Package 'UniDOE'

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Type Package

Title Uniform Design of Experiments

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Description Efficient procedures for constructing uniform design of experiments under various space-filling criteria. It is based on a stochastic and adaptive threshold accepting algorithm with flexible initialization, adaptive threshold, and stochastic evolution. The package may also construct the augmented uniform designs in a sequential manner.

License GPL-3

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R topics documented:

DesignEval   *Evaluate design in terms of criteria*

Description

This function takes matrix X0,q and crit to output the criterion value.

Usage

```
DesignEval(X0,crit)
```

Arguments

X0	an integer matrix object
crit	an integer object, criterion to choose:
	"MD2" – MD2
	"CD2" – CD2
	"WD2" – WD2
	"maximin" – maximin
	Default: "MD2"

Value

criterion value.

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
x0 = matrix(c(1,1,1,2,2,2,3,3,3),nrow=3,byrow=TRUE)
crit="MD2"
value = DesignEval(x0,crit)
```

| DesignPairPlot | *Draw pair plot for design of experiments* |

Description

This function takes a design D and a boolean value Diag to draw pair plot.

Usage

```
DesignPairPlot(D,Diag)
```

Arguments

D	a matrix object. Design of Experiment.
Diag	a boolean R object.

Value

A pair plot

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
##e.g.1
n=12 #(must be multiples of q)
s=3
q=4
crit = "MD2"#(Mixture L2 criteria)
D = DesignQuery(n=n,s=s,q=q,crit="MD2")
DesignPairPlot(D)

##e.g.2
n=12 #(must be multiples of q)
s=3
q=3
crit = "MD2"#(Mixture L2 criteria)
D = DesignQuery(n=n,s=s,q=q,crit="MD2")
DesignPairPlot(D,Diag=TRUE)
```

DesignQuery   *Evaluate design in terms of criteria*

Description

This function takes size of desired design,criterion crit. If the required design exists in database, then return the design, else return NULL.

Usage

```
DesignQuery(n,s,q,crit, ShowCrit)
```

Arguments

n	an integer R object. Run of Experiment
s	an integer R object. Factor of Experiment.
q	an integer R object. Level of Experiment.
crit	an integer object, criterion to choose: "MD2" – MD2 "CD2" – CD2 "maximin" – maximin Default: "CD2"
ShowCrit	If TRUE, print CD2,MD2,maximin value of required design. Default: TRUE

Value

Desired design

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
n = 9
s = 3
q = 3
crit="MD2"
D = DesignQuery(n,s,q,crit)
D
```

GenAUD *Generating Augmented Uniform Design of Experiments*

Description

This function takes n,s,q; a unchanged initial design and other arguments to output a list (described below).

Usage

```
GenAUD(X0,n,crit,maxiter,hits_ratio,vis)
```

Arguments

X0   an integer matrix R object

n   an integer R object. Run of Experiment

crit   an character R object. Type of criterion to use.
                "maximin" – maximin Discrepancy;
                "CD2" –Centered L2 Discrepancy;
                "WD2" – Wrap-around L2 Discrepancy;
                "MD2" –Mixture L2 Discrepancy;

maxiter   a positive integer R object. Maximum iteration number in outer while loop of
                SOAT algorithm.

hits_ratio   an float R object. Default value is 0.1, which is the ratio to accept changes
                of design in inner for loop. Details can be checked in (Zhang, A. and Li, H.
                (2017). UniDOE: An R package for constructing uniform design of experiments
                via stochastic and adaptive threshold accepting algorithm. Technical Report.)

vis   an boolean variable. If true, plot the trace of criterion values.

Value

A list that contains Initial design matrix(initial_design),optimal design matrix(final_design), initial criterion value(initial_criterion), final criterion value(criterion_value) and criterion list(criterion_lists) in update process.

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
#Example 1.
#Set a fixed initial matrix:
n=12 #(must be multiples of q)
mat0 = matrix(c(1,1,1,2,2,2,3,3,3),ncol=3,byrow=TRUE)# nb. of columns=s
crit = "MD2" #(Mixture L2 criteria)
res = GenAUD(X0=mat0,n,crit=crit,maxiter=100)

# Example 2.
# Set a fixed initial matrix with visualization:
n=9 #(must be multiples of q)
mat0 = matrix(c(1,1,1,2,2,2,3,3,3), ncol = 3, byrow = TRUE)
crit = "MD2" #(Mixture L2 criteria)
list1=GenAUD(X0=mat0,n,crit=crit,vis=TRUE,maxiter=100)
```

GenAUD_MS	*Generating sequential Uniform Design of Experiments using diffrent initial designs*

Description

This function takes n,s,q and other arguments to output a list(described below).

