Effects of Inventory costs on the Capacitated Lot-Sizing with Setup Carryover and Setup Splitting

Srimathy Mohan[1], Cheng-Lung Chen[2] and Muhong Zhang[1]

[1]Arizona State University, Tempe, Arizona , USA
[2]Ohio State University, Ohio, Columbus, USA

Abstract

One of the recent research trends in the big bucket capacitated lot sizing problem (CLSP) is the inclusion of carrying over the setup state across periods and allowing the duration of a setup to cross period boundaries. Considering setup carryover and splitting in the formulation generally generates a better production schedule in terms of lower costs and at times, removes infeasibility from models that do not consider setup carryover and splitting. However, the resulting model and the solution procedures tend to be more complex and computationally more expensive. In this research, we present a model for the CLSP with setup carryover and setup splitting (CLSP-SCSS) and develop an efficient fix-and-optimize heuristic. We utilize this heuristic to investigate the effect of inventory costs on the inclusion of setup splitting in the resulting production schedules.

We formulate the CLSP-SCSS as a mixed integer model using a simple plant location reformulation and add three types of valid inequalities to tighten the formulation. We develop a generic fix-and-optimize heuristic to solve the model. The heuristic fixes the value for a small set of the binary setup state variables and the model with the remaining binary variables and continuous variables is solved to optimality using a branch-and-bound procedure. The heuristic uses iterative product and period decomposition procedures to develop a good solution to the initial model. We have also extended the model and heuristic to accommodate demand backlogging. The proposed model and heuristic was coded using AMPL and solved using IBM ILOG CPLEX 12.0.6.1.

We tested our heuristic on the data sets from Trigeiro et al. (1989) and Belo-Filho et al (2013). The experiments vary the capacity of periods, demand, setup cost, setup time as well as inventory costs. Our experimental results indicate that the proposed heuristic is very efficient and produces solutions within 6% and 8% of optimality for data without and with demand backlogging respectively. The experimental results also show that setup splitting is essential for finding a feasible solution when setup times are long, problem size increases, as well as when inventory costs increase. When inventory costs are high, it becomes advantageous to produce closer to the actual demand and this might require splitting setups across periods, when capacity is tight.