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Integrated Batch Production and Distribution Scheduling with Limited Vehicle Capacity

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Abstract

We study a variation of the *Integrated Production and Distribution Problem* (*IPDP*) in which orders are processed and delivered in batches with limited vehicle capacity. We emphasize the no-wait condition between the production and distribution of each batch, and prove that the general version of this integrated operational scheduling problem is strongly *NP*-hard. Two special cases, with identical order processing time and identical delivery time respectively, are investigated to explore the optimal solution structures, such as how orders should be sequenced based on their processing and delivery time. These optimal solution structures not only help the design of polynomial time algorithms for the special cases, but also reveal insights that facilitate the development of the heuristic for the general problem. We also offer the analytical worst case error bound of this heuristic in solving the general problem by providing a performance ratio less than two, and numerically demonstrate the effectiveness of our heuristic in terms of accuracy and speed. Statistical tests are carried out to investigate the impacts of problem parameters, including order number, vehicle capacity, and variety of order processing time and delivery time, on the accuracy of the heuristic.

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