Package 'BDEsize'

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Type Package

Title Efficient Determination of Sample Size in Balanced Design of Experiments

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Description Provides the sample size in balanced design of experiments and three graphs ; detectable standardized effect size vs power, sample size vs detectable standardized effect size, and sample size vs power.
Sample size is computed in order to detect a certain standardized effect size with power at the significance level.
Three graphs show the mutual relationship between the sample size, power and the detectable standardized effect size.
By investigating those graphs, it can be checked that which effects are sensitive to the efficient sample size determination.
Lenth,R.V.(2006-9) <http://www.stat.uiowa.edu/~rlenth/Power>
Lim, Yong Bin (1998)
Marvin, A., Kastenbaum, A. and Hoel, D.G. (1970) <doi:10.2307/2334851>
Montgomery, Douglas C. (2013, ISBN: 0849323312).

License GPL (>= 2)

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RoxygenNote 6.1.1

NeedsCompilation no

Repository CRAN

Imports fpow, shiny, shinyalert, ggplot2

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`BDEsizeApp` *Shiny App for efficient determination of the size of experiments in Balanced design of experiments*

Description

Shiny App for efficient determination of the size of experiments in Balanced design of experiments

Usage

```
BDEsizeApp()
```

Examples

```
#BDEsizeApp()
```

`fsize` *Detectable minimum effect size*

Description

Detectable minimum effect size is calculated using the distribution function of noncentral F-distribution with noncentrality parameter.

Usage

```
fsize(alpha,beta,nu1,nu2,c,delta_type,flag)
```

Arguments

alpha	Type I error
beta	Type II error
nu1	numerator degree of freedom for the f-test
nu2	denominator degree of freedom for the f-test
c	the coefficient of sum of squares
delta_type	type of standardized effect size ; 1 : standard deviation type, 2 : range of effect type
flag	In case of delta_type=2 ; If flag=1 , two-way interaction effect for range of effect type. If flag=0(default), main effect for range of effect type.

Value

detectable minimal effect sizes

Examples

```
#two-level full factorial design with 2 factors
#5 replications, main effect for standardized type
fsize(alpha=0.05, beta=0.2, nu1=1, nu2=17,
c=10,delta_type=1 )
```

---

plots.2levFr *Graphs for investigating sample size in 2 level fractional factorial design*

Description

Three graphs in 2 level fractional factorial design are for investigating the mutual relationship between the sample size, power "1-beta" and the detectable standardized effect size "delta"

Usage

```
plots.2levFr(factor,fraction,order,delta_type,delta,deltao,alpha,beta,type)
```

Arguments

factor	the number of factor
fraction	the number of generators p ex) $2^(k-p)$
order	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects
delta_type	type of standardized effect size ; 1 : standard deviation type(default), 2 : range of effect type

delta	lists of effects size; The first and the second column is effect size of main and two-way interaction effects, respectively. The third column is standard devitaion of noise.
deltao	deltao is the detectable standardized effect size for the sample size vs power plot (in case of type=3) ; 1 (default)
alpha	Type I error ; 0.05 (default)
beta	Type II error ; 0.20 (default)
type	three graphs ; If type=1, Delta vs Power plot. If type=2, Sample size vs Delta plot. If type=3, Sample ize vs Power plot

Value

one of three graphs ; Delta vs Power plot , Sample size vs Delta plot, and Sample ize vs Power plot

Examples

```
#Delta vs Power plot
plots.2levFr(factor=3, fraction=1,order=1,
delta_type=1, delta=c(1,0,1), alpha=0.05, beta=0.2, type=1)
#Sample ize vs Power plot including two-way interaction effects
plots.2levFr(factor=5, fraction=1,order=2,
delta_type=1, delta=c(1,1,1), deltao=1, alpha=0.05, beta=0.2, type=3)
```

---

plots.Block *Graphs for investigating sample size in randomized complete block design*

Description

Three graphs in randomized complete block design are for investigating the mutual relationship between the sample size, power "1-beta" and the detectable standardized effect size "delta"

Usage

```
plots.Block(factor,factor.lev,order,delta_type,delta,deltao,alpha,beta,type)
```

Arguments

factor	the number of factor
factor.lev	factor levels
order	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects
delta_type	type of standardized effect size ; 1 : standard deviation type(default), 2 : range of effect type

delta	lists of effects size; The first and the second column is effect size of main and two-way interaction effects, respectively. The third column is standard devitaion of noise.
deltao	deltao is the detectable standardized effect size for the sample size vs power plot (in case of type=3) ; 1 (default)
alpha	Type I error ; 0.05 (default)
beta	Type II error ; 0.20 (default)
type	three graphs ; If type=1, Delta vs Power plot. If type=2, Sample size vs Delta plot. If type=3, Sample ize vs Power plot

