# Package 'grpseq'

October 13, 2022

**Type** Package

**Title** Group Sequential Analysis of Clinical Trials

**Version** 1.0

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**URL** <https://sites.google.com/view/lmaowisc/>

**Description** Design of group sequential trials, including non-binding futility analysis
at multiple time points (Gallo, Mao, and Shih, 2014, <doi:10.1080/10543406.2014.932285>).

**License** GPL (>= 2)

**Encoding** UTF-8

**RoxygenNote** 7.1.1

**VignetteBuilder** knitr

**Depends** R (>= 2.10)

**Imports** mvtnorm

**Suggests** knitr, rmarkdown

**NeedsCompilation** no

**Repository** CRAN

**Date/Publication** 2021-12-06 17:20:02 UTC

## R topics documented:

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fut *Design of non-binding futility analysis at multiple points*

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### Description

Design of non-binding futility looks at multiple information times based on conditional power (CP), predictive power (PP), or condition power under current estimate (CPd) (Gallo, Mao, and Shih, 2014).

### Usage

```
fut(
  alpha,
  beta,
  t,
  gamma,
  side = 2,
  increment = 1e-04,
  si = 0,
  scale = "CP",
  seed = 12345
)
```

### Arguments

| | |
|---|---|
| alpha | Type I error. |
| beta | Type II error (1 - power). |
| t | A numeric vector of information times in $(0, 1)$ for futility looks. |
| gamma | A numeric vector of probabilities (whose meaning depends on scale) at information times t. |
| side | 1- or 2-sided test. |
| increment | Error for the numerical solution of the sample size inflation factor. |
| si | 0: without sample size inflation; 1: with sample size inflation. |
| scale | Character string specifying the scaled used: "CP", conditional power; "PP", predictive power; "CPd": condition power under current estimate. |
| seed | Seed number for the randomized evaluation of multivariate normal distribution. |

### Value

An object of class fut with the following components. gamma1: conditional power at information times t converted from the supplied gamma and scale; theta: local alternative associated with the actual power when the futility rules of enforced; IF: sample size inflation factor if si=1; loss: power loss if si=0.

## References

Gallo, P., Mao, L., and Shih, V.H. (2014). Alternative views on setting clinical trial futility criteria. Journal of Biopharmaceutical Statistics, 24, 976-993.

## See Also

print.fut, summary.fut, plot.fut, powerplot

## Examples

```
## load the package
library(grpseq)
## two-sided level 0.05 test with 80% power;
## evenly spaced three futility looks with predictive power 20%;
## inflate sample size to recoup power.
obj1 <- fut(alpha=0.05,beta=0.2,t=(1:3)/4,gamma=0.2*rep(1,3),side=2,scale="PP",si=1)
obj1
## print the summary results
summary(obj1)

## do the same thing without sample size inflation
obj2 <- fut(alpha=0.05,beta=0.2,t=(1:3)/4,gamma=0.2*rep(1,3),side=2,scale="PP",si=0)
obj2
## print the summary results
summary(obj2)
oldpar <- par(mfrow = par("mfrow"))
par(mfrow=c(1,2))
## plot the futility boundaries by z-value
plot(obj2,scale='z',lwd=2,main="")
## plot the futility boundaries by B-value
plot(obj2,scale='b',lwd=2,main="")
par(oldpar)
## plot the power curve as a function of the (local)
## effect size in units of the hypothesized effect size
## ref=TRUE requests the power curve for the original one-time analysis
powerplot(obj2,lwd=2, ref=TRUE)
```

---

plot.fut *Plot the planned futility boundaries*

---

## Description

Plot the planned futility boundaries in B- or z-values as a function of information time.

