

Package ‘OBsMD’

August 19, 2024

Title Objective Bayesian Model Discrimination in Follow-Up Designs

Version 12.0

Description Implements the objective Bayesian methodology proposed in Consonni and Deldossi in order to choose the optimal experiment that better discriminate between competing models, see Deldossi and Nai Ruscone (2020) <[doi:10.18637/jss.v094.i02](https://doi.org/10.18637/jss.v094.i02)>.

License GPL (>= 2)

Encoding UTF-8

LazyData true

RoxygenNote 7.2.3

NeedsCompilation yes

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Repository CRAN

Date/Publication 2024-08-19 18:40:14 UTC

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| | |
|---------------|---|
| OBsMD-package | <i>Objective Bayesian Model Discrimination in Follow-Up Designs</i> |
|---------------|---|

Description

Implements the objective Bayesian methodology proposed in Consonni and Deldossi in order to choose the optimal experiment that better discriminate between competing models.

Details

Package: OBsMD
 Type: Package
 Version: 12.0
 Date: 2024-08-19
 License: GPL version 3 or later

The packages allows you to perform the calculations and analyses described in Consonni and Deldossi paper in TEST (2016), Objective Bayesian model discrimination in follow-up experimental designs.

Author(s)

Author: Laura Deldossi and Marta Nai Ruscone based on Daniel Meyer's code.\ Maintainer: Marta Nai Ruscone <marta.nairuscone@unige.it>

References

- Deldossi, L., Nai Ruscone, M. (2020) R Package OBsMD for Follow-up Designs in an Objective Bayesian Framework. *Journal of Statistical Software* **94**(2), 1–37. doi:10.18637/jss.v094.i02.
- Consonni, G. and Deldossi, L. (2016) Objective Bayesian Model Discrimination in Follow-up design., *Test* **25**(3), 397–412. doi:10.1007/s1174901504613.
- Box, G. E. P. and Meyer R. D. (1986) An Analysis of Unreplicated Fractional Factorials., *Technometrics* **28**(1), 11–18. doi:10.1080/00401706.1986.10488093.
- Box, G. E. P. and Meyer R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. doi:10.1080/00224065.1993.11979432.
- Meyer, R. D., Steinberg, D. M. and Box, G. E. P. (1996) Follow-Up Designs to Resolve Confounding in Multifactor Experiments (with discussion), *Technometrics* **38**(4), 303–332. doi:10.2307/1271297.

Examples

```
data(BM86.data)
```

BM86.data

Data sets in Box and Meyer (1986)

Description

Design factors and responses used in the examples of Box and Meyer (1986)

Usage

```
data(BM86.data)
```

Format

A data frame with 16 observations on the following 19 variables.

- X1** numeric vector. Contrast factor.
- X2** numeric vector. Contrast factor.
- X3** numeric vector. Contrast factor.
- X4** numeric vector. Contrast factor.
- X5** numeric vector. Contrast factor.
- X6** numeric vector. Contrast factor.
- X7** numeric vector. Contrast factor.
- X8** numeric vector. Contrast factor.
- X9** numeric vector. Contrast factor.
- X10** numeric vector. Contrast factor.
- X11** numeric vector. Contrast factor.
- X12** numeric vector. Contrast factor.
- X13** numeric vector. Contrast factor.
- X14** numeric vector. Contrast factor.
- X15** numeric vector. Contrast factor.
- y1** numeric vector. Log drill advance response.
- y2** numeric vector. Tensile strength response.
- y3** numeric vector. Shrinkage response.
- y4** numeric vector. Yield of isatin response.

References

Box, G. E. P. and Meyer, R. D. (1986) An Analysis of Unreplicated Fractional Factorials., *Technometrics* **28**(1), 11–18. [doi:10.1080/00401706.1986.10488093](https://doi.org/10.1080/00401706.1986.10488093).

Examples

```
library(OBsMD)
data(BM86.data,package="OBsMD")
print(BM86.data)
```

BM93.e1.data

Example 1 data in Box and Meyer (1993)

Description

12-run Plackett-Burman design from the 2^5 reactor example from Box, Hunter and Hunter (1977).

Usage

```
data(BM93.e1.data)
```

Format

A data frame with 12 observations on the following 7 variables.

Run a numeric vector. Run number from a 2^5 factorial design in standard order.

A a numeric vector. Feed rate factor.

B a numeric vector. Catalyst factor.

C a numeric vector. Agitation factor.

D a numeric vector. Temperature factor.

E a numeric vector. Concentration factor.

y a numeric vector. Percent reacted response.

References

Box, G. E. P., Hunter, W. C. and Hunter, J. S. (1978) *Statistics for Experimenters*. Wiley.

Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. doi:[10.1080/00224065.1993.11979432](https://doi.org/10.1080/00224065.1993.11979432).

