Package ‘VdgRsm’

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Retrieve small exact D-, A-, G-, and IV-Optimal designs generated by a genetic algorithm. These designs are catalogued by Borkowski (2003).

**Usage**

\[ \text{Borkowski2003}(\text{criterion, } k, N) \]

**Arguments**

- **criterion**  Only optimal criteria "D", "A", "G", and "IV" are available now.
- **k**  The number of factor, \( k = 2 \) and \( 3 \)
- **N**  The number of design points

**Value**

Borkowski2003 is called to generate the data frame of the design matrix of exact optimal designs.

**References**


**Examples**

- Borkowski2003("D", 2, 10)
- Borkowski2003("G", 3, 13)
- Borkowski2003("IV", 2, 7)
- Borkowski2003("A", 3, 15)
Description

Create a variance dispersion graph for a response surface design in a cuboidal region.

Usage

cpv(design.matrix, design.matrix.2 = NULL, des.names = c("Design 1","Design 2"),
add.xls = TRUE)

Arguments

design.matrix, design.matrix.2
Data frames of design points to be compared in coded or uncoded units. There should be one column for each factor in the design, and one row for each run in the design. The maximum number of factors is 6. If the number of factors is more than 4, only one design is allowed.

add.xls
Generate scaled prediction variances of random design points in the VDG. By default add.xls = TRUE.

des.names
A vector of descriptive names for designs in character strings.

Value

cpv is called to generate a variance dispersion graph when the number of factors k = 2, 3, or 4 and to generate side-by-side boxplots for k = 5 and 6. In the former case, a table of the minimum, maximum, and average of scaled prediction variances is also produced.

Examples

CCD1<- gen.CCD(n.vars = 3, n.center = 2, alpha = 1)
CCD2<- gen.CCD(n.vars = 3, n.center = 5, alpha = 1)
cpv(CCD1, CCD2, des.names = c("CCD with nc=2","CCD with nc=5"), add.xls = FALSE)

fds.cube

The Fraction of Design Space (FDS) plots for cuboidal-region designs

Description

Create fraction of design space plots for response surface designs in cuboidal regions.

Usage

fds.cube(design.matrix, design.matrix.2 = NULL, design.matrix.3 = NULL,
        des.names = c("Design 1","Design 2","Design 3"))
Arguments

design.matrix, design.matrix.2, design.matrix.3

Data frames of design points to be compared in coded or uncoded units. There should be one column for each factor in the design, and one row for each run in the design. The maximum number of factors is 6.

des.names A vector of descriptive names for designs in character strings.

Value

fds.sphere is called to generate fraction of design space plots for cuboidal-region designs.

Examples

ccd1 <- gen.CCD(n.vars = 4, n.center = 2, alpha = 1)
ccd2 <- gen.CCD(n.vars = 4, n.center = 5, alpha = 1)
fds.cube(ccd1, ccd2)

fds.sphere

The Fraction of Design Space (FDS) plots for spherical-region designs

Description

Create fraction of design space plots for response surface designs in spherical regions.

Usage

fds.sphere(design.matrix, design.matrix.2 = NULL, design.matrix.3 = NULL,
des.names = c("Design 1","Design 2","Design 3"), scale = TRUE, label = "ON")

Arguments

design.matrix, design.matrix.2, design.matrix.3

Data frames of design points to be compared in coded or uncoded units. There should be one column for each factor in the design, and one row for each run in the design. The maximum number of factors is 7.

des.names A vector of descriptive names for designs in character strings.

scale Design points are scaled by a factor equal to the square root of the number of factors divided by the maximum of radii across the set of design points. This factor makes two or more designs comparable by scaling the maximum design point radius to be the square root of the number of factors.

label The default is "ON" meaning that all legends will be appeared, and if it is "OFF", legends will be removed.

Value

fds.sphere is called to generate Fraction of Design Space plots for spherical-region designs.
**Box-Behnken Designs (BBDs)**

**Description**

Generate Box-Behnken designs for $k = 3$ to $7$.

**Usage**

```r
gen.BBD(k, n.center = 1)
```

**Arguments**

- `k`: The number of factors or independent variables, $k = 3$ to $7$.
- `n.center`: The number of center points

**Value**

`gen.BBD` is called to generate the data frame of the design matrix of the BBD.