Usage

```
GenAUD_MS(X0, n, crit, maxiter, nshoot, vis=FALSE)
```

Arguments

X0	an integer matrix R object. Fixed design to be used.
n	an integer R object. Number of rows to be added to design
crit	an character R object. Type of criterion to use.
	"maximin" – maximin Discrepancy ;
	"CD2" – Centered L2 Discrepancy ;
	"WD2" – Wrap-around L2 Discrepancy;
	"MD2" – Mixture L2 Discrepancy ;
maxiter	a positive integer R object. Maximum iteration number in outer while loop of SATA algorithm in each shoot.
nshoot	Total counts to try different initial designs.
vis	an boolean R object. If true, plot the criterion value sequence for all shoots.

Value

Best design over all shoots.

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
D1 = DesignQuery(n = 18, s = 7, q = 3, crit = "MD2")
D2 = GenAUD_MS(X0=D1+1, n=18, crit="MD2",
               maxiter = 100, nshoot = 5,
               vis = TRUE)
```

GenLP   *Generating uniform designs by level permutation*

Description

Function for generating uniform designs by level permutation. It can be also used to improve a user-specified design with randomized level permutation.

Usage

```
GenLP(X0, crit, maxiter, hits_ratio, vis)
```

Arguments

X0	Current design
crit	an character R object. Type of criterion to use.
	"maximin" – maximin Discrepancy ;
	"CL2" –Centered L2 Discrepancy ;
	"WD2" – Wrap-around L2 Discrepancy;
	"MD2" –Mixture L2 Discrepancy ;
maxiter	a positive integer R object
hits_ratio	an float R object. Default value is 0.1, which is the ratio to accept changes of design in inner for loop. Details can be checked in (Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.)
vis	an boolean R object. If true, plot the criterion value sequence.

Value

A list that contains Initial design matrix(initial_design),optimal design matrix(final_design), initial criterion value(initial_criterion), final criterion value(criterion_value) and criterion list(criterion_lists) in update process.

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
n=27#(must be multiples of q)
s=13
q=3
crit = "MD2" #(Mixture L2 criteria)
res1 = GenUD(n,s,q,crit=crit,maxiter=100)
res2 = GenLP(res1$final_design,vis=TRUE, maxiter=100) # To improve ...
```

GenUD	*Generating Uniform Design of Experiments*

Description

This function takes n,s,q and other arguments to output a list(described below).

Usage

```
GenUD(n,s,q,init,initX,crit,maxiter,hits_ratio,vis)
```

Arguments

n	an integer R object. Run of Experiment
s	an integer R object. Factor of Experiment.
q	an integer R object. Level of Experiment.
init	an string vector R object: "rand"(default), "orth" or "input". Criterion used
initX	an user-defined integer matrix R object, which is fixed in search. Needed when init="orth" or init="input"
crit	an character R object. Type of criterion to use.
	"maximin" – maximin Discrepancy ;
	"CD2" –Centered L2 Discrepancy ;
	"WD2" – Wrap-around L2 Discrepancy;
	"MD2" –Mixture L2 Discrepancy ;
maxiter	a positive integer R object. Maximum iteration number in outer while loop of SATA algorithm.

hits_ratio	an float R object. Default value is 0.1, which is the ratio to accept changes of design in inner for loop. Details can be checked in (Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.)
vis	an boolean R object. If true, plot the criterion value sequence.

Value

A list that contains Initial design matrix(initial_design),optimal design matrix(final_design), initial criterion value(initial_criterion), final criterion value(criterion_value) and criterion list(criterion_lists) in update process.