Examples

```
library(OBsMD)
data(BM93.e1.data,package="OBsMD")
print(BM93.e1.data)
```

BM93.e2.data

Example 2 data in Box and Meyer (1993)

Description

12-run Plackett-Burman design for the study of fatigue life of weld repaired castings.

Usage

```
data(BM93.e2.data)
```

Format

A data frame with 12 observations on the following 8 variables.

A a numeric vector. Initial structure factor.

B a numeric vector. Bead size factor.

C a numeric vector. Pressure treat factor.

D a numeric vector. Heat treat factor.

E a numeric vector. Cooling rate factor.

F a numeric vector. Polish factor.

G a numeric vector. Final treat factor.

y a numeric vector. Natural log of fatigue life response.

References

Hunter, G. B., Hodi, F. S., and Eager, T. W. (1982) High-Cycle Fatigue of Weld Repaired Cast Ti-6Al-4V., *Metallurgical Transactions* **13**(9), 1589–1594.

Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. [doi:10.1080/00224065.1993.11979432](https://doi.org/10.1080/00224065.1993.11979432).

Examples

```
library(OBsMD)
data(BM93.e2.data, package="ObsMD")
print(BM93.e2.data)
```

BM93.e3.data

Example 3 data in Box and Meyer (1993)

Description

2^{8-4} Fractional factorial design in the injection molding example from Box, Hunter and Hunter (1978).

Usage

```
data(BM93.e3.data)
```

Format

A data frame with 20 observations on the following 10 variables.

blk a numeric vector

A a numeric vector. Mold temperature factor.

B a numeric vector. Moisture content factor.

C a numeric vector. Holding Pressure factor.

D a numeric vector. Cavity thickness factor.

E a numeric vector. Booster pressure factor.

F a numeric vector. Cycle time factor.

G a numeric vector. Gate size factor.

H a numeric vector. Screw speed factor.

y a numeric vector. Shrinkage response.

References

Box G. E. P., Hunter, W. C. and Hunter, J. S. (1978) *Statistics for Experimenters*. Wiley.

Box G. E. P., Hunter, W. C. and Hunter, J. S. (2004) *Statistics for Experimenters II*. Wiley.

Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. doi:[10.1080/00224065.1993.11979432](https://doi.org/10.1080/00224065.1993.11979432).

Examples

```
library(OBsMD)
data(BM93.e3.data, package="OBsMD")
print(BM93.e3.data)
```

Description

combinations enumerates the possible combinations of a specified size from the elements of a vector.

Usage

```
combinations(n, r, v=1:n, set=TRUE, repeats.allowed=FALSE)
```

Arguments

| | |
|-----------------|---|
| n | Size of the source vector |
| r | Size of the target vectors |
| v | Source vector. Defaults to 1:n |
| set | Logical flag indicating whether duplicates should be removed from the source vector v. Defaults to TRUE. |
| repeats.allowed | Logical flag indicating whether the constructed vectors may include duplicated values. Defaults to FALSE. |

Details

Caution: The number of combinations increases rapidly with n and r!

To use values of n above about 45, you will need to increase R's recursion limit. See the expression argument to the options command for details on how to do this.

Value

Returns a matrix where each row contains a vector of length r.

Author(s)

Original versions by Bill Venables <Bill.Venables@cmis.csiro.au>. Extended to handle repeats.allowed by Gregory R. Warnes <greg@warnes.net>.

References

Venables, Bill. "Programmers Note", R-News, Vol 1/1, Jan. 2001. <https://cran.r-project.org/doc/Rnews/>

Examples

```
combinations(3,2,letters[1:3])
combinations(3,2,c(1:3),repeats=TRUE)
combinations(6,3,1:6,repeats=TRUE)
```

```
# To use large 'n', you need to change the default recursion limit
options(expressions=1e5)
cmat <- combinations(100,2)
dim(cmat) # 4950 by 2
```

MetalCutting

Data sets in Edwards, Weese and Palmer (2014)

Description

Design factors and responses used in the examples of Edwards, Weese and Palmer (2014)

Usage

```
data(MetalCutting)
```

Format

A data frame with 64 observations on the following 8 variables.

blk block

A numeric vector. Tool speed.

B numeric vector. Workpiece speed.

C numeric vector. Depth of cut.

D numeric vector. Coolant.

E numeric vector. Direction of cut.

F numeric vector. Number of cut.

Ytransformed numeric vector. Response.

References

Edwards, D. J. P., Weese, M. L. and Palmer, G. A. (2014) Comparing methods for design follow-up revisiting a metal-cutting case study., *Applied Stochastic Models in Business and Industry* **30**(4), 464–478. doi:[10.1002/asmb.1988](https://doi.org/10.1002/asmb.1988)

Examples

```
library(OBsMD)
data(MetalCutting,package="ObsMD")
print(MetalCutting)
```

 OBsMD.es5

OBsMD.es5

Description

Data of the Reactor Experiment from Box, Hunter and Hunter (1978).

