vs control.
frac	numeric Vector of fractions for information time at each look.

Value

List of cumulative sample size for each stage of treatment and control groups along with maximum total sample size of the trial. It also provides efficacy and futility boundaries of the trial.

Examples

```
design_ord(alpha = 0.05,  
          beta = 0.1,  
          k = 4,  
          prob = c(0.075, 0.182, 0.319, 0.243, 0.015, 0.166),  
          or = 3.06,  
          or0 = 1.32,  
          frac = c(1 / 2, 1))
```

`design_surv`*Design the clinical trial for survival outcome*

Description

This function generates the design parameters of a clinical trial for survival outcome.

Usage

```
design_surv(m0, alpha, beta, k, hr0, hr1, ta, tf, kappa, eta, frac)
```

Arguments

<code>m0</code>	numeric Median survival time of control group.
<code>alpha</code>	numeric Type I error.
<code>beta</code>	numeric Type II error.
<code>k</code>	numeric Number of treatment arms.
<code>hr0</code>	numeric Hazard ratio of ineffective treatment group vs control.
<code>hr1</code>	numeric Hazard ratio of effective treatment group vs control.
<code>ta</code>	numeric Accrual time.
<code>tf</code>	numeric Follow-up time.
<code>kappa</code>	numeric Shape parameter (kappa=1 for exponential distribution).
<code>eta</code>	numeric Rate of loss to follow-up.
<code>frac</code>	numeric Vector of fractions for information time at each look.

Value

List of cumulative number of events for each stage of combined treatment and control groups along with total number of subjects and maximum total number of events for the trial. It also provides efficacy and futility boundaries of the trial.

Examples

```
design_surv(m0 = 20,  
           hr0 = 1,  
           hr1 = 0.65,  
           ta = 20,  
           tf = 40,  
           alpha = 0.05,  
           beta = 0.1,  
           k = 3,  
           kappa = 1,  
           eta = 0,  
           frac = c(1 / 2, 1))
```

op_fwer_cont	<i>Provides operating characteristics of group sequential MAMS trial for continuous outcome under null hypothesis</i>
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Description

Computes FWER and other characteristics for group-sequential MAMS trial for continuous outcome.

Usage

```
op_fwer_cont(alpha, beta, p, frac, delta0, delta1, nsim, seed)
```

Arguments

alpha	numeric Type I error.
beta	numeric Type II error.
p	numeric Number of treatment arms.
frac	numeric vector of fractions for information time at each look.
delta0	numeric Standardized effect size in ineffective arm.
delta1	numeric Standardized effect size in effective arm.
nsim	numeric Number of simulations.
seed	numeric Random seed number.

Value

A list of FWER, stage-wise type I error, average sample size used per arm, stopping probability, probability of futility.

Examples

```
op_fwer_cont(alpha=0.05, beta=0.1, p=2, frac=c(0.5, 1), delta0=0.178, delta1=0.545, nsim=15, seed=1)
```

op_fwer_ord	<i>Provides operating characteristics of group sequential MAMS trial for ordinal outcome under null hypothesis</i>
-------------	--

Description

Computes FWER and other characteristics for group-sequential MAMS trial for ordinal outcome.

Usage

```
op_fwer_ord(alpha, beta, p, frac, or0, or, nsim, prob, seed)
```

Arguments

alpha	numeric Type I error.
beta	numeric Type II error.
p	numeric Number of treatment arms.
frac	numeric vector of fractions for information time at each look.
or0	numeric Odds ratio of ineffective treatment group vs control.
or	numeric Odds ratio of effective treatment group vs control.
nsim	numeric Number of simulations.
prob	numeric Probability of ordinal outcomes in control group.
seed	numeric Random seed number.

Value

A list of FWER, stage-wise type I error, average sample size used per arm, stopping probability, probability of futility.

Examples

```
op_fwer_ord(alpha = 0.05,
            beta = 0.1,
            p = 4,
            frac = c(0.5, 1),
            or0 = 1.32,
            or = 3.06,
            nsim = 15,
            prob = c(0.075, 0.182, 0.319, 0.243, 0.015, 0.166),
            seed = 13)
```

op_fwer_surv

Provides operating characteristics of group sequential MAMS trial for survival outcome under null hypothesis

Description

Computes FWER and other characteristics for group-sequential MAMS trial for survival outcome.