Value

one of three graphs ; Delta vs Power plot , Sample size vs Delta plot, and Sample ize vs Power plot

Examples

```
#Delta vs Power plot
plots.Block(factor=2, factor.lev=c(2,2),order=1,
delta_type=1, delta=c(1,0,1), alpha=0.05, beta=0.2, type=1)
#Sample ize vs Power plot including two-way interaction effects
plots.Block(factor=2, factor.lev=c(2,2),order=2,
delta_type=1, delta=c(1,1,1), deltao=1.5, alpha=0.05, beta=0.2, type=3)
```

---

plots.Full *Graphs for investigating sample size in full factorial design*

Description

Three graphs in full factorial design are for investigating the mutual relationship between the sample size, power "1-beta" and the detectable standardized effect size "delta"

Usage

```
plots.Full(factor,factor.lev,order,delta_type,delta,deltao,alpha,beta,type)
```

Arguments

factor	the number of factor
factor.lev	factor levels
order	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects
delta_type	type of standardized effect size ; 1 : standard deviation type(default), 2 : range of effect type

delta	lists of effects size; The first and the second column is effect size of main and two-way interaction effects, respectively. The third column is standard devitaion of noise.
deltao	deltao is the detectable standardized effect size for the sample size vs power plot (in case of type=3) ; 1 (default)
alpha	Type I error ; 0.05 (default)
beta	Type II error ; 0.20 (default)
type	three graphs ; If type=1, Delta vs Power plot. If type=2, Sample size vs Delta plot. If type=3, Sample ize vs Power plot

Value

one of three graphs ; Delta vs Power plot , Sample size vs Delta plot, and Sample ize vs Power plot

Examples

```
#Delta vs Power plot in case of two-level full factorial design with 2 factors
plots.Full(factor=2, factor.lev=c(2,2),order=1,
delta_type=1, delta=c(1,0,1), alpha=0.05, beta=0.2, type=1)
#Sample ize vs Power plot in case of two-level full factorial design with 2 factors
plots.Full(factor=2, factor.lev=c(2,2),order=2,
delta_type=1, delta=c(1,1,1), deltao=1.5, alpha=0.05, beta=0.2, type=3)
```

---

plots.Split *Graphs for investigating sample size in split-plot design*

Description

Three graphs in split-plot design are for investigating the mutual relationship between the sample size, power "1-beta" and the detectable standardized effect size "delta"

Usage

```
plots.Split(whole.factor,whole.factor.lev,
split.factor,split.factor.lev,order,delta_type,
delta,deltao,alpha,beta,type)
```

Arguments

whole.factor	the number of whole factor
whole.factor.lev	whole factor levels
split.factor	the number of split factor
split.factor.lev	split factor levels

`order`	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects
`delta_type`	type of standardized effect size ; 1 : standard deviation type(default), 2 : range of effect type
`delta`	lists of effects size; The first and the second column is effect size of main and two-way interaction effects, respectively. The third column is standard devitaion of noise.
`deltao`	deltao is the detectable standardized effect size for the sample size vs power plot (in case of type=3) ; 1 (default)
`alpha`	Type I error ; 0.05 (default)
`beta`	Type II error ; 0.20 (default)
`type`	three graphs ; If type=1, Delta vs Power plot. If type=2, Sample size vs Delta plot. If type=3, Sample ize vs Power plot

Value

one of three graphs ; Delta vs Power plot , Sample size vs Delta plot, and Sample ize vs Power plot

Examples

```
#Delta vs Power plot
plots.Split(whole.factor=1, whole.factor.lev=c(2),
split.factor=1, split.factor.lev=c(2), order=1,
delta_type=1, delta=c(1,0,1,1), alpha=0.05, beta=0.2, type=1)
#Sample ize vs Power plot including two-way interaction effects
plots.Split(whole.factor=1, whole.factor.lev=c(2),
split.factor=1, split.factor.lev=c(2), order=2,
delta_type=1, delta=c(1,1,1,1),deltao=1, alpha=0.05, beta=0.2, type=3)
```

`Size.2levFr` *Sample size calculator for 2 level fractional factorial design*

Description

Sample size in 2 level fractional factorial design is computed in order to detect a certain standardized effect size "delta" with power "1-beta" at the significance level "alpha". The model for fractional factorial design contains only main effects in resolution III and IV.

