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Experimental Analysis of Optimization Heuristics

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Exercise 1

We test a random restart Nelder-Mead algorithm and study the effect of six different parameters. A list of them with the corresponding values tested is given in Table 1. Below a short explanation for these parameters.

`max.restart`: the number of restarts before halting the algorithm,

`initial.method`: the method for generating initial solutions, this can be uniform random or quasi Monte Carlo,

`max.reinforce`: the number of times the Nelder-Mead algorithm is re-run from a point to which it converged before restarting,

`alpha`: the reflection factor,

`beta`: the contraction factor,

`gamma`: the expansion factor.

Factor	Levels
`max.restart`	$\{400; 800; 1600; 3200; 6400\}$
`initial.method`	{random; quasi-random}
`max.reinforce`	$\{1; 3; 5\}$
`alpha`	$\{0.5; 1.5\}$
`beta`	$\{0.5; 1\}$
`gamma`	$\{1; 2\}$

Table 1: The list of parameters and the values tested.

The experiments were conducted in a full factorial design on the parameters described. Each configuration was run once on a set of 22 instances obtained from the Dow Jones data using a window of 400 days. The data are available in the file `RRNM.txt` at `http://www.imada.sdu.dk/~marco/COMISEF08/`.

Using your favorite software environment for statistical analysis and graphics address the following points.

- Is there a value of `max.restart` for which we can say with enough confidence that the algorithm has converged?
- By means of opportune data transformations and graphics, determine which is the winner configuration.

- Prepare one plot and one table for resuming the results in a paper by ensuring that the results are well summurized while at the same time reproducibility is guaranteed.
- Outline a procedure for simulating a race on these data. In particular, indicate which statistical tests are suitable for carrying out the race. Time and coding skills permitting implement the race and, using the available data, compare the winner with the one indicated at point 2.
- Which initial solution generation method is preferable? Does the use of uniform random restart and quasi Monte Carlo sampling depend on how many restarts?

Exercise 2

Hadamard matrices are square matrices with entries $+1$ and -1 whose row vectors are mutually orthogonal, that is, their scalar products is equal to zero. They find applications in statistics in balanced repeated replication designs.

Finding large Hadamard matrices is not an easy task. It can be formulated as a combinatorial optimization problem and solved by heuristics.

A tabu search algorithm has been implemented for this task and two versions of it, with different tabu length parameter, have been run to find Hadamard matrices of order 74. For each version, 50 runs where performed, each run with a time limit of 100 seconds.

The file `R37.txt` at `http://www.imada.sdu.dk/~marco/COMISEF08/` contains the results in the following form:

```
time iter event case
101 185737 0 1
57 84850 1 1
1 568 1 1
51 94974 1 1
...
```

The column `time` is the time at which the program ended, `iter` is the number of iterations completed and `event` is 1 if the program ended with a solution found and 0 otherwise. The column `case` indicates the version of the algorithm.

Recognize the type of censoring of this experiment and fit one of the following parametric distributions to these data: exponential, Weibull, log-normal. For the best fit, calculate the cutoff time for a restarting strategy.