Package 'SFOCDs'

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Type Package

Title Space Filling Optimal Covariate Designs

Version 1.1.0

Description We have designed this package to address experimental scenarios involving multiple covariates. It focuses on construction of Optimal Covariate Designs (OCDs), checking space filling property of the developed design. The primary objective of the package is to generate OCDs using four methods viz., M array method, Juxtapose method, Orthogonal Integer Array and Hadamard method. The package also evaluates space filling properties of both the base design and OCDs using the MaxPro criterion, providing a meaningful basis for comparison. In addition, it includes tool to visualize the spread offered by the design points in the form of scatterplot, which help users to assess distribution and coverage of design points.

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NeedsCompilation no

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Contents

`HadamardOCDs` *Hadamard Method for Optimal Covariate Designs (OCDs)*

Description

Construct Hadamard matrix H_k = (1, h_1 , h_2,..., h_k-1) where k is the block size of the required design. Then superimpose each columns of H_k leaving the first column which is in natural order separately into the N matrix to get the W matrices. The maximum number of W matrices will be k-1.

Usage

```
HadamardOCDs(design)
```

Arguments

`design`	Input a design in matrix format and block size k is multiple of 4.

Value

Generates W matrices and Inter product sums of W matrices.

Author(s)

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References

Das, K., N. K. Mandal, and B. K. Sinha. (2003) <https://doi.org/10.1016/S0378-3758(02)00151-9>. Optimal experimental designs for models with covariates. Journal of Statistical Planning and Inference 115(1): 273-285.

Bansal, N., and D. K. Garg. (2022)<https://doi.org/10.1007/s42519-022-00244-0>. Optimum covariate designs for three associate PBIB designs. Journal of Statistical Theory and Practice 16(3): 1-15.

Examples

```
library(SFOCDs)
mat<-matrix(c(1,2,3,4,1,2,4,5,1,3,4,5,2,3,4,5),nrow=4,byrow=TRUE)
HadamardOCDs(mat)
```

JuxtaOCDs *Juxtaposed Method for Optimal Covariate Designs (OCDs)*

Description

Consider L matrix, construct resolvable sets by grouping columns into pairs that have the same ordered set of elements. For each pair, arrange the two column-sets horizontally (2(s-1)) and change the signs of any two sets. This new setup form the P_i matrix of order 2(s-1) x 2. Then superimpose the first column of P_i onto N and that produce W_i, where first set of order v x b will be W_i^11 and other set below is W_i^21. Likewise use second column of P_i to get W_i^12 and W_i^22. Repeat for every P_i to get collection of W_i's. The grand total of Hadamard product of all W_i^ij will be zero provided a foldover of any one of the W_i^ij is taken.

Usage

```
JuxtaOCDs(design)
```

Arguments

design	Input a design in matrix format and block size k such that (k+1) is a prime number.

Value

Generates W matrices and Inter product sums of W matrices.

Author(s)

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References

Das, K., N. K. Mandal, and B. K. Sinha. (2003) <https://doi.org/10.1016/S0378-3758(02)00151-9>. Optimal experimental designs for models with covariates. Journal of Statistical Planning and Inference 115(1): 273-285.

Bansal, N., and D. K. Garg. (2022)<https://doi.org/10.1007/s42519-022-00244-0>. Optimum covariate designs for three associate PBIB designs. Journal of Statistical Theory and Practice 16(3): 1-15.

Examples

```
library(SFOCDs)
mat1<-matrix(c(
1,2,3,4,5,6,
7,8,9,10,11,1,
12,13,14,15,2,7,
16,17,18,3,8,12,
19,20,4,9,13,16,
21,5,10,14,17,19,
6,11,15,18,20,21),nrow=7,byrow=TRUE)
JuxtaOCDs(mat1)
```

MaxDot *Treatment Position Vs Treatment Scatter Plot*

Description

The function will give the scatter plot showing the spread offered by design points in the experimental space. The x axis of the plot represent treatments and y axis the position of treatments in each block. Different colors in the dot represent the blocks.

Usage

```
MaxDot(design)
```

Arguments

design	Input a design in matrix format

Value

Generates scatter plot of treatment position Vs treatment

Examples

```
library(SFOCDs)
mat<-matrix(c(  1,  4,  2,  5,
2,  5,  3,  6,
3,  6,  1,  4,
4,  1,  5,  2,
5,  2,  6,  3,
6,  3,  4,  1),nrow=6,byrow=TRUE)
MaxDot(mat)
```

Maxpro_Criterion *Maxpro Criterion for Treatment vs Position*

Description

User input should be the original design and this function automatically convert the design in treatment vs position 2D array and then print the Maxpro Criterion value.

Usage

```
Maxpro_Criterion(design)
```

Arguments

design	Input a design in matrix format

Value

Maxpro criterion value for a given design

Examples

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

MOCDs *M Array Method for Optimal Covariate Designs (OCDs)*

Description

Consider Mutually Orthogonal Latin squares of order s x s, extract first column from it and make a new matrix called Initial block sequence matrix L of order s x s-1. Remove the last row from the L matrix and obtain the incidence matrix of it keeping zeros to the positions corresponding to the elements that were present in the deleted row of L, and then remove the row that contains only non-zero elements, the square matrix thus formed is the M matrix. From the columns of M matrix, choose((s-1),2) pairs are possible. Each of these column pairs is then superimposed to N. Through this method choose((s-1),2) W matrices can be developed.

Usage

```
MOCDs(design)
```

Arguments

design	Input a design in matrix format and block size k such that (k+1) is a prime number.

Value

Generates W matrices and Inter product sums of W matrices.

Author(s)

Neethu RS

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References

Das, K., N. K. Mandal, and B. K. Sinha. (2003) <https://doi.org/10.1016/S0378-3758(02)00151-9>. Optimal experimental designs for models with covariates. Journal of Statistical Planning and Inference 115(1): 273-285.

Bansal, N., and D. K. Garg. (2022)<https://doi.org/10.1007/s42519-022-00244-0>. Optimum covariate designs for three associate PBIB designs. Journal of Statistical Theory and Practice 16(3): 1-15.

Examples

```
library(SFOCDs)
mat<-matrix(c(1,2,3,4,1,2,4,5,1,3,4,5,2,3,4,5),nrow=4,byrow=TRUE)
MOCDs(mat)
```

OIAOCDs *Orthogonal Integer Array Method for Optimal Covariate Designs (OCDs)*

Description

Consider OIA of order same as the block size of the required design. Superimpose each array separately into the incidence matrix (N) to get the W matrices. The maximum number of W matrices depends on the column order of OIA.

Usage

```
OIAOCDs(design)
```

Arguments

design	Input a design in matrix format and block size k such that it is an odd number.

Value

Generates W matrices and Inter product sums of W matrices.

Author(s)

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References

Das, K., N. K. Mandal, and B. K. Sinha. (2003) <https://doi.org/10.1016/S0378-3758(02)00151-9>. Optimal experimental designs for models with covariates. Journal of Statistical Planning and Inference 115(1): 273-285.

Bansal, N., and D. K. Garg. (2022)<https://doi.org/10.1007/s42519-022-00244-0>. Optimum covariate designs for three associate PBIB designs. Journal of Statistical Theory and Practice 16(3): 1-15.

Examples

```
library(SFOCDs)
mat<-matrix(c(1,2,3,1,2,4,1,2,5,1,3,4,1,3,5,1,4,5,2,3,4,2,3,5,2,4,5,3,4,5),nrow=10,byrow=TRUE)
OIAOCDs(mat)
```

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