Usage

```
data(OBsMD.es5)
```

Format

A data frame with 8 observations on the following 6 variables.

A numeric vector. Contrast factor.

B numeric vector. Contrast factor.

C numeric vector. Contrast factor.

D numeric vector. Contrast factor.

E numeric vector. Contrast factor.

y numeric vector. Response.

References

Box G. E. P., Hunter, W. C. and Hunter, J. S. (1978) *Statistics for Experimenters*. Wiley.

Box G. E. P., Hunter, W. C. and Hunter, J. S. (2004) *Statistics for Experimenters II*. Wiley.

Examples

```
library(OBsMD)
data(OBsMD.es5, package="OBsMD")
print(OBsMD.es5)
```

 OBsProb

Objective Posterior Probabilities from Bayesian Screening Experiments

Description

Objective model posterior probabilities and marginal factor posterior probabilities from Bayesian screening experiments according to Consonni and Deldossi procedure.

Usage

```
OBsProb(X, y, abeta=1, bbeta=1, blk, mFac, mInt, nTop)
```

Arguments

| | |
|-------|--|
| X | Matrix. The design matrix. |
| y | vector. The response vector. |
| abeta | First parameter of the Beta prior distribution on model space |
| bbeta | Second parameter of the Beta prior distribution on model space |
| blk | integer. Number of blocking factors (≥ 0). These factors are accommodated in the first columns of matrix X. There are $\text{ncol}(X) - \text{blk}$ design factors. |
| mFac | integer. Maximum number of factors included in the models. |
| mInt | integer ≤ 3 . Maximum order of interactions among factors considered in the models. |
| nTop | integer ≤ 100 . Number of models to print ordered according to the highest posterior probability. |

Details

Model and factor posterior probabilities are computed according to Consonni and Deldossi Objective Bayesian procedure. The design factors are accommodated in the matrix X after blk columns of the blocking factors. So, $\text{ncol}(X) - \text{blk}$ design factors are considered. A $\text{BETA}(\text{ABETA}, \text{BBETA})$ distribution is assumed as a prior on model space. The function calls the FORTRAN subroutine 'obm' and captures summary results. The complete output of the FORTRAN code is save in the 'OBsPrint.out' file in the working directory. The output is a list of class OBsProb for which print, plot and summary methods are available.

Value

Below a list with all output parameters of the FORTRAN subroutine 'obm'. The names of the list components are such that they match the original FORTRAN code. Small letters are used for capturing program's output.

| | |
|-------|--|
| X | matrix. The design matrix. |
| Y | vector. The response vector. |
| N | integer. Number of runs of the screening experiment. |
| COLS | integer. Number of design factors. |
| abeta | integer. First parameter of the Beta prior distribution on model space |
| bbeta | integer. Second parameter of the Beta prior distribution on model space |
| BLKS | integer. Number of blocking factors accommodated in the first columns of matrix X. |
| MXFAC | integer. Maximum number of factors considered in the models. |
| MXINT | integer. Maximum interaction order among factors considered in the models. |
| NTOP | integer. Number of models to print ordered according to the highest posterior probability. |
| mdcnt | integer. Total number of models evaluated. |
| ptop | vector. Vector of posterior probabilities of the top ntop models. |

| | |
|--------|---|
| nftop | integer. Number of factors in each of the top ntop models. |
| jtop | matrix. Matrix of the factors' labels of the top ntop models. |
| prob | vector. Vector of factor posterior probabilities. |
| sigtop | vector. Vector of residual variances of the top ntop models. |
| ind | integer. Indicator variable. ind is 1 if the 'obm' subroutine exited properly. Any other number correspond to the format label number in the FORTRAN subroutine script. |

Note

The function is a wrapper to call the FORTRAN subroutine 'obm', modification of Daniel Meyer's original program, 'mbcqp5.f', for the application of Objective Bayesian follow-up design.

Author(s)

Laura Deldossi. Adapted for R by Marta Nai Ruscone.

References

Consonni, G. and Deldossi, L. (2016) Objective Bayesian Model Discrimination in Follow-up design., *Test* **25**(3), 397–412. doi:10.1007/s1174901504613.

Meyer, R. D., Steinberg, D. M. and Box, G. E. P. (1996) Follow-Up Designs to Resolve Confounding in Multifactor Experiments (with discussion)., *Technometrics* **38**(4), 303–332. doi:10.2307/1271297.

See Also

[print.OBsProb](#), [plot.OBsProb](#), [summary.OBsProb](#).

