
`runTPLS``runTPLS`

Description

This function implements the *Multi-Stratum Two-Phase Local Search* (MS-TPLS) algorithm described in Borrotti, Sambo, Mylona and Gilmour (2017). The MS-TPLS algorithm is useful to obtain exact optimal multi-stratum designs using a multi-criteria approach. The number of iterations of the MS-TPLS algorithm must be set by the user. The resulting experimental designs can minimize up to six criteria simultaneously from the following: I, D, A, Id, Ds and As. The `runTPLS` function is able to provide the set of solutions that build the approximate Pareto front for the specified optimization problem.

Usage

```
runTPLS(facts, units, criteria, model, iters, ...)
```

```
runTPLS(facts, units, criteria, model, iters, "Etas", etas, "Levels",  
levels, "Restarts", restarts, "RestInit", restInit)
```

Arguments

facts	A list of vectors representing the distribution of factors across strata. Each item in the list represents a stratum and the first item is the highest stratum of the multi-stratum structure of the experiment. Within the vectors, experimental factors are indicated by progressive integer from 1 (the first factor of the highest stratum) to the total number of experimental factors (the last factor of the lowest stratum). Blocking factors are differently denoted by empty vectors.
units	A list whose i -th element, n_i , is the number of experimental units within each unit at the previous stratum ($i - 1$). The first item in the list, n_1 , represents the number of experimental units in the stratum 0. The latter is defined as the entire experiment, such that $n_0 = 1$.
criteria	<p>A list specifying the criteria to be optimized. It can contain any combination of:</p> <ul style="list-style-type: none">• “I” : I-optimality• “Id” : Id-optimality• “D” : D-optimality• “A” : Ds-optimality• “Ds” : A-optimality• “As” : As-optimality <p>These criteria are well explained in Borrotti, Sambo, Mylona and Gilmour (2017). More detailed information on the available criteria is also given in <code>MSOpt</code>.</p>
model	A string which indicates the type of model, among “main”, “interaction” and “quadratic”.
iters	An integer indicating the number of iterations of the MS-TPLS algorithm.
...	optional arguments (see below).

Details

Additional arguments can be specified as follows:

- **'Restarts', restarts**: A string and an integer, used in pair. **r** defines the number of times the MS-Opt procedure is altogether called within each iteration of the MS-TPLS algorithm. The default value is **r=100**.
- **'Levels', levels**: A string and a vector, used in pair. **levels** is a vector containing the number of available levels for each experimental factor in the argument **facts** (blocking factors are excluded). If all experimental factors share the number of levels one integer is sufficient.
- **'Etas', etas**: A string and a list, used in pair. In **etas** the user must specify the ratios of error variance between subsequent strata, starting from the highest strata. It follows that **length(etas)** must be equal to **length(facts)-1**.
- **'RestInit', restInit**: A string and an integer, used in pair. Through these parameters, it is possible to determine how many of the **r** iterations of MS-Opt should be used for each criterion in the first step of the MS-TPLS algorithm (lines 3-6 of the pseudo-code of MS-TPLS, see Borrotti, Sambo, Mylona and Gilmour (2017)). The default value is **restInit=50**. Let n be the number of criteria under consideration. One can calculate accordingly as $r - (n * restInit)$ the number of times MS-Opt is called in the second step (lines 7-11 of the pseudo-code of MS-TPLS) of each iteration of MS-TPLS.

Value

runTPLS returns a list, whose elements are:

- **ar**: A list of length equal to **iters**. The i -th element is a list whose elements are:
 - **nsols**: Number of designs produced during the i -th iteration.
 - **dim**: The criteria space dimension.
 - **scores**: A matrix of **nsols** rows and **dim** columns. Every row contains the value of the criteria for each solution of the i -th iteration.
 - **solutions**: A list of length equal to **nsols** containing the design matrices produced during the i -th iteration. The values of the criteria corresponding at the first element of **solutions** are placed in the first row of the **scores** matrix and so on.
- **stats**: A list of length equal to **iters**. Every element is a vector of size $r - (n * restInit) + 1$, where n is the number of the considered criteria. The first element represents the number of function evaluations during the first step of the MS-TPLS algorithm; the i -th element (excluding the first one) is the sum of the number of evaluations for the i -th scalarization and the maximum value in the **stats**.
- **megaAR**: A list whose elements are:
 - **nsols**: The number of the Pareto front solutions.
 - **dim**: The criteria space dimension.
 - **scores**: A matrix of **nsols** rows and **dim** columns. Every row contains the criteria values for each Pareto front design.
 - **solutions**: A list of length equal to **nsols** containing the design matrices for the Pareto front designs. The values of the criteria corresponding at the first element of **solutions** are placed in the first row of the **scores** matrix and so on.

References

M. Borrotti and F. Sambo and K. Mylona and S. Gilmour. A multi-objective coordinate-exchange two-phase local search algorithm for multi-stratum experiments. *Statistics & Computing*, 2017.