Usage

```
Size.2levFr(factor,fraction,order,delta_type,delta,alpha,beta)
```

Arguments

factor	the number of factor
fraction	the number of generators p ex) $2^(k-p)$
order	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects
delta_type	type of standardized effect size ; 1 : standard deviation type(default), 2 : range of effect type
delta	lists of effects size; The first and the second column is effect size of main and two-way interaction effects, respectively. The third column is standard devitaion of noise.
alpha	Type I error ; 0.05 (default)
beta	Type II error ; 0.20 (default)

Value

model, optimal sample size and detectable standardized effect sizes

Detectable standardized effect sizes return only one or two values for main and two-way interaction effects.

References

Lenth,R.V., 2006-9. Java Applets for Power and Sample Size[Computer software]. Retrieved March 27, 2018 from http://www.stat.uiowa.edu/~rlenth/Power

Lim, Yong Bin, 1998. Study on the Size of Minimal Standardized Detectable Difference in Balanced Design of Experiments, *Journal of the Korean society for Quality Management*, 26(4),239-249.

Marvin, A., Kastenbaum, A. and Hoel, D.G., 1970. Sample size requirements : one-way analysis of variance, *Biometrika* 57(2),421-430.

Examples

```
#only main effects
A<-Size.2levFr(factor=3, fraction=1,order=1,
delta_type=1, delta=c(1,0,1), alpha=0.05, beta=0.2)
A$model
A$n
A$Delta

#including two-way interaction effects
B<-Size.2levFr(factor=5, fraction=1,order=2,
delta_type=1, delta=c(1,1,1), alpha=0.05, beta=0.2)
```

`Size.Block` *Sample size calculator for randomized complete block design*

Description

Sample size in randomized complete block design is computed in order to detect a certain standardized effect size "delta" with power "1-beta" at the significance level "alpha".

Usage

```
Size.Block(factor,factor.lev,order,delta_type,delta,alpha,beta)
```

Arguments

`factor`	the number of factor
`factor.lev`	factor levels
`order`	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects
`delta_type`	type of standardized effect size ; 1 : standard deviation type(default), 2 : range of effect type
`delta`	lists of effects size; The first and the second column is effect size of main and two-way interaction effects, respectively. The third column is standard devitaion of noise.
`alpha`	Type I error ; 0.05 (default)
`beta`	Type II error ; 0.20 (default)

Value

model, optimal sample size and detectable standardized effect sizes

References

Lenth,R.V., 2006-9. Java Applets for Power and Sample Size[Computer software]. Retrieved March 27, 2018 from http://www.stat.uiowa.edu/~rlenth/Power

Lim, Yong Bin, 1998. Study on the Size of Minimal Standardized Detectable Difference in Balanced Design of Experiments, *Journal of the Korean society for Quality Management*, 26(4),239-249.

Marvin, A., Kastenbaum, A. and Hoel, D.G., 1970. Sample size requirements : one-way analysis of variance, *Biometrika* 57(2),421-430.

Examples

```
#only main effects
A<-Size.Block(factor=2, factor.lev=c(2,2),order=1,
delta_type=1, delta=c(1,0,1), alpha=0.05, beta=0.2)
A$model
A$n
A$Delta

#including two-way interaction effects
B<-Size.Block(factor=2, factor.lev=c(2,2),order=2,
delta_type=1, delta=c(1,1,1), alpha=0.05, beta=0.2)
```

`Size.Full` *Sample size calculator for full factorial design*

Description

Sample size in full factorial design is computed in order to detect a certain standardized effect size "delta" with power "1-beta" at the significance level "alpha".

Usage

```
Size.Full(factor,factor.lev,order,delta_type,delta,alpha,beta)
```

Arguments

`factor`	the number of factor
`factor.lev`	factor levels
`order`	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects
`delta_type`	type of standardized effect size ; 1 : standard deviation type(default), 2 : range of effect type
`delta`	lists of effects size; The first and the second column is effect size of main and two-way interaction effects, respectively. The third column is standard devitaion of noise.
`alpha`	Type I error ; 0.05 (default)
`beta`	Type II error ; 0.20 (default)

Value

model, optimal sample size and detectable standardized effect sizes

References

Lenth,R.V., 2006-9. Java Applets for Power and Sample Size[Computer software]. Retrieved March 27, 2018 from http://www.stat.uiowa.edu/~rlenth/Power

Lim, Yong Bin, 1998. Study on the Size of Minimal Standardized Detectable Difference in Balanced Design of Experiments, *Journal of the Korean society for Quality Management*, 26(4),239-249.