Examples

```
library(OBsMD)
data(OBsMD.es5, package="OBsMD")
X <- as.matrix(OBsMD.es5[,1:5])
y <- OBsMD.es5[,6]
# Using for model prior probability a Beta with parameters a=1 b=1
es5.OBsProb <- OBsProb(X=X,y=y, abeta=1, bbeta=1, blk=0,mFac=5,mInt=2,nTop=32)
print(es5.OBsProb)
summary(es5.OBsProb)
```

OMD

*Objective Model Discrimination (OMD) in Follow-Up Experiments***Description**

Optimal follow-up experiments to discriminate between competing models. The extra-runs are derived from the maximization of the objective model discrimination criterion represented by a weighted average of Kullback-Leibler divergences between all possible pairs of rival models

Usage

```
OMD(OBsProb, nFac, nBlk = 0, nMod, nFoll, Xcand, mIter, nStart, startDes, top = 20)
```

Arguments

| | |
|----------|---|
| OBsProb | list. OBsProb class list. Output list of OBsProb function. |
| nFac | integer. Number of factors in the initial experiment. |
| nBlk | integer ≥ 0 . Number of blocking factors in the initial experiment. They are accommodated in the first columns of matrix X. |
| nMod | integer. Number of competing models considered to compute OMD. |
| nFoll | integer. Number of additional runs in the follow-up experiment. |
| Xcand | matrix. Matrix $[2^{nFac} \times (nBlk + nFac)]$ of candidate runs for the follow-up design. It generally represents the full 2^{nFac} design. |
| mIter | integer ≥ 0 . Maximum number of iterations in the exchange algorithm. If mIter = 0 exchange algorithm doesn't work. |
| nStart | integer. Number of different designs of dimension nFoll to be evaluated by OMD criterion. When exchange algorithm is used nStart represents the number of random starts to initialize the algorithm; otherwise nStart = nrow(startDes). |
| startDes | matrix. Input matrix $[nStart \times nFoll]$ containing different nStart designs to be evaluated by OMD criterion. If the exchange algorithm is used startDes = NULL. |
| top | integer. Number of highest OMD follow-up designs recorded. |

Details

The OMD criterion, proposed by Consonni and Deldossi, is used to discriminate among competing models. Random starting runs chosen from Xcand are used for the Wynn search of best OMD follow-up designs. nStart starting points are tried in the search limited to mIter iterations. If mIter=0 then startDes user-provided designs are used. Posterior probabilities and residual variances of the competing models are obtained from OBsProb. The function calls the FORTRAN subroutine 'omd' and captures summary results. The complete output of the FORTRAN code is save in the 'MDPrint.out' file in the working directory.

Value

Below a list with all input and output parameters of the FORTRAN subroutine OMD. Most of the variable names kept to match FORTRAN code.

| | |
|---------|---|
| NSTART | integer. Number of different designs of dimension nFol1 to be evaluated by OMD criterion. When exchange algorithm is used nStart represents the number of random starts to initialize the algorithm; otherwise nStart = nrow(startDes). |
| NRUNS | integer. Number nFol1 of runs used in follow-up designs. |
| ITMAX | integer. Maximum number mIter of iterations in the exchange algorithm. |
| INITDES | integer. Indicator variable. If INITDES = 1 exchange algorithm is used, otherwise INITDES = 0 exchange algorithm doesn't work. |
| N0 | integer. Numbers of runs nrow(X) of the initial experiment before follow-up. |
| X | matrix. Matrix from initial experiment (nrow(X); ncol(X)=nBlk+nFac). |
| Y | double. Response values from initial experiment (length(Y)=nrow(X)). |
| BL | integer >=0. The number of blocking factors in the initial experiment. They are accommodated in the first columns of matrix X and Xcand. |
| COLS | integer. Number of factors nFac. |
| N | integer. Number of candidate runs nrow(Xcand). |
| Xcand | matrix. Matrix [2^nFac x (nBlk + nFac)] candidate runs for the follow-up design. It generally represents the full 2^nFac design [nrow(Xcand)=N, ncol(Xcand)=ncol(X)]. |
| NM | integer. Number of competing models nMod considered to compute OMD . |
| P | double. Models posterior probability optop. It derives from the OBsProb output. |
| SIGMA2 | double. Competing models residual variances osigtop. It derives from the OBsProb output. |
| NF | integer. Number of main factors in each competing models onftop. It derives from the OBsProb output. |
| MNF | integer. Maximum number of factor in models (MNF=max(onftop)). |
| JFAC | matrix. Matrix ojtop of dimension [nMod x max(onftop)] of the labels of the main factors present in each competing models. It derives from the OBsProb output. |
| CUT | integer. Maximum order of the interaction among factors in the models mInt. |
| MBEST | matrix. If INITDES=0, the first row of the MBEST[1,] matrix has the first user-supplied starting design. The last row the NSTART-th user-supplied starting design. |
| NTOP | integer. Number of the top best OMD designs top. |
| TOPD | double. The OMD value for the best top NTOP designs. |
| TOPDES | matrix. Top NTOP optimal OMD follow-up designs. |
| flag | integer. Indicator = 1, if the 'md' subroutine finished properly, -1 otherwise. |

Note

The function is a wrapper to call the modified FORTRAN subroutine 'omd', 'OMD.f', part of the **mdopt** bundle for Bayesian model discrimination of multifactor experiments.

