

# Package ‘MOFAT’

October 29, 2022

**Title** Maximum One-Factor-at-a-Time Designs

**Version** 1.0

**Imports** SLHD, stats

**Description** Identifying important factors from a large number of potentially important factors of a highly nonlinear and computationally expensive black box model is a difficult problem. Xiao, Joseph, and Ray (2022) <[doi:10.1080/00401706.2022.2141897](https://doi.org/10.1080/00401706.2022.2141897)> proposed Maximum One-Factor-at-a-Time (MOFAT) designs for doing this. A MOFAT design can be viewed as an improvement to the random one-factor-at-a-time (OFAT) design proposed by Morris (1991) <[doi:10.1080/00401706.1991.10484804](https://doi.org/10.1080/00401706.1991.10484804)>. The improvement is achieved by exploiting the connection between Morris screening designs and Monte Carlo-based Sobol' designs, and optimizing the design using a space-filling criterion. This work is supported by a U.S. National Science Foundation (NSF) grant CMMI-1921646 <[https://www.nsf.gov/awardsearch/showAward?AWD\\_ID=1921646](https://www.nsf.gov/awardsearch/showAward?AWD_ID=1921646)>.

**License** GPL (>= 2)

**Encoding** UTF-8

**RoxygenNote** 7.2.1

**NeedsCompilation** no

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**Repository** CRAN

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measure

*Screening measures*

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### Description

This function can be used for computing screening measures.

### Usage

```
measure(design, y)
```

### Arguments

design	design matrix, which should have the Sobol' design structure
y	response vector

### Details

The measure function computes the screening measures such as the total Sobol' indices (Sobol' 1993) and  $\mu^*$  measure of Campolongo et al. (2007). The design matrix should have the Sobol' design structure. Please see Xiao et al. (2022) for details.

### Value

t	Total Sobol' index
mustar	$\mu^*$ measure

### Author(s)

Qian Xiao and V. Roshan Joseph

### References

Sobol', I. M. (1993), "On sensitivity estimation for nonlinear mathematical models," *Mathematical Modeling and Computational Experiments*, 1, 407–414.

Campolongo, F., Cariboni, J., and Saltelli, A. (2007), "An effective screening design for sensitivity analysis of large models," *Environmental modelling and software*, 22, 1509–1518.

Xiao, Q., Joseph, V. R., and Ray, D. M. (2022). "Maximum One-Factor-At-A-Time Designs for Screening in Computer Experiments". *Technometrics*, to appear.

**Examples**

```
#Friedman function
fun <- function (X)
{
  Y <- 10*sin(pi*X[1]*X[2]) + 20*(X[3] - 0.5)^2 + 10*X[4] + 5*X[5]
  return(Y)
}
design = mofat(p=10, l=3)
y = apply(design, 1, fun)

#Screening measures
measure(design, y)
```

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mofat

*MOFAT*


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**Description**

This function can be used for generating MOFAT designs.

**Usage**

```
mofat(p, l, method = "best")
```

**Arguments**

p	number of factors
l	number of base runs
method	choose among "uniform", "projection", and "best"

**Details**

The `mofat` function generates the MOFAT design for a given number of factors ( $p \geq 2$ ) and number of base runs ( $l \geq 3$ ). The total number of runs in the MOFAT design will be  $l(p+1)$ . A MOFAT design can be viewed as an optimized version of Morris screening design (Morris 1991) by exploiting its connections with the Monte Carlo-based design of Sobol' (1993). Please see Xiao et al. (2022) for details.

Three choices for the method are given: "uniform", "projection", and "best". Option "uniform" gives  $l$  equally-spaced levels for the entire design, which are also balanced. "projection" option adjusts the levels of the two base matrices A and B such that there are  $2l$  or  $2l - 1$  levels in the design depending on  $l$  is even or odd. Option "best" (default) chooses the best among the first two options using maximin distance criterion.

**Value**

design	MOFAT design
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**Author(s)**

Qian Xiao and V. Roshan Joseph

**References**

Morris, M. D. (1991), “Factorial sampling plans for preliminary computational experiments,” *Technometrics*, 33, 161–174.

Sobol’, I. M. (1993), “On sensitivity estimation for nonlinear mathematical models,” *Mathematical Modeling and Computational Experiments*, 1, 407–414.

Xiao, Q., Joseph, V. R., and Ray, D. M. (2022). “Maximum One-Factor-At-A-Time Designs for Screening in Computer Experiments”. *Technometrics*, to appear.

**Examples**

```
#MOFAT with three base runs
mofat(p=10, l=3, method="uniform")
mofat(p=10, l=3, method="projection")
```

```
#MOFAT with five base runs
mofat(p=10, l=5)
dim(mofat(p=125, l=5))
```

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