COPSolver

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Abstract

This paper presents the software COPSolver, originally developed to solve decision and/or optimization problems, especially from the combinatory optimization area. The first version of COPSolver has an application of the Fraga's exact method for solving the multi-product batch processing time maximization problem. This paper address the COPSolver_1.0-1 and the next steps that will be implemented for the software's applications development.

combinatorial optimization problem; exact method; multi-product batch problem; processing time maximization.

Code metadata

Nr.	Code metadata description	Please fill in this column
C1	Current code version	COPSolver_1.0-1
C2	Permanent link to code/repository used for this code version	*https : //github.com/tbfraga/COPSolver*
C3	Permanent link to Reproducible Capsule	*https : //github.com/tbfraga/COPSolver*
C4	Legal Code License	Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International Public License
C5	Code versioning system used	git
C6	Software code languages, tools, and services used	c++, CodeBlocks, LINGO, Ubuntu 22.04.1, GitHub
C7	Compilation requirements, operating environments & dependencies	elementary OS (can be adapted to Ubuntu)
C8	If available Link to developer documentation/manual	*http : //tbfraga.github.io/COPSolver/documentation/*
C9	Support email for questions	tbfraga@proton.me

A decision problem arises when we need to choose an option from a set of known options so that the chosen decision meets a set of pre-established constraints. This problem is configured as an optimization problem when the decision taken must, in addition to meeting the constraints, be the one that best contributes to the achievement of a given group of objectives.

Decision and/or optimization problems are frequent in industrial and organizational environments, as well as in our daily lives. Usually the resolution of these problems brings great benefits, such as improving the efficiency of industrial processes, reducing costs, increasing productivity, increasing the useful life of equipments, helping to make better choices, bringing better cost-effectiveness, improving customer satisfaction, etc.

Given the enormous variety of decision-making and/or optimization problems and the complexity of such problems, the scientific literature brings numerous scientific materials that deal with the various problems and propose different solution methodologies for these problems. However, it is rare to find software that solves such problems. Usually such software is closed code, developed directly to solve very specific industrial problems, and the rights of use are kept by the companies themselves.

COPSolver software was (and is being) developed by Dr. Tatiana Balbi Fraga with the purpose of solving several decision and optimization problems in the most efficient and robust way possible.

The first version of the software, COPSolver_1.0-1, applies the analytical solution method developed by Fraga et al. (2023) to solve the Multi-product Batch Processing Time Maximization (MBPTM) problem. This problem arises in production process operations where a set of products are processed simultaneously on the same machine, but with production rates that can be different for each product. There is a production limit for each product and also for the products group, as well as a limit for the batch processing time. The problem consists of defining the maximum processing time of the multi-product batch respecting the known production limits. The exact analytical method of Fraga et al. (2023) is extremely efficient, proposing solutions very quickly and with low computational cost.

COPSolver package also contains the MBPTM.lng file, which is a code written in LINGO language to solve the model proposed by Fraga et al. (2023) for the multi-product batch processing time maximization problem. When run, COPSolver automatically generates a data.ldt file to be used with this LINGO code. However, the MBPTM.lng file can only be used through the LINGO software. More details about the LINGO software are available at https://www.lindo.com.

COPSolver_1.0-1 can serve as an important tool for inventory control for some companies. Also, it can be used for teaching and research. As future works, we will be applying COPSolver to assist in planning the production of extruders, in companies of the plastic bag production sector. We will also include new solution methods for other decision and/or optimization problems. As the MBPTM problem considers the planning

period of just one day, in the next solver version, we will be considering a multi-period scenario.

Professor Fraga, author of this paper, and, more generally, her research group GAMOS (Group of Analysis, Modeling and Optimization of Systems), have developed many works focused on the identification, modeling and solution/optimization of real problems in industrial/organizational environments. Therefore, the development of COPSolver will be done in conjunction with the development of these works. Our intention is that the software can, in the near future, cover a wide range of methodologies to solve real problems and standard problems found in the literature. Later we intend to develop a pattern identification method (possibly based on neural networks) to recognize model patterns and solve different problems automatically. In the future, we will also be developing extension projects to train micro and small companies to use COPSolver. We hope that COPSolver can help to improve several processes and, in particular, the productive and administrative processes of micro and small companies, offering them a tool to improve their competitive potential.

References

Fraga, T.B., Aquino, Í.R.B. and Menêzes, R.C.S. (2023). Multi-product Batch Processing Time Maximization Problem. Manuscript submitted for publication.