Author(s)

Laura Deldossi. Adapted for R by Marta Nai Ruscone.

References

- Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. doi:10.1080/00224065.1993.11979432.
- Consonni, G. and Deldossi, L. (2016) Objective Bayesian Model Discrimination in Follow-up design., *Test* **25**(3), 397–412. doi:10.1007/s1174901504613.
- Meyer, R. D., Steinberg, D. M. and Box, G. E. P. (1996) Follow-Up Designs to Resolve Confounding in Multifactor Experiments (with discussion)., *Technometrics* **38**(4), 303–332. doi:10.2307/1271297.

See Also

[print.OMD](#), [OBsProb](#)

Examples

```
library(OBsMD)
data(OBsMD.es5, package="OBsMD")
X <- as.matrix(OBsMD.es5[,1:5])
y <- OBsMD.es5[,6]
es5.OBsProb <- OBsProb(X=X,y=y,blk=0,mFac=5,mInt=2,nTop=32)
nMod <- 26
Xcand <- matrix(c(-1,-1,-1, -1,-1,
1,-1,-1,-1,-1,
-1,1,-1,-1,-1,
1,1,-1,-1,-1,
-1,-1,1,-1,-1,
1,-1,1,-1,-1,
-1,1,1,-1,-1,
1,1,1,-1,-1,
-1,-1,-1,1,-1,
1,-1,-1,1,-1,
-1,1,-1,1,-1,
1,1,-1,1,-1,
-1,-1,1,1,-1,
1,-1,1,1,-1,
-1,1,1,1,-1,
1,1,1,1,-1,
-1,-1,-1,-1,1,
1,-1,-1,-1,1,
-1,1,-1,-1,1,
1,1,-1,-1,1,
-1,-1,1,-1,1,
1,-1,1,-1,1,
-1,1,1,-1,1,
1,1,1,-1,1,
-1,-1,-1,1,1,
1,-1,-1,1,1,
```

```

-1,1,-1,1,1,
1,1,-1,1,1,
-1,-1,1,1,1,
1,-1,1,1,1,
-1,1,1,1,1,
1,1,1,1,1
),nrow=32,ncol=5,dimnames=list(1:32,c("A","B","C","D","E")),byrow=TRUE)
p_omd <- OMD(OBsProb=es5.OBsProb,nFac=5,nBlk=0,nMod=26,nFoll=4,Xcand=Xcand,
mIter=20,nStart=25,startDes=NULL,top=30)
print(p_omd)

```

PB12Des

*12-run Plackett-Burman Design Matrix***Description**

12-run Plackett-Burman design matrix.

Usage

```
data(PB12Des)
```

Format

A data frame with 12 observations on the following 11 variables.

- x1** numeric vectors. Contrast factor.
- x2** numeric vectors. Contrast factor.
- x3** numeric vectors. Contrast factor.
- x4** numeric vectors. Contrast factor.
- x5** numeric vectors. Contrast factor.
- x6** numeric vectors. Contrast factor.
- x7** numeric vectors. Contrast factor.
- x8** numeric vectors. Contrast factor.
- x9** numeric vectors. Contrast factor.
- x10** numeric vectors. Contrast factor.
- x11** numeric vectors. Contrast factor.

References

Box G. E. P., Hunter, W. C. and Hunter, J. S. (2004) *Statistics for Experimenters II*. Wiley.

Examples

```

library(OBsMD)
data(PB12Des,package="OBsMD")
str(PB12Des)
X <- as.matrix(PB12Des)
print(t(X)%*%X)

```

plot.OBsProb

Plotting of Posterior Probabilities from Objective Bayesian Design

Description

Method Function for plotting marginal factor posterior probabilities from Objective Bayesian Design.

Usage

```
## S3 method for class 'OBsProb'
plot(x, code = TRUE, prt = FALSE, cex.axis=par("cex.axis"), ...)
```

Arguments

| | |
|----------|--|
| x | list. List of class OBsProb output from the OBsProb function. |
| code | logical. If TRUE coded factor names are used. |
| prt | logical. If TRUE, summary of the posterior probabilities calculation is printed. |
| cex.axis | Magnification used for the axis annotation. See par . |
| ... | additional graphical parameters passed to plot. |

Details

A spike plot, similar to barplots, is produced with a spike for each factor. Marginal posterior probabilities are used for the vertical axis. If code=TRUE, X1, X2, ... are used to label the factors otherwise the original factor names are used. If prt=TRUE, the [print.OBsProb](#) function is called and the marginal posterior probabilities are displayed.

