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"Can Deep Reinforcement Learning Improve Inventory Management? Performance on Dual Sourcing, Lost Sales and Multi-Echelon Problems"

Abstract: Is Deep Reinforcement Learning (DRL) effective at solving inventory problems? Given that DRL has successfully been applied in computer games and robotics, supply chain researchers and companies are interested in its potential in inventory management. We provide a rigorous performance evaluation of DRL in three classic and intractable inventory problems: lost sales, dual-sourcing and multi-echelon inventory management. We model each inventory problem as a Markov Decision Process and apply and tune the Asynchronous Advantage Actor Critic (A3C) DRL algorithm for a variety of parameter settings. We demonstrate that the A3C algorithm can match performance of state-of-the-art heuristics and other approximate dynamic programming methods. While the initial tuning was computationally- and time-demanding, only small changes to the tuning parameters were needed for the other studied problems. Our study provides evidence that DRL can effectively solve inventory problems. This is especially promising when problem-dependent heuristics are lacking. Yet generating structural policy insight or designing specialized policies that are (ideally provably) near optimal remains desirable.

Biosketch: Joren Gijsbrechts is an Assistant Professor in Operations Management. He graduated as a Bachelor and Master in Business Engineering at the University of Antwerp in Belgium. Prior to obtaining his doctoral degree from KU Leuven in Belgium, he attained business experience in the Supply Chain and Operations division of Procter and Gamble in Sweden. As a PhD student, he regularly visited Kellogg School of Management and has on-going research projects with renowned institutions. His research centers around data-driven decision making in Operations Management with a strong focus on the recent developments in Machine Learning and Prescriptive Analytics. His models have assisted companies to improve their inventory and transportation management. In addition to research, he is providing guest lectures and company workshops on the recent developments within Analytics.