## Usage

```
## S3 method for class 'fut'
plot(
  x,
```

```
    scale = "z",
    add = FALSE,
    lty = 8,
    xlab = "Info Time",
    ylab = "z score",
    type = "b",
    pch = 1,
    cex = 1,
    main = "Futility Boundary for the Planned Test",
    xlim = c(0, 1.1),
    ylim = NULL,
    ...
)
```

## Arguments

| | |
|---|---|
| x | An object returned by [fut](#). |
| scale | "z": plot z-values; "b": plot B-values. |
| add | If TRUE, the curve will be overlaid on an existing plot; otherwise, a separate plot will be constructed. |
| lty | Line type for the segments connecting the z-/B-value points. |
| xlab | A label for the x axis, defaults to a description of x. |
| ylab | A label for the y axis, defaults to a description of y. |
| type | Plot type. "l": only line segments; "p": only z-/B-value points; "b": both. |
| pch | Point types for the z-/B-values. |
| cex | Point size. |
| main | A main title for the plot. |
| xlim | The x limits of the plot. |
| ylim | The y limits of the plot. |
| ... | Other arguments that can be passed to the underlying plot method. |

## Value

No return value, called for side effects.

## See Also

[fut](#), [summary.fut](#), [powerplot](#).

## Examples

```
# see example for fut
```

---

powerplot | *Plot the power function of the planned analysis*

---

### Description

Plot the power curve of the planned futility analysis as a function of the effect size (in units of the hypothesized effect size).

### Usage

```
powerplot(
  x,
  ref = FALSE,
  add = FALSE,
  lty = 1,
  ref.lty = 2,
  lwd = 1,
  xlab = expression(delta),
  ylab = "Power",
  main = "Power curve of the planned futility analysis",
  xlim = c(0, 1.5),
  ylim = c(0, 1),
  ...
)
```

### Arguments

| | |
|---|---|
| x | An object returned by [fut](). |
| ref | If TRUE, power curve of the reference test (one that ignores the futility boundaries) will be overlaid. |
| add | If TRUE, the curve will be overlaid on an existing plot; otherwise, a separate plot will be constructed. |
| lty | Line type for the power curve of the futility analysis. |
| ref.lty | Line type for the power curve of the reference if ref=TRUE. |
| lwd | Line width. |
| xlab | A label for the x axis, defaults to a description of x. |
| ylab | A label for the y axis, defaults to a description of y. |
| main | A main title for the plot. |
| xlim | The x limits of the plot. |
| ylim | The y limits of the plot. |
| ... | Other arguments that can be passed to the underlying plot method. |

### Value

No return value, called for side effects.

## See Also

[fut](#), [summary.fut](#), [plot.fut](#).

## Examples

```
# see example for fut
```

---

print.fut                       *Print basic information about the futility design*

---

## Description

Print the power loss or sample size inflation factor due to the planned futility analysis.

## Usage

```
## S3 method for class 'fut'
print(x, ...)
```

## Arguments

x               An object of class `fut`.

...             Further arguments passed to or from other methods.

## Value

Print the results of `fut` object.

## See Also

[fut](#), [summary.fut](#)

## Examples

```
# see example for fut
```

---

print.summary.fut *Print method for summary.fut objects*

---

### Description

Print the detailed summary of the futility design.

### Usage

```
## S3 method for class 'summary.fut'
print(x, ...)
```

### Arguments

x          An object returned by summary.fut.

...        Further arguments passed to or from other methods

### Value

No return value, called for side effects.

### See Also

fut, summary.fut.

---

summary.fut *Detailed summary of the futility design*

---

### Description

Provide key information about the futility design, including B-/z-values, beta (type II error) spent, and power loss at each futility look as well the the sample size distribution under the null hypothesis.

### Usage

```
## S3 method for class 'fut'
summary(object, ...)
```

### Arguments

object     An object returned by fut.

...        further arguments passed to or from other methods.

**Value**

An object of class `summary.fut` with components:

| | |
|---|---|
| t | A $K$-dimensional vector of information times. |
| b | A $K$-dimensional vector of B-values at `t`. |
| z | A $K$-dimensional vector of z-values at `t`. |
| type2 | A $K$-dimensional vector of beta spent at `t`. |
| loss | A $K$-dimensional vector of power loss at `t`. |
| ess | Expected sample size at $H_0$. |
| ... | |

**See Also**

`fut`, `print.fut`, `print.summary.fut`.

**Examples**

```
# see example for fut
```

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