Value

The function is called for its side effects. It returns an invisible NULL.

Author(s)

Marta Nai Ruscone.

References

- Box, G. E. P. and Meyer R. D. (1986) An Analysis of Unreplicated Fractional Factorials., *Technometrics* **28**(1), 11–18. [doi:10.1080/00401706.1986.10488093](https://doi.org/10.1080/00401706.1986.10488093).
- Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. [doi:10.1080/00224065.1993.11979432](https://doi.org/10.1080/00224065.1993.11979432).
- Consonni, G. and Deldossi, L. (2016) Objective Bayesian Model Discrimination in Follow-up design., *Test* **25**(3), 397–412. [doi:10.1007/s1174901504613](https://doi.org/10.1007/s1174901504613).

See Also

[OBsProb](#), [print.OBsProb](#), [summary.OBsProb](#).

Examples

```
library(OBsMD)
data(OBsMD.es5, package="OBsMD")
X <- as.matrix(OBsMD.es5[,1:5])
y <- OBsMD.es5[,6]
# Using for model prior probability a Beta with parameters a=1 b=1
es5.OBsProb <- OBsProb(X=X,y=y, abeta=1, bbeta=1, blk=0,mFac=5,mInt=2,nTop=32)
print(es5.OBsProb)
summary(es5.OBsProb)
plot(es5.OBsProb)
```

```
print.OBsProb
```

Printing Objective Posterior Probabilities from Bayesian Design

Description

Printing method for lists of class OBsProb. It prints the posterior probabilities of factors and models from the Objective Bayesian procedure.

Usage

```
## S3 method for class 'OBsProb'
print(x, X = TRUE, resp = TRUE, factors = TRUE, models = TRUE,
      nTop, digits = 3, plt = FALSE, verbose = FALSE, Sh= TRUE, CV=TRUE,...)
```

Arguments

| | |
|---------|--|
| x | list. Object of OBsProb class, output from the OBsProb function. |
| X | logical. If TRUE, the design matrix is printed. |
| resp | logical. If TRUE, the response vector is printed. |
| factors | logical. If TRUE, marginal posterior probabilities are printed . |
| models | logical. If TRUE, models posterior probabilities are printed. |
| nTop | integer. Number of the top ranked models to print. |
| digits | integer. Significant digits to use for printing. |
| plt | logical. If TRUE, factor marginal probabilities are plotted. |
| verbose | logical. If TRUE, the unclass-ed list x is displayed. |
| Sh | logical. If TRUE, the Shannon index is printed. |
| CV | logical. If TRUE, the coefficient of variation is printed. |
| ... | additional arguments passed to print function. |

Value

The function prints out marginal factors and models posterior probabilities. Returns invisible list with the components:

| | |
|---------------|---|
| calc | numeric vector with general calculation information. |
| probabilities | Data frame with the marginal posterior factor probabilities. |
| models | Data frame with model posterior probabilities. |
| Sh | Normalized Shannon heterogeneity index on the posterior probabilities of models |
| CV | Coefficient of variation of factor posterior probabilities. |

Author(s)

Marta Nai Ruscone.

References

Box, G. E. P. and Meyer R. D. (1986) An Analysis of Unreplicated Fractional Factorials., *Technometrics* **28**(1), 11–18. doi:10.1080/00401706.1986.10488093.

Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. doi:10.1080/00224065.1993.11979432.

See Also

[OBsProb](#), [summary.OBsProb](#), [plot.OBsProb](#).

Examples

```
library(OBsMD)
data(OBsMD.es5, package="OBsMD")
X <- as.matrix(OBsMD.es5[,1:5])
y <- OBsMD.es5[,6]
# Using for model prior probability a Beta with parameters a=1 b=1
es5.OBsProb <- OBsProb(X=X,y=y, abeta=1, bbeta=1, blk=0,mFac=5,mInt=2,nTop=32)
print(es5.OBsProb)
summary(es5.OBsProb)
plot(es5.OBsProb)
```

print.OMD

Print Optimal OMD Follow-Up Experiments

Description

Printing method for lists of class OMD. It displays the best extra-runs according to the OMD criterion together with the correspondent OMD values.

