Package: LA (via r-universe)

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Type Package

Title Lioness Algorithm (LA)

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Description Contains Lioness Algorithm (LA) for finding optimal designs over continuous design space, optimal Latin hypercube designs, and optimal order-of-addition designs. LA is a brand new nature-inspired meta-heuristic optimization algorithm. Detailed methodologies of LA and its implementation on numerical simulations can be found at Hongzhi Wang, Qian Xiao and Abhyuday Mandal (2021) <doi:10.48550/arXiv.2010.09154>.

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Suggests testthat (>= 3.0.0), knitr, rmarkdown, devtools

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Author Hongzhi Wang [aut, cre], Qian Xiao [aut], Abhyuday Mandal [aut]

Maintainer Hongzhi Wang <wanghongzhi.ut@gmail.com>

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LA_LHDC *Lioness Algorithm for Latin hypercube design*

Description

LA_LHDC returns an optimal n by k Latin hypercube design (LHD) matrix generated by lioness algorithm (LA)

Usage

```
LA_LHDC(n, k, m = 100L, N = 5000L, OC = "phi_p", p = 15L, q = 1L)

permuC(x)

seqC(a, b)

rLHDC(n, k)

dijC(X, i, j, q = 1L)

phi_pC(X, p = 15L, q = 1L)

MaxProCriterionC(X)

corC(x, y)

MaxAbsCorC(X)

AvgAbsCorC(X)

exchangeC(X, j, type = "col")
```

Arguments

n	A positive integer that stands for the number of rows (or run size).
k	A positive integer that stands for the number of columns (or factor size).
m	A positive integer that stands for the number of starting design candidates. The default is set to be 100.
N	A positive integer that stands for the maximum number of iterations. The default is set to be 5000. A larger value of N may result a high CPU time.
OC	An optimality criterion. The default setting is "phi_p" (for space-filling LHDs), and it could be one of the following: "phi_p", "AvgAbsCor", "MaxAbsCor", "MaxProCriterion".
p	A positive integer that is the parameter in the phi_p formula, and p is preferred to be large. The default and recommended value is 15.

q	The default is set to be 1, and it could be either 1 or 2. If q is 1, the Manhattan (rectangular) distance will be used. If q is 2, the Euclidean distance will be used.
x	A vector.
a	is the starting value of the sequence.
b	is the ending value of the sequence.
X	A matrix object. In general, X stands for a design matrix.
i	A positive integer, which stands for the ith row of X.
j	A positive integer, which stands for the jth column (or row) of X, and it should be within [1,ncol(X)] (or [1,nrow(X)]).
y	A vector.
type	An exchange type. If type is "col" (the default setting), two random elements will be exchanged within column j. If type is "row", two random elements will be exchanged within row j.

Value

If all inputs are logical, then the output will be an optimal n by k LHD.

Examples

```
#generate a 6 by 3 maximin distance LHD with the default setting
try=LA_LHDC(n=6,k=3)
try

#Another example
#generate a 9 by 4 nearly orthogonal LHD
try2=LA_LHDC(n=9,k=4,OC="AvgAbsCor")
try2
```

LA_OofAC *Lioness Algorithm for order-of-addition design*

Description

LA_OofAC returns a n by k D-optimal order-of-addition design matrix generated by lioness algorithm (LA)

Usage

```
LA_OofAC(n, k, m = 100L, N = 5000L)

factorialC(x)

modC(a, b)
```

```
rOofAC(n, k)

PWOC(X)

TC(X)

MOMC(X)
```

Arguments

n	A positive integer, which stands for the number of rows (or run size). Note that the maximum of n cannot be greater than k factorial.
k	A positive integer, which stands for the number of columns (or factor size).
m	A positive integer that stands for the number of starting design candidates. The default is set to be 100.
N	A positive integer that stands for the maximum number of iterations. The default is set to be 5000. A larger value of N may result a high CPU time.
x	is a positive integer.
a	is a positive integer.
b	is a positive integer.
X	A matrix object. In general, X stands for the design matrix.

Value

If all inputs are logical, then the output will be a n by k D-optimal order-of-addition design.

Examples

```
#generate a D-optimal full OofA with 4 factors.
try=LA_OofAC(n=24,k=4,m=10,N=50)
try

#Another example
#generate a D-optimal 11-run OofA with 4 factors.
try2=LA_OofAC(n=11,k=4,m=10,N=50)
try2
```

LA_OptC *Lioness Algorithm for experimental designs with continuous factors*

Description

LA_OptC returns optimal designs with continuous factors

Usage

```
LA_OptC(n, lb, ub, m = 100L, N = 5000L, OC = "D", alpha = 0.1)

D(X)

A(X)

GscoreC(X, x)

rSign(s = 2L)

G(Y)
```

Arguments

n	A positive integer that stands for the number of rows (or run size) for a design.
lb	A vector contains the lower bounds of all the continuous factors. For example, if there are 3 factors whose lower bounds are 0, 5, and 15, lb should be lb=c(0,5,15).
ub	A vector contains the upper bounds of all the continuous factors. For example, if there are 3 factors whose upper bounds are 10, 15, and 25, ub should be lb=c(10,15,25).
m	A positive integer that stands for the number of starting design candidates. The default is set to be 100.
N	A positive integer that stands for the maximum number of iterations. The default is set to be 5000. A larger value of N may result a high CPU time.
OC	An optimality criterion. The default setting is "D-optimality" under first-order simple/multiple linear regression model. It could be one of the following: "D", "A", and "G", which stands for "D-optimality", "A-optimality", and "G-optimality", respectively. Note that both "D-optimality" and "A-optimality" are under first-order simple/multiple linear regression model, while "G-optimality" is under second-order multiple linear regression model.
alpha	A tuning parameter in algorithm for controlling how big the change would be when updating elements in the step of avoiding local optimum. The default is set to be 0.1, which is the recommended value.
X	A matrix object. In general, X stands for the design matrix.
x	A vector.
s	A positive integer.
Y	A matrix object. In general, Y stands for the design matrix.

Value

If all inputs are logical, then the output will be either a n by length(lb) optimal design. Here, the length(lb) is assumed to be at least 2.

Examples

```
#Assume in a simple linear regression model, we want to find a 20-run
#D-optimal design, where the input variable takes values between 0 and 24.
#In theory, we know the optimal design is the following:
#matrix(c(rep(1,20),rep(0,10),rep(24,10)),ncol=2,nrow=20,byrow=FALSE)

#Use LA with default setting to find the optimal design for above problem.
try=LA_OptC(n=20,lb=c(1,0),ub=c(1,24))
round(try,8)
```

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