Package: MixedLevelRSDs (via r-universe)

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Type Package

Title Mixed Level Response Surface Designs

Version 1.0.0

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Description Response Surface Designs (RSDs) involving factors not all at same levels are called Mixed Level RSDs (or Asymmetric RSDs). In many practical situations, RSDs with asymmetric levels will be more suitable as it explores more regions in the design space. (J.S. Mehta and M.N. Das (1968) <doi:10.2307/1267046>. ``Asymmetric rotatable designs and orthogonal transformations").This package contains function named ATORDs_I() for generating asymmetric third order rotatable designs (ATORDs) based on third order designs given by Das and Narasimham (1962). Function ATORDs_II() generates asymmetric third order rotatable designs developed using t-design of unequal set sizes, which are smaller in size as compared to design generated by function ATORDs_I(). In general, third order rotatable designs can be classified into two classes viz., designs that are suitable for sequential experimentation and designs for non-sequential experimentation. The sequential experimentation approach involves conducting the trials step by step whereas, in the non-sequential experimentation approach, the entire runs are executed in one go (M. N. Das and V. Narasimham (1962) <doi:10.1214/AOMS/1177704374>. ``Construction of Rotatable Designs through Balanced Incomplete Block Designs"). ATORDs_I() and ATORDs_II() functions generate non-sequential asymmetric third order designs. Function named SeqTORD() generates symmetric sequential third order design in blocks and also gives G-efficiency of the given design. Function named Asymseq() generates asymmetric sequential third order designs in blocks (M. Hemavathi, Eldho Varghese, Shashi Shekhar and Seema Jaggi (2020) <doi:10.1080/02664763.2020.1864817>. ``Sequential asymmetric third order rotatable designs (SATORDs)"). In response surface design, situations may arise

in which some of the factors are qualitative in nature (Jyoti Divecha and Bharat Tarapara (2017) <doi:10.1080/08982112.2016.1217338>. ``Small, balanced, efficient, optimal, and near rotatable response surface designs for factorial experiments asymmetrical in some quantitative, qualitative factors''). The Function named QualRSD() generates second order design with qualitative factors along with their D-efficiency and G-efficiency. The function named RotatabilityQ() calculates a measure of rotatability (measure Q, 0 <= Q <= 1) given by Draper and Pukelshiem(1990) for given a design based on a second order model, (Norman R. Draper and Friedrich Pukelsheim(1990) <doi:10.1080/00401706.1990.10484635>. ``Another look at rotatability'').

Suggests TORDs, FrF2, MASS

License GPL (>= 2)

Encoding UTF-8

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Contents

`Asymseq` *Asymmetric Third Order Designs for sequential experimentation*

Description

Generates asymmetric sequential third order design for v (3 <= v <= 9) factors in two blocks. Block I gives a second order design for the first stage of the experimentation. If lack of fit of the second order model is found to be significant, then further experimentation can be done with the design given in block II. Runs from block-I and block-II combined form a third order design. It also gives G-efficiency of the third order design.

Usage

```
Asymseq(v)
```

Arguments

v	Total number of input factors

Value

Third order design in two blocks

Note

The user is given with a set of mixed level response surface designs and after entering the serial number of any of the designs from the displayed set, the chosen design will be generated and displayed.

References

1) G.E.P. Box and K.B. Wilson (1951). " On the experimental attainment of optimum conditions".

2) J.S. Mehta and M.N. Das (1968). "Asymmetric rotatable designs and orthogonal transformations".

3) M. Hemavathi, Shashi Shekhar, Eldho Varghese, Seema Jaggi, Bikas Sinha & Nripes Kumar Mandal (2022)<doi: 10.1080/03610926.2021.1944213>." Theoretical developments in response surface designs: an informative review and further thoughts".

4) M. Hemavathi, Eldho Varghese, Shashi Shekhar & Seema Jaggi (2020) <doi: 10.1080/02664763.2020.1864817>. "Sequential asymmetric third order rotatable designs (SATORDs)".

Examples

```
if(interactive()){
library(MixedLevelRSDs)
Asymseq(4)
}
```

ATORDs_I *Asymmetric Third Order Rotatable Designs based on Third Order Designs given by Das and Narasimham (1962)*

Description

Generates asymmetric third order rotatable designs based on third order designs given by Das and Narasimham (1962) for a given number of input factors, v (3<=v<=9) with coded levels of the factors.

Usage

```
ATORDs_I(v)
```

Arguments

v	Number of input factors

Details

The user is given two options for design generation. Method 1 generates asymmetric third order rotatable designs based on the third order designs given by Das and Narasimham (1962) for a given number of input factors, while method 2 generates asymmetric third order rotatable designs in a smaller number of runs as compared to the design generated by method 1, however, the variances of estimated parameters of the same order may not remain the same in case of design generated by method 2. After entering the serial number of any of the methods from the displayed set, the design from the chosen method will be generated and displayed.

Value

Asymmetric Third Order Rotatable Designs (ATORDs) for a given v.

Note

The user is given with a set of mixed level response surface designs and after entering the serial number of any of the designs from the displayed set, the chosen design will be generated and displayed.

References

1) J.S. Mehta and M.N. Das (1968). "Asymmetric rotatable designs and orthogonal transformations".

