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LAGRANGIAN RELAXATION FOR LOT SIZING

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ABSTRACT

This study addresses the lot-sizing problem, motivated by practical challenges in Brazilian food manufacturing environments. The production setting comprises multiple production lines that share limited resources, such as labor and machinery. Due to the scarcity of these resources and operational constraints, not all lines can operate simultaneously. Each line is specialized and solely responsible for producing specific items. The mathematical model was designed by Medeiros, Soler, and Queiroz [3], based on formulations proposed by Haase [2], and Soler, Santos, and Akartunali [4]. To accurately model item perishability, the variable redefinition technique introduced by Eppen and Martin [1] was adopted, enabling a suitable representation of product shelf life within the planning horizon. This study aims to apply Lagrangian Relaxation and heuristic methods to the Lot-Sizing Problem with Perishable Products and Production Lines Sharing Scarce Resources. The main objective is to improve upon the results reported in the literature, particularly on large-scale instances that are often more computationally demanding. The implementation was carried out using the Python programming language, integrated with CPLEX, a high-performance optimization solver widely adopted in operations research.

During the computational experiments, a significant increase in solution time was observed as the instance size increased. To address this challenge, Lagrangian Relaxation was applied using the subgradient method, which enables the decomposition of the original problem into more manageable subproblems [5]. Also, feasibility and improvement heuristics were developed to generate good-quality solutions efficiently. These heuristics were designed to accelerate convergence and enhance solution quality by addressing infeasibilities and refining upper bounds. The computational results indicated that the proposed approach significantly reduced processing time and, in some instances, provided better-quality solutions than those obtained exclusively by CPLEX within the established time limit.

***K*eywords** Lot Sizing Problem · Lagrangian Relaxation · Subgradient Method · Heuristics

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