

Package ‘CompExpDes’

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Title Computer Experiment Designs

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Maintainer Ashutosh Dalal <ashutosh.dalal97@gmail.com>

Description In computer experiments space-filling designs are having great impact. Most popularly used space-filling designs are Uniform designs (UDs), Latin hypercube designs (LHDs) etc. For further references one can see Mckay (1979) <DOI:10.1080/00401706.1979.10489755> and Fang (1980) <<https://cir.nii.ac.jp/crid/1570291225616774784>>. In this package, we have provided algorithms for generate efficient LHDs and UD. Here, generated LHDs are efficient as they possess lower value of Maxpro measure, Phi_p value and Maximum Absolute Correlation (MAC) value based on the weightage given to each criterion. On the other hand, the produced UD are having good space-filling property as they always attain the lower bound of Discrete Discrepancy measure. Further, some useful functions added in this package for adding more value to this package.

License GPL (>= 2)

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Author Ashutosh Dalal [aut, cre],
Cini Varghese [aut, ctb],
Rajender Parsad [aut, ctb],
Mohd Harun [aut, ctb]

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Discrete_Discrepancy *Measure of Discrete Discrepancy*

Description

Discrete Discrepancy is a measure of uniformity for any uniform design. Lesser the value of Discrete Discrepancy measure, better is the uniform design.

Usage

```
Discrete_Discrepancy(Design, a, b)
```

Arguments

Design	A matrix
a	Any value $a > b > 0$. By default it is set to 1.
b	Any value $a > b > 0$. By default it is set to 0.5.

Value

The function calculates the value of Discrete Discrepancy measure and its lower bound for a given design.

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

References

Qin H, Fang KT (2004) <DOI:10.1007/s001840300296> Discrete discrepancy in factorial designs. *Metrika*, 60, 59-72.

Examples

```
library(CompExpDes)
lhd1<-matrix(c(1,5,7,3,4,2,6,2,1,4,5,3,7,6,4,5,6,1,2,3,7),nrow=7,ncol=3,byrow=FALSE)
lhd2<-cbind(lhd1[,3],lhd1[,2],lhd1[,1])
lhd<-rbind(lhd1,lhd2)
Discrete_Discrepancy(lhd, 1, 0.5)
```

Description

For prime number of factors, $F (>2)$, this method will generate LHDs with runs ranges from $F+2$ to F^2 . Maxpro criterion measure, Phi_p measure also provided as a measure of space-filling and orthogonality measure maximum absolute correlation (MAC) value also provided.

Usage

```
LHDs_I(levels, factors, weight, iterations)
```

Arguments

levels	Ranges from (factors+2) to factors ²
factors	A prime number (>2)
weight	Weight should be given to Maxpro, Phi_p and MAC such that sum is 1. Default it is 0.3, 0.3 and 0.4
iterations	Number of iterations. By default it is 400.

Value

This function will provide a series of LHDs along with space-filling and orthogonality measures for a prime numbers.

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

References

McKay, M.D., Beckman, R.J. and Conover, W.J. (1979). Comparison of three methods for selecting values of input variables in the analysis of output from a computer code. *Technometrics*, 21(2), 239-245.

Examples

```
## Not run:
library(CompExpDes)
LHDs_I(9, 3, c(0.6, 0, 0.4))

## End(Not run)
```

Description

For any number of factors, $F (>2)$, this method will generate LHDs with runs ranges from $F+2$ to $sC2$, where $s=2*F+1$. Maxpro criterion measure, Phi_p measure also provided as a measure of space-filling and orthogonality measure maximum absolute correlation (MAC) value also provided.

Usage

```
LHDs_II(levels, factors, weight, iterations)
```

Arguments

levels	Ranges from (factors+2) to $sC2$, where $s=2*factors+1$
factors	Any integer (>2)
weight	Weight should be given to Maxpro, Phi_p and MAC such that sum is 1. Default it is 0.3, 0.3 and 0.4
iterations	Number of iterations. By default it is 400.

Value

This function will provide a series of LHDs along with space-filling and orthogonality measures for any number.

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

References

McKay, M.D., Beckman, R.J. and Conover, W.J. (1979). Comparison of three methods for selecting values of input variables in the analysis of output from a computer code. *Technometrics*, 21(2), 239-245.

Examples

```
## Not run:
library(CompExpDes)
LHDs_II(20, 3, c(0.4, 0.2, 0.4))

## End(Not run)
```

MAC	<i>Maximum Absolute Correlation</i>
-----	-------------------------------------

Description

Maximum Absolute Correlation (MAC) is the maximum absolute value rather than 1 of a correlation matrix.

Usage

```
MAC(matrix)
```

Arguments

matrix	Input a matrix
--------	----------------

Value

It returns a maximum absolute value of the correlation matrix for a given matrix.