**Examples**

```r
gen.BBD(3)
gen.BBD(4, n.center = 3)
gen.BBD(7, n.center = 5)
```

**References**

Central Composite Designs

Description
Generate central composite designs

Usage
```r
gen.CCD(n.vars, n.center, alpha, varNames)
```

Arguments
- `n.vars`: The number of factors or independent variables
- `n.center`: The number of center points
- `alpha`: The axial distance
- `varNames`: The variable names. If it is not provided, the default names are X1, X2, ..., Xk

Value
`gen.CCD` is called to generate the data frame of the design matrix of the CCD

Examples
```r
ccd1 <- gen.CCD(n.vars = 3, n.center = 2, alpha = 1)
ccd2 <- gen.CCD(n.vars = 3, n.center = 2, alpha = 1, varNames = c("T1", "T2", "T3"))
```

Factorial Designs

Description
Generate factorial designs

Usage
```r
gen.Factr(n.vars, n.levels, varNames = NULL, scale = TRUE)
```

Arguments
- `n.vars`: The number of factors or independent variables
- `n.levels`: The number of levels of the factor
- `varNames`: The names of factors. If it is not provided, the default names are X1, X2, ..., Xk.
- `scale`: If it is `scale = TRUE`, the level values will be scaled to -1 to 1.
Value

gen.Factr is called to generate the data frame of the design matrix of the factorial design.

Examples

CCD1<- gen.Factr(n.vars = 3, n.levels = 5)
CCD2<- gen.Factr(n.vars = 3, n.levels = 5, varNames = c("T1","T2","T3"), scale = FALSE)

---

Description

Generate Hartley’s small composite designs for k = 2 to 7

Usage

gen.HSCD(k, alpha ="rotatable", n.center = 0)

Arguments

k The number of factors or independent variables, k = 2, 3, 4, 5, 6, and 7.
alpha Axial distance. User may specify "rotatable", "face-center", or other numeric numbers. See examples.
n.center The number of center points

Value

gen.HSCD is called to generate the data frame of the design matrix of the HSCD

References


Examples

gen.HSCD(3)
gen.HSCD(4, alpha ="face-center")
gen.HSCD(7, alpha = 2, n.center = 4)
Plackett-Burman Composite Designs (Draper and Lin’s Method)

Description

Generate Plackett-Burman composite designs proposed by Draper and Lin (1990) for $k = 3$ to $7$.

Usage

```r
gen.PBCD(k, alpha = "rotatable", n.center = 0)
```

Arguments

- **k**: The number of factors or independent variables, $k = 3$ to $7$.
- **alpha**: Axial distance. User may specify "rotatable", "face-center", or other numeric numbers. See examples.
- **n.center**: The number of center points.

Value

`gen.PBCD` is called to generate the data frame of the design matrix of the PBCD.

References


Examples

```r
gen.PBCD(3)
gen.PBCD(4, alpha = 1)
gen.PBCD(5, alpha = "face-center", n.center = 3)
gen.PBCD(6, alpha = 2, n.center = 5)
```

Roquemore’s Hybrid Designs

Description

Generate Roquemore (1976) hybrid designs for $k = 3$, $4$, and $6$. For $k = 3$, R310, R311A, and R311B will be produced, for $k = 4$, R416A, R416B, and R416C will be generated, and for $k = 6$ R628A and R628B will be given.

Usage

```r
gen.Roquemore(k, n.center = 0)
```
**Arguments**

- **k**  
  The number of factors or independent variables, k = 3, 4, and 6.

- **n.center**  
  The number of center points

**Value**

`gen.Roquemore` will retrieve the hybrid design points stored and the output is a list containing relevant Roquemore’s designs given a k value.

**References**


**Examples**

```r
    gen.Roquemore(3)
    gen.Roquemore(4, n.center = 2)
    gen.Roquemore(6, n.center = 1)
```

---

**Description**

Generate uniform shell designs for k = 2 to 6

**Usage**

```r
    gen.USD(k, alpha = 1)
```

**Arguments**

- **k**  
  The number of factors or independent variables, k = 2 to 6.