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
##e.g.1
n=12 #(must be multiples of q)
s=3
q=4
crit = "MD2"#(Mixture L2 criteria)
res = GenUD(n,s,q,crit=crit,maxiter=100)

##e.g.2
n=10 #(must be multiples of q)
s=3
q=5
init = "rand"
crit = "MD2" #(Mixture L2 criteria)
vis=TRUE
res=GenUD(n,s,q,init=init,crit=crit,maxiter=100,vis=vis)

##e.g.3
#If init = "orth",
#algorithm will fix columns of initX and expand total number of columns to s for final design.
s=5
init = "orth"
# initX should be orthogonal design with nrow=n&level=q
initX = matrix(c(1,1,2,2,3,3,3,3,1,1,2,2), ncol=2)
res = GenUD(s=s,init=init,initX = initX,maxiter=100)

##e.g.4
#If init="input", algorithm will search for better a better design with same size as initX.
init = "input"
```

```
# initX should be orthogonal design with nrow=n&level=q
initX = matrix(c(1,1,2,2,3,3,3,3,1,1,2,2),ncol=2)
res = GenUD(init=init,initX = initX,maxiter=100)
```

GenUD_MS   *Generating Uniform Design of Experiments using diffrent initial de-*
                           signs

Description

This function takes n,s,q,crit and nshoot to return a design. nshoot number of random initial designs
are used in each shoot. The design returned is the best design over all shoots.

Usage

```
GenUD_MS(n, s, q, crit, maxiter, nshoot, vis)
```

Arguments

n	an integer R object. Run of Experiment
s	an integer R object. Factor of Experiment.
q	an integer R object. Level of Experiment.
crit	an character R object. Type of criterion to use.
	"maximin" – maximin Discrepancy ;
	"CD2" –Centered L2 Discrepancy ;
	"WD2" – Wrap-around L2 Discrepancy;
	"MD2" –Mixture L2 Discrepancy ;
maxiter	a positive integer R object. Maximum iteration number in outer while loop of SATA algorithm in each shoot.
nshoot	Total counts to try different initial designs.
vis	an boolean R object. If true, plot the criterion value sequence for all shoots.

Value

Best design over all shoots.

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experi-
ments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
D = GenUD_MS(36, 4, 6, crit="CD2",
             maxiter=50, nshoot = 6,
             vis=TRUE)
```

LHD_CD2   *LHD Tables under CD2*

Description

Latin Hypercube designs constructed by CD2 criterion

Usage

```
data(LHD_CD2)
```

Format

A list containing (n,s,q,CD2,WD2) and the design matrix

LHD_MD2   *LHD Tables under MD2*

Description

Latin Hypercube designs constructed by MD2 criterion

Usage

```
data(LHD_MD2)
```

Format

A list containing (n,s,q,CD2,WD2) and the design matrix

UD_CD2   *UD Tables under CD2*

Description

Uniform designs constructed by CD2 criterion

Usage

```
data(UD_CD2)
```

Format

A list containing (n,s,q,CD2,WD2) and the design matrix

UD_MD2   *UD Tables under MD2*

Description

Uniform designs constructed by MD2 criterion

Usage

```
data(UD_MD2)
```

Format

A list containing (n,s,q,CD2,WD2) and the design matrix

UniTracePlot   *Draw discrepancy value trace in optimization process.*

Description

This function takes an output from GenUD or GenAUD function and a integer value skip to draw trace plot.

Usage

```
UniTracePlot(output, skip=0)
```

Arguments

output	an output from GenUD or GenAUD function.
skip	an integer value. Number of values in the head to skip for the given sequence.

Value

A trace plot

Author(s)

Aijun Zhang, Haoyu Li, Shijie Quan

References

Zhang, A. and Li, H. (2017). UniDOE: An R package for constructing uniform design of experiments via stochastic and adaptive threshold accepting algorithm. Technical Report.

Examples

```
##e.g.
n=12 #(must be multiples of q)
s=3
q=4
Dlst = GenUD(n=n,s=s,q=q,crit="MD2",maxiter=100)
UniTracePlot(output=Dlst)
```

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