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

Examples

```
library(CompExpDes)
lhd<-matrix(c(1,5,7,3,4,2,6,2,1,4,5,3,7,6,4,5,6,1,2,3,7),nrow=7,ncol=3,byrow=FALSE)
MAC(lhd)
```

Maxpro_Measure	<i>Measure of Maxpro criterion</i>
----------------	------------------------------------

Description

Based upon a provided design, this function generates the value of maxpro criterion. Lesser the value of it better the design.

Usage

```
Maxpro_Measure(Design)
```

Arguments

Design	Provide a design in matrix format
--------	-----------------------------------

Value

Provides Maxpro criterion value

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

References

Joseph, V.R., Gul, E. and Ba, S. (2015). Maximum projection designs for computer experiments. *Biometrika*, 102 (2), 371-380.

Examples

```
library(CompExpDes)
lhd<-matrix(c(1,5,7,3,4,2,6,2,1,4,5,3,7,6,4,5,6,1,2,3,7),nrow=7,ncol=3,byrow=FALSE)
Maxpro_Measure(lhd)
```

Meeting_Number	<i>Maximum Coincidence (or Meeting) numbers between rows</i>
----------------	--

Description

Finding out Maximum coincidence (or Meeting) number between unique pair of rows.

Usage

```
Meeting_Number(matrix)
```

Arguments

matrix Any matrix

Value

This function provides the maximum coincidence number between any pair of rows of for given matrix.

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

Examples

```
library(CompExpDes)
mat<-matrix(c(1,2,3,3,2,1,4,2,1),nrow=3,byrow=TRUE)
Meeting_Number(mat)
```

PhipMeasure	<i>Phi_p criterion</i>
-------------	------------------------

Description

For a given design Phi_p criterion is calculated. It is based on Morris and Mitchell (1995). Lesser the value of Phi_p criterion better the design.

Usage

```
PhipMeasure(design,p=15,q=2)
```

Arguments

design	A design matrix is needed
p	Any positive integer. Default value of p = 15.
q	Any positive integer. Default value of q = 2. This implies that we are considering here Euclidean distance.

Value

Generates Phi_p criterion value

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

References

Morris, M.D. and Mitchell, T.J. (1995). Exploratory designs for computer experiments. Journal of Statistical Planning and Inference, 43, 38-402.

Examples

```
library(CompExpDes)
lhd<-matrix(c(1,5,7,3,4,2,6,2,1,4,5,3,7,6,4,5,6,1,2,3,7),nrow=7,ncol=3,byrow=FALSE)
PhipMeasure(lhd,p=15,q=2)
```

Description

For $v = pq$ ($p > 2, q \geq 2$ and $v \geq 6$) these uniform designs are generated. This function provides designs based on two types. It also provides number of factors, number of levels, number of runs along with maximum absolute correlation value and discrete discrepancy measure with its lower bound value.

Usage

```
UDesigns_I(p, q, type)
```

Arguments

p	any integer > 2
q	any integer ≥ 2
type	1 or 2

Details

Type 1 or type 2 both can exist for a same parameter range. For type 1 it will require more runs than designs generated by type 2. But type 1 provides designs which are having more spread than type 2 series designs.

Value

Returns a uniform designs along with number of factors, levels, runs, maximum absolute value and discrete discrepancy measure with its lower bound value.

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

References

Fang, K.T. (1980). The uniform design: application of number-theoretic methods in experimental design. *Acta Math Appl Sin*, 3, 363-372.

Examples

```
library(CompExpDes)
UDesigns_I(4, 3, 1)
```


U Designs_II

Uniform Designs with multiple factors

Description

For $v = sC2$, where $s (\geq 5)$ is any odd number. These are uniform designs in terms of discrete discrepancy. It also provides number of factors, number of levels and number of runs and discrete discrepancy measure with its lower bound value.

Usage

U Designs_II(s)

Arguments

s any odd integer ≥ 5

Value

Returns a series of high dimensional uniform designs along with number of factors, levels, runs and discrete discrepancy measure with its lower bound value.

Author(s)

Ashutosh Dalal, Cini Varghese, Rajender Parsad and Mohd Harun

References

Fang, K.T. (1980). The uniform design: application of number-theoretic methods in experimental design. Acta Math Appl Sin, 3, 363-372.

Examples

```
library(CompExpDes)
U Designs_II(5)
```

U Designs_III

Orthogonal Uniform Designs for Two and Four Factors (Even number v)

Description

For even number $v (\geq 6)$ this function will provide total three uniform designs of two factors (2) and four factors (1).

Usage

UDesigns_III(v)

Arguments

v An even number of factors, $v \geq 6$

Details

Uniform Design 1 and Uniform Design 3 are orthogonal/ nearly orthogonal but Uniform Design 2 is always orthogonal design.

Value

This function will generate 3 Uniform Designs along with the number of levels, factors, runs and MAC value.

Author(s)

Ashutosh Dalal, Cini varghese, Rajender Parsad and Mohd Harun

References

Fang, K.T. (1980). The uniform design: application of number-theoretic methods in experimental design. Acta Math Appl Sin, 3, 363-372.

Examples

```
## Not run:  
library(CompExpDes)  
UDesigns_III(10)  
  
## End(Not run)
```

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