Marvin, A., Kastenbaum, A. and Hoel, D.G., 1970. Sample size requirements : one-way analysis of variance, *Biometrika* 57(2),421-430.

Examples

```
#only main effects
A<-Size.Full(factor=2, factor.lev=c(2,2),order=1,
delta_type=1, delta=c(1,0,1), alpha=0.05, beta=0.2)
A$model
A$n
A$Delta

#including two-way interaction effects
B<-Size.Full(factor=2, factor.lev=c(2,2),order=2,
delta_type=1, delta=c(1,1,1), alpha=0.05, beta=0.2)
```

`Size.Split` *Sample size calculator for split-plot design*

Description

Sample size in split-plot design is computed in order to detect a certain standardized effect size "delta" with power "1-beta" at the significance level "alpha".

Usage

```
Size.Split(whole.factor, whole.factor.lev,split.factor,
split.factor.lev, order, delta_type, delta, alpha, beta)
```

Arguments

`whole.factor`	the number of whole factor
`whole.factor.lev`	whole factor levels
`split.factor`	the number of split factor
`split.factor.lev`	split factor levels
`order`	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects

delta_type	type of standardized effect size ; 1 : standard deviation type(default), 2 : range of effect type
delta	lists of effects size; The first and the second column is effect size of main and two-way interaction effects, respectively. The third and the forth column is standard devitaion of whole noise and noise, respectively.
alpha	Type I error ; 0.05 (default)
beta	Type II error ; 0.20 (default)

Details

The linear model for the split-plot design is

$$y_{ijklm} = \mu+\tau_i+\beta_j+\gamma_k+(\beta\tau)_{ik}+\theta_{ijk}+\delta_l+\lambda_m+(\delta\lambda)_{im}+(\beta\delta)_{jl}+(\beta\lambda)_{jm}+(\gamma\delta)_{kl}+(\delta\lambda)_{lm}+\epsilon_{ijklm}$$

where τ_i represents the replicate effect, β_j, γ_k represents the whole plot main effects, θ_{ijk} is the whole plot error, δ_l, λ_m represent the subplot main effects, and ϵ_{ijklm} is the subplot error.

Value

model, optimal sample size and detectable standardized effect sizes

References

Lenth,R.V., 2006-9. Java Applets for Power and Sample Size[Computer software]. Retrieved March 27, 2018 from http://www.stat.uiowa.edu/~rlenth/Power

Lim, Yong Bin, 1998. Study on the Size of Minimal Standardized Detectable Difference in Balanced Design of Experiments, *Journal of the Korean society for Quality Management*, 26(4),239-249.

Marvin, A., Kastenbaum, A. and Hoel, D.G., 1970. Sample size requirements : one-way analysis of variance, *Biometrika* 57(2),421-430.

Montgomery, Douglas C., 2013. Design and analysis of experiments. John wiley & sons. ISBN: 978-1-118-14692-7

Examples

```
#only main effects
A<-Size.Split(whole.factor=2, whole.factor.lev=c(2,2),
split.factor=2, split.factor.lev=c(2,2), order=1,
delta_type=1, delta=c(1,0,1,1), alpha=0.05, beta=0.2)
A$model
A$n
A$Delta

#including two-way interaction effects
B<-Size.Split(whole.factor=2, whole.factor.lev=c(2,2),
split.factor=2, split.factor.lev=c(2,2), order=2,
delta_type=1, delta=c(1,1,1,1), alpha=0.05, beta=0.2)
```

sizelist *Buliding the model*

Description

Model is built on the number of factor and order.

Usage

```
sizelist(factor,order)
```

Arguments

factor	the number of factor
order	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects

Value

terms and expansion of model

Examples

```
#2 factors; both main and two-way interaction effects
A<-sizelist(2,2)
A$full_list
A$list1
```

sizelist.split *Buliding the model for split-plot design*

Description

Model is built on the number of factor and order.

Usage

```
sizelist.split(whole.factor,split.factor,order)
```

Arguments

whole.factor	the number of whole factor
split.factor	the number of split factor
order	building the model with main or including the interaction effects ; 1 : only main effects(default) , 2 : both main and two-way interaction effects

Value

terms and expansion of model

Examples

```
#one whole.factor and one split.factor ; both main and two-way interaction effects
A<-sizelist.split(1,1,2)
A$full_list
A$list1
```

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