Big data driven order-up-to level model: Application of machine learning

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Abstract

Data driven optimisation has become one of the research frontiers in operations management and operations research. Likewise, the recent academic interest in big data has created a desire for big data driven operations research. A new data driven methodology, which employs the empirical risk minimisation (ERM) principle, has recently been introduced in the inventory management literature. It has been used to formulate data driven inventory models which can take multiple features into account and do not need classical distributional assumptions. However, the research on big data driven inventory models is currently confined to the newsvendor model. In this paper, we aim to generalize the previous results on the big data driven newsvendor model and to expand the research by solving a big data driven dynamic order-up-to level inventory model. We show how the ERM methodology is employed to formulate a big data driven order-up-to level inventory model and design a machine learning algorithm to solve the model. The performance of our big data driven inventory model and solution algorithm is demonstrated by an experimental study based on real business data. The numerical results show that our integrated big data driven model generates up to 60% cost savings compared to the best performing univariate benchmark model, and up to 6.37% cost savings compared to the best performing big data driven benchmark model.

Keywords: Inventory Models, Machine Learning, Big Data, Data Driven Operations Research, Empirical Risk Minimisation, Neural Networks.