Usage

```
op_fwer_surv(
  m0,
  alpha,
  beta,
  p,
  frac,
  hr0,
```

```

    hr1,
    nsim,
    ta,
    tf,
    kappa,
    eta,
    seed
  )

```

Arguments

m0	numeric Median survival time in control group.
alpha	numeric Type I error.
beta	numeric Type II error.
p	numeric Number of treatment arms.
frac	numeric Vector of fractions for information time at each look.
hr0	numeric Hazard ratio of ineffective treatment group vs control.
hr1	numeric Hazard ratio of effective treatment group vs control.
nsim	numeric Number of simulations.
ta	numeric Accrual time.
tf	numeric Follow-up time.
kappa	numeric Shape parameter (Kappa=1 for exponential distribution).
eta	numeric Rate of loss to follow-up.
seed	numeric Random seed number.

Value

A list of FWER, stage-wise type I error, stopping probability, probability of futility, average number of events happened per arm, average duration of trial.

Examples

```

op_fwer_surv(m0 = 20,
             alpha = 0.05,
             beta = 0.1,
             p = 4,
             frac = c(1 / 2, 1),
             hr0 = 1,
             hr1 = 0.75,
             nsim = 12,
             ta = 40,
             tf = 20,
             kappa = 1,
             eta = 0,
             seed = 12)

```

op_power_cont	<i>Provides operating characteristics of group sequential MAMS trial for continuous outcome</i>
---------------	---

Description

Computes power and other characteristics for group-sequential MAMS trial for continuous outcome.

Usage

```
op_power_cont(alpha, beta, p, frac, delta0, delta1, nsim, seed)
```

Arguments

alpha	numeric Type I error.
beta	numeric Type II error.
p	numeric Number of treatment arms.
frac	numeric Vector of fractions for information time at each look.
delta0	numeric Standardized effect size in ineffective arm.
delta1	numeric Standardized effect size in effective arm.
nsim	numeric Number of simulations.
seed	numeric Random seed number.

Value

A list of power, stage-wise probability of success, average sample size used per arm, stopping probability, probability of futility.

Examples

```
op_power_cont(alpha = 0.05,  
              beta = 0.1,  
              p = 4,  
              frac = c(1 / 5, 2 / 5, 3 / 5, 4 / 5, 1),  
              delta0 = 0.178,  
              delta1 = 0.545,  
              nsim = 12,  
              seed = 12)
```

op_power_ord	<i>Provides operating characteristics of group sequential MAMS trial for ordinal outcome</i>
--------------	--

Description

Computes power and other characteristics for group-sequential MAMS trial for ordinal outcome.

Usage

```
op_power_ord(alpha, beta, p, frac, or0, or, nsim, prob, seed)
```

Arguments

alpha	numeric Type I error.
beta	numeric Type II error.
p	numeric Number of treatment arms.
frac	numeric Vector of fractions for information time at each look.
or0	numeric Odds ratio of ineffective treatment group vs control.
or	numeric Odds ratio of effective treatment group vs control.
nsim	numeric Number of simulations.
prob	numeric Probability of ordinal outcomes in control group.
seed	numeric Random seed number.

Value

A list of power, stage-wise probability of success, average sample size used per arm, stopping probability, probability of futility.

Examples

```
op_power_ord(alpha = 0.05,
             beta = 0.1,
             p = 4,
             frac = c(0.5, 1),
             or0 = 1.32,
             or = 3.06,
             nsim = 12,
             prob = c(0.075, 0.182, 0.319, 0.243, 0.015, 0.166),
             seed = 13)
```

op_power_surv	<i>Provides operating characteristics of group sequential MAMS trial for survival outcome</i>
---------------	---

Description

Computes power and other characteristics for group-sequential MAMS trial for survival outcome.

Usage

```
op_power_surv(
  m0,
  alpha,
  beta,
  p,
  frac,
  hr0,
  hr1,
  nsim,
  ta,
  tf,
  kappa,
  eta,
  seed
)
```

Arguments

m0	numeric Median survival time of control group.
alpha	numeric Type I error.
beta	numeric Type II error.
p	numeric Number of treatment arms.
frac	numeric Vector of fractions for information time at each look.
hr0	numeric Hazard ratio of ineffective treatment group vs control.
hr1	numeric Hazard ratio of effective treatment group vs control.
nsim	numeric Number of simulations.
ta	numeric Accrual time.
tf	numeric Follow-up time.
kappa	numeric Shape parameter (kappa=1 for exponential distribution).
eta	numeric Rate of loss to follow-up.
seed	numeric Random seed number.

Value

A list of power, stage-wise probability of success, stopping probability, probability of futility, average number of events happened per arm, average duration of trial.

Examples

```
op_power_surv(m0 = 20,  
              alpha = 0.05,  
              beta = 0.1,  
              p = 4,  
              frac = c(1 / 2, 1),  
              hr0 = 1,  
              hr1 = 0.74,  
              ta = 12,  
              tf = 40,  
              nsim = 20,  
              kappa = 1,  
              eta = 0,  
              seed = 12)
```

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