- **alpha**  
  A scaling factor. See examples.

**Value**

`gen.USD` is called to generate the data frame of the design matrix of the USD.

**References**

Examples

gen.U(2)
gen.U(3, alpha = sqrt(3))
gen.U(6)
gen.U(6, alpha = sqrt(6))

Description

Create a graph of scaled prediction variances for points in nested cubes (hyperarcs)

Usage

hyperarcs.vdg(design.matrix, design.matrix.2 = NULL, design.matrix.3 = NULL,
             des.names = c("Design 1","Design 2","Design 3"))

Arguments

design.matrix, design.matrix.2, design.matrix.3
  Data frames of design points to be compared in coded or uncoded units. There
  should be one column for each factor in the design, and one row for each run
  in the design. The minimum and maximum number of factors are 3 and 6,
  respectively.

des.names
  A vector of descriptive names for designs in character strings.

Value

hyperarcs.vdg is called to generate a plot of scaled prediction variances on hyperarcs.

Examples

CCD1<- gen.CCD(n.vars = 3, n.center = 2, alpha = 1)
CCD2<- gen.CCD(n.vars = 3, n.center = 5, alpha = 1)
hyperarcs.vdg(CCD1, CCD2)
**Spherical Prediction Variance**

**Description**

Create variance dispersion graphs (VDGs) for response surface designs in spherical regions.

**Usage**

```r
spv(design.matrix, design.matrix.2 = NULL, design.matrix.3 = NULL,
     des.names = c("Design 1","Design 2","Design 3"),
     scale = TRUE, add.pts = TRUE, label = "ON")
```

**Arguments**

- `design.matrix, design.matrix.2, design.matrix.3`
  - Data frames of design points to be compared in coded or uncoded units. There should be one column for each factor in the design, and one row for each run in the design. The maximum number of factors is 7.
- `des.names`
  - A vector of descriptive names for designs in character strings.
- `scale`
  - Design points are scaled by a factor equal to the square root of the number of factors divided by the maximum of radii across the set of design points. This factor makes two or more designs comparable by scaling the maximum design point radius to be the square root of the number of factors.
- `add.pts`
  - Generate scaled prediction variances of random design points in the VDG. By default `add.pts = TRUE`.
- `label`
  - The default is "ON" meaning that all legends will be appeared, and if it is "OFF", legends will be removed.

**Value**

`spv` is called to generate the Variance Dispersion Graph(s) and a table of the minimum, maximum, and average of scaled prediction variances.

**Examples**

```r
CCD1<- gen.CCD(n.vars = 3, n.center = 2, alpha = 1)
CCD2<- gen.CCD(n.vars = 3, n.center = 2, alpha = sqrt(3))
spv(CCD1, CCD2, des.names = c("CCD 1","CCD 2"))
```
Description

Create a contour plot of scaled prediction variances

Usage

spvcontour(design.matrix, shape, max.radius = sqrt(2), length = 100, nlevels = 10, title = "Contour of SPVs")

Arguments

- design.matrix: A data frame of design points. There should be one column for each factor in the design, and one row for each run in the design. Only design with 2 factors is allowed.
- shape: The shape can be "circle" or "square" which represent a shape of design space.
- max.radius: The radius of a circle.
- length: Argument from the interp function in library akima.
- nlevels: Argument from the interp function in library akima.
- title: The title of a contour plot.

Value

spvcontour is called to generate a contour plot of scaled prediction variances for response surface designs.

Examples

library(akima)
CCD1<- gen.CCD(n.vars = 2, n.center = 2, alpha = 1)
spvcontour(CCD1, shape = "square")
CCD2<- gen.CCD(n.var = 2, alpha = sqrt(2), n.center = 3)
spvcontour(CCD2, shape = "circle")
spvcontour(CCD2, shape = "circle", length = 200)
spvcontour(CCD2, shape = "circle", length = 200, nlevels = 20)
Plots of Scaled Prediction Variances for Response Surface Designs

Description

Functions for creating variance dispersion graphs, fraction of design space plots, and contour plots of scaled prediction variances for second-order response surface designs in spherical and cuboidal regions. Also, some standard response surface designs can be generated.

Details

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