Data Description for the Test Problem Instances Used in "Supported Solutions as a Representation of the Nondominated Set: An Empirical Analysis"

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The test instances in this data set belong to the general class of Multiple Objective Discrete Optimization (MODO) problem, which can be written as

$$\begin{array}{lll} (MODO) & \min & f_i(x), \quad i = 1, \ldots, p \\ & s.t. & x \in \mathcal{X}, \end{array}$$

where $f_i : \mathbb{R}^n \to \mathbb{R},\ i = 1, \ldots, p$ denote the objective functions of the problem and $\mathcal{X} \subseteq \mathbb{R}^n$ is the discrete set of feasible points.

Test Problems

The Knapsack Problem

The knapsack problem used in this study is the single constraint binary knapsack problem with n items and associated values $v_r^j,\ j = 1, \ldots, p, r = 1, \ldots, n$ and weights $w_r,\ r = 1, \ldots, n$.

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$$
\begin{aligned}
\max \quad & \sum_{r=1}^{n} v_r^j x_r, \quad j = 1, \ldots, p, \\
s.t. \quad & \sum_{i=1}^{n} w_r x_r \leq W, \\
& x_r \in \{0, 1\}, r = 1, \ldots, n,
\end{aligned}
$$

where $x_r = \begin{cases} 1 & : \quad if\ item\ r\ is\ chosen \\ 0 & : \quad otherwise. \end{cases}$

In the so-called no-correlation case, v_r^j and w_r are random integers drawn from the interval $[1, 1000]$ according to a uniform distribution for all $j \in \{1, \ldots, p\}$ and $r \in \{1, \ldots, n\}$.

In this data set, there are also positively correlated instances of the knapsack problem at three different levels ($\ell = 1, 2, 3$) of correlation according to the following scheme. A core vector a of size n consists of random integers in the interval $[1, 250\ell]$. All value and weight vectors are calculated as the sum of this vector a and a vector with randomly generated elements in the interval $[1, 1000 - 250\ell]$. Thus, the category of $\ell = 0$ consists of uncorrelated instances for each problem size. In all cases, the knapsack capacity W is set as $W = \lceil 0.5 \sum_{r=1}^{n} w_r \rceil$.

The instances have $p = 3$ and $n \in \{25, 50, 75, 100\}$.

The data file names are given in the following format, "$KPc\_p{-}3\_n{-}X\_ins{-}Y\_r{-}Z.dat$." KPc stands for the knapsack problem with correlated data, X represents the number of objects, $X \in \{25, 50, 75, 100\}$, Y is the instance number, $Y \in \{1, \ldots, 10\}$, Z is the correlation level, $\ell \in \{0, 1, 2, 3\}$. Each data file is in lp format with an arbitrary objective function. The three objective functions appear as the first three constraints, the knapsack constraint appears as the fourth constraint.

The Assignment Problem

$$
\begin{aligned}
\min \quad & \sum_{i=1}^{n} \sum_{j=1}^{n} c_{rk}^j x_{rk}, \ j = 1, \ldots, p \\
s.t. \quad & \sum_{r=1}^{n} x_{rk} = 1, \ k = 1, \ldots, n \\
& \sum_{k=1}^{n} x_{rk} = 1, \ r = 1, \ldots, n \\
& x_{rk} \in \{0, 1\} \ r = 1, \ldots, n; k = 1, \ldots, n
\end{aligned}
$$

The decision variables are defined as: $x_{rk} = \begin{cases} 1 & : \quad if\ task\ r\ is\ assigned\ to\ server\ k \\ 0 & : \quad otherwise \end{cases}$

For an assignment problem with n tasks and costs of $c^j_{rk},\ r,k = 1,\ldots,n,\ j = 1,\ldots,p$, the coefficients in the base case are random integers from a uniform distribution $[1, 20]$. This is indicated with correlation level $\ell = 0$. For correlation levels $\ell = 1, 2, 3$, the cost coefficients are generated as the sum of two integer values generated randomly in the interval $[1, 5\ell]$ (the core coefficients, same for all objectives) and $[1, 20 - 5\ell]$ (different for each objective) respectively.

The data file names are given in the following format, "$APc\_p{-}3\_n{-}X\_ins{-}Y\_r{-}Z.dat$." APc stands for the assignment problem with correlated data, X represents the number of objects, $X \in \{5,\ldots,50\}, Y$ is the instance number, $Y \in \{1,\ldots,10\}$, Z is the correlation level, $\ell \in \{0, 1, 2, 3\}$. Each data file is in lp format with an arbitrary objective function. The three objective functions appear as the first three constraints, the two sets of assignment constraints appear afterwards.