Usage

```
## S3 method for class 'OMD'
print(x, X = FALSE, resp = FALSE, Xcand = TRUE, models = TRUE, nMod = x$nMod,
      digits = 3, verbose=FALSE, ...)
```

Arguments

| | |
|---------|---|
| x | list of class OMD. Output list of the OMD function. |
| X | logical. If TRUE, the initial design matrix is printed. |
| resp | logical. If TRUE, the response vector of initial design is printed. |
| Xcand | logical. If TRUE, prints the candidate runs. |
| models | logical. Competing models are printed if TRUE. |
| nMod | integer. Top models to print. |
| digits | integer. Significant digits to use in the print out. |
| verbose | logical. If TRUE, the unclass-ed x is displayed. |
| ... | additional arguments passed to print generic function. |

Value

The function is mainly called for its side effects. Prints out the selected components of the class OMD objects, output of the OMD function. For example the marginal factors and models posterior probabilities and the top OMD follow-up experiments with their corresponding OMD statistic. It returns invisible list with the components:

| | |
|-----------|---|
| calc | Numeric vector with basic calculation information. |
| models | Data frame with the competing models posterior probabilities. |
| follow-up | Data frame with the runs for follow-up experiments and their corresponding OMD statistic. |

Author(s)

Marta Nai Ruscone.

References

Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. doi:[10.1080/00224065.1993.11979432](https://doi.org/10.1080/00224065.1993.11979432).

Meyer, R. D., Steinberg, D. M. and Box, G. E. P. (1996) Follow-Up Designs to Resolve Confounding in Multifactor Experiments (with discussion)., *Technometrics* **38**(4), 303–332. doi:[10.2307/1271297](https://doi.org/10.2307/1271297).

See Also

[OMD](#), [OBsProb](#)

Examples

```

library(OBsMD)
data(OBsMD.es5, package="OBsMD")
X <- as.matrix(OBsMD.es5[,1:5])
y <- ObsMD.es5[,6]
es5.OBsProb <- ObsProb(X=X,y=y,blk=0,mFac=5,mInt=2,nTop=32)
nMod <- 26
Xcand <- matrix(c(-1,-1,-1, -1,-1,
1,-1,-1,-1,-1,
-1,1,-1,-1,-1,
1,1,-1,-1,-1,
-1,-1,1,-1,-1,
1,-1,1,-1,-1,
-1,1,1,-1,-1,
1,1,1,-1,-1,
-1,-1,-1,1,-1,
1,-1,-1,1,-1,
-1,1,-1,1,-1,
1,1,-1,1,-1,
-1,-1,1,1,-1,
1,-1,1,1,-1,
-1,1,1,1,-1,
1,1,1,1,-1,
-1,-1,-1,-1,1,
1,-1,-1,-1,1,
-1,1,-1,-1,1,
1,1,-1,-1,1,
-1,-1,1,-1,1,
1,-1,1,-1,1,
-1,1,1,-1,1,
1,1,1,-1,1,
-1,-1,-1,1,1,
1,-1,-1,1,1,
-1,1,-1,1,1,
1,1,-1,1,1,
-1,-1,1,1,1,
1,-1,1,1,1,
-1,1,1,1,1,
1,1,1,1,1
),nrow=32,ncol=5,dimnames=list(1:32,c("A","B","C","D","E")),byrow=TRUE)
p_omd <- OMD(OBsProb=es5.OBsProb,nFac=5,nBlk=0,nMod=26,
nFoll=4,Xcand=Xcand,mIter=20,nStart=25,startDes=NULL,
top=30)
print(p_omd)

```

Reactor.data

Reactor Experiment Data

Description

Data of the Reactor Experiment from Box, Hunter and Hunter (1978).

Usage

```
data(Reactor.data)
```

Format

A data frame with 32 observations on the following 6 variables.

A numeric vector. Feed rate factor.

B numeric vector. Catalyst factor.

C numeric vector. Agitation rate factor.

D numeric vector. Temperature factor.

E numeric vector. Concentration factor.

y numeric vector. Percentage reacted response.

References

Box G. E. P., Hunter, W. C. and Hunter, J. S. (1978) *Statistics for Experimenters*. Wiley.

Box G. E. P., Hunter, W. C. and Hunter, J. S. (2004) *Statistics for Experimenters II*. Wiley.

Examples

```
library(OBsMD)
data(Reactor.data, package="OBsMD")
print(Reactor.data)
```

summary.OBsProb

Summary of Posterior Probabilities from Objective Bayesian Design

Description

Reduced printing method for class OBsProb lists. Prints posterior probabilities of factors and models from Objective Bayesian procedure.

Usage

```
## S3 method for class 'OBsProb'
summary(object, nTop = 10, digits = 3, ...)
```

Arguments

| | |
|--------|--|
| object | list. OBsProb class list. Output list of OBsProb function. |
| nTop | integer. Number of the top ranked models to print. |
| digits | integer. Significant digits to use. |
| ... | additional arguments passed to summary generic function. |

Value

The function prints out the marginal factors and models posterior probabilities. Returns invisible list with the components:

| | |
|---------------|---|
| calc | Numeric vector with basic calculation information. |
| probabilities | Data frame with the marginal posterior probabilities. |
| models | Data frame with the models posterior probabilities. |

Author(s)

Marta Nai Ruscone.