2) M. N. Das, V. Narasimham (1962). < doi:10.1214/AOMS/1177704374>. "Construction of Rotatable Designs Through Balanced Incomplete Block Designs".

3) M. Hemavathi, Shashi Shekhar, Eldho Varghese, Seema Jaggi, Bikas Sinha & Nripes Kumar Mandal (2022)<doi: 10.1080/03610926.2021.1944213>. "Theoretical developments in response surface designs: an informative review and further thoughts".

Examples

```
if(interactive()){
library(MixedLevelRSDs)
ATORDs_I(3)}
```

ATORDs_II *Asymmetric Third Order Rotatable Designs based on t-designs*

Description

Generates asymmetric third order rotatable designs based on t- designs of unequal set sizes for a given number of input factors v (4<=v<=9) with coded levels of the factors. Design size is smaller than the design produced by by method 1 in function ATORDs_I.

Usage

```
ATORDs_II(v)
```

Arguments

v	Number of input factors

Value

Asymmetric Third Order Rotatable Designs (ATORDs) for a given v.

Note

The user is given with a set of mixed level response surface designs and after entering the serial number of any of the designs from the displayed set, the chosen design will be generated and displayed.

References

1)Damaraju Raghavarao & Bei Zhou (1998). < doi: 10.1080/03610929808832657>. "Universal optimality of ue 3-designs for a competing effects model".

2) J.S. Mehta and M.N. Das (1968). "Asymmetric rotatable designs and orthogonal transformations".

3) M. Hemavathi, Shashi Shekhar, Eldho Varghese, Seema Jaggi, Bikas Sinha & Nripes Kumar Mandal (2022)<doi: 10.1080/03610926.2021.1944213>."Theoretical developments in response surface designs: an informative review and further thoughts".

Examples

```
if(interactive()){
library(MixedLevelRSDs)
}
```

QualRSD *Second Order RSDs with qualitative factors*

Description

Generate a Second Order Design where first v-k column represent v-k quantitative factors and the last k column represents the k qualitative factors (1<=k<=v-2). It also gives D-efficiency and G-efficiency for the generated design.

Usage

```
QualRSD(v, k, Interaction = FALSE)
```

Arguments

v	Total number of input factors
k	Number of qualitative factors, 1<=k<=v-2
Interaction	To specify whether to generate a design for fitting second order model which include Interaction term between qualitative and quantitative factors. The interaction = T means the generated designs will be suitable to fit a second order model which include interaction between qualitative factors and the linear terms of quantitative factors

Value

Second Order RSDs with qualitative factors along with D-efficiency and G-efficiency

References

1) M. Hemavathi, Shashi Shekhar, Eldho Varghese, Seema Jaggi, Bikas Sinha & Nripes Kumar Mandal (2022)<doi: 10.1080/03610926.2021.1944213>."Theoretical developments in response surface designs: an informative review and further thoughts".

2) Jyoti Divecha and Bharat Tarapara (2017). < doi:10.1080/08982112.2016.1217338>. "Small, balanced, efficient, optimal, and near rotatable response surface designs for factorial experiments asymmetrical in some quantitative, qualitative factors".

Examples

```
library(MixedLevelRSDs)
QualRSD(5,2, Interaction = FALSE )
```

RotatabilityQ *Measure of rotatability Q based on a second order model*

Description

Calculates the measure of rotatability (measure Q, 0 <= Q <= 1) given by Draper and Pukelsheim(1990) for given design based on a second order model.

Usage

```
RotatabilityQ(design)
```

Arguments

design	Second order design matrix without intercept

Value

Rotatability measure Q

References

1) Norman R. Draper and Friedrich Pukelsheim(1990), <doi: 10.1080/00401706.1990.10484635>. "Another look at rotatability".

2) M. Hemavathi, Shashi Shekhar, Eldho Varghese, Seema Jaggi, Bikas Sinha & Nripes Kumar Mandal (2022)<doi: 10.1080/03610926.2021.1944213>." Theoretical developments in response surface designs: an informative review and further thoughts.".

Examples

```
## Not run:
library(MixedLevelRSDs)
RotatabilityQ(design)

## End(Not run)
```

SeqTORD *Symmetric Third Order Designs for sequential experimentation*

Description

Generates symmetric sequential Third Order Design with v (3<=v<=9) factors in two blocks. Block I gives a second order design for the first stage of the experimentation. If lack of fit of the second order model is found to be significant, then further experimentation can be done with the design given in block II. Runs from block-I and block-II combined form a third order design. It also gives G-efficiency of the third order design.

Usage

```
SeqTORD(v)
```

Arguments

v	Total number of input factors

Value

Third Order Design in two blocks along with G-efficiency

References

1) G.E.P. Box and K.B. Wilson (1951). " On the experimental attainment of optimum conditions".

2) M. Hemavathi, Shashi Shekhar, Eldho Varghese, Seema Jaggi, Bikas Sinha & Nripes Kumar Mandal (2022)<doi: 10.1080/03610926.2021.1944213>. "Theoretical developments in response surface designs: an informative review and further thoughts".

3) M. Hemavathi, Eldho Varghese, Shashi Shekhar & Seema Jaggi (2020) <doi: 10.1080/02664763.2020.1864817>. "Sequential asymmetric third order rotatable designs (SATORDs) ".

Examples

```
library(MixedLevelRSDs)
SeqTORD(4)
```

Index