References

- Box, G. E. P. and Meyer R. D. (1986) An Analysis of Unreplicated Fractional Factorials., *Technometrics* **28**(1), 11–18. doi:[10.1080/00401706.1986.10488093](https://doi.org/10.1080/00401706.1986.10488093).
- Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. doi:[10.1080/00224065.1993.11979432](https://doi.org/10.1080/00224065.1993.11979432).
- Consonni, G. and Deldossi, L. (2016) Objective Bayesian Model Discrimination in Follow-up design., *Test* **25**(3), 397–412. doi:[10.1007/s1174901504613](https://doi.org/10.1007/s1174901504613).

See Also

[OBsProb](#), [print.OBsProb](#), [plot.OBsProb](#).

Examples

```
library(OBsMD)
data(OBsMD.es5, package="OBsMD")
X <- as.matrix(OBsMD.es5[,1:5])
y <- OBsMD.es5[,6]
# Using for model prior probability a Beta with parameters a=1 b=1
es5.OBsProb <- OBsProb(X=X,y=y, abeta=1, bbeta=1, blk=0,mFac=5,mInt=2,nTop=32)
print(es5.OBsProb)
summary(es5.OBsProb)
```

summary.OMD

Summary of Optimal OMD Follow-Up Experiments

Description

Reduced printing method for lists of class OMD. It displays the best extra-runs according to the OMD criterion together with the correspondent OMD value.

Usage

```
## S3 method for class 'OMD'
summary(object, digits = 3, verbose=FALSE, ...)
```

Arguments

| | |
|---------|---|
| object | list of OMD class. Output list of OMD function. |
| digits | integer. Significant digits to use in the print out. |
| verbose | logical. If TRUE, the unclass-ed object is displayed. |
| ... | additional arguments passed to summary generic function. |

Value

It prints out the marginal factors and models posterior probabilities and the top OMD follow-up experiments with their corresponding OMD statistic.

Author(s)

Marta Nai Ruscone.

References

- Box, G. E. P. and Meyer, R. D. (1993) Finding the Active Factors in Fractionated Screening Experiments., *Journal of Quality Technology* **25**(2), 94–105. doi:[10.1080/00224065.1993.11979432](https://doi.org/10.1080/00224065.1993.11979432).
- Consonni, G. and Deldossi, L. (2016) Objective Bayesian Model Discrimination in Follow-up design., *Test* **25**(3), 397–412. doi:[10.1007/s1174901504613](https://doi.org/10.1007/s1174901504613).
- Meyer, R. D., Steinberg, D. M. and Box, G. E. P. (1996) Follow-Up Designs to Resolve Confounding in Multifactor Experiments (with discussion)., *Technometrics* **38**(4), 303–332. doi:[10.2307/1271297](https://doi.org/10.2307/1271297).

See Also

[print.OMD](#) and [OMD](#)

Examples

```
library(OBsMD)
data(OBsMD.es5, package="OBsMD")
X <- as.matrix(OBsMD.es5[,1:5])
y <- OBsMD.es5[,6]
es5.OBsProb <- OBsProb(X=X,y=y,blk=0,mFac=5,mInt=2,nTop=32)
nMod <- 26
Xcand <- matrix(c(-1,-1,-1, -1,-1,
1,-1,-1,-1,-1,
-1,1,-1,-1,-1,
1,1,-1,-1,-1,
-1,-1,1,-1,-1,
1,-1,1,-1,-1,
-1,1,1,-1,-1,
1,1,1,-1,-1,
-1,-1,-1,1,-1,
1,-1,-1,1,-1,
-1,1,-1,1,-1,
1,1,-1,1,-1,
```

```
-1,-1,1,1,-1,  
1,-1,1,1,-1,  
-1,1,1,1,-1,  
1,1,1,1,-1,  
-1,-1,-1,-1,1,  
1,-1,-1,-1,1,  
-1,1,-1,-1,1,  
1,1,-1,-1,1,  
-1,-1,1,-1,1,  
1,-1,1,-1,1,  
-1,1,1,-1,1,  
1,1,1,-1,1,  
-1,-1,-1,1,1,  
1,-1,-1,1,1,  
-1,1,-1,1,1,  
1,1,-1,1,1,  
-1,-1,1,1,1,  
1,-1,1,1,1,  
-1,1,1,1,1,  
1,1,1,1,1  
) ,nrow=32,ncol=5,dimnames=list(1:32,c("A","B","C","D","E")),byrow=TRUE)  
p_omd <- OMD(OBsProb=es5.OBsProb,nFac=5,nBlk=0,nMod=26,  
nFoll=4,Xcand=Xcand,mIter=20,nStart=25,startDes=NULL,  
top=30)  
summary(p_omd)
```


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