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"Chips and Beer: Using Machine Learning to Optimize Inventory"

Abstract: I will discuss two applications of machine learning in inventory optimization. The first uses deep neural networks (DNN) to optimize the order quantity in a newsvendor-type problem in which the demand distribution depends on exogenous features. Our approach uses DNN to optimize the order quantity directly from data, as opposed to the classical "forecast-then-optimize" approach. (I'll illustrate this idea using an example based on potato chips.) In the second application, we develop a deep reinforcement learning (DRL) agent to play the beer game, a popular classroom activity that demonstrates certain aspects of inventory management. Our DRL agent learns near-optimal performance when its computerized "teammates" follow a base-stock policy. More interestingly, it outperforms the best-known policy when its teammates emulate (irrational) human players, suggesting that we might be able to learn from how the DRL agent plays the game. We demonstrate using a computerized beer game that we developed in collaboration with Opex Analytics (now Coupa).

Biosketch: Larry Snyder is a Professor of Industrial and Systems Engineering and Director of the Institute for Data, Intelligent Systems, and Computation (I-DISC) at Lehigh University in Bethlehem, PA. He received his Ph.D. in Industrial Engineering and Management Sciences from Northwestern University. Dr. Snyder's research interests include modeling and solving problems in supply chain management and energy systems, particularly when the problem exhibits significant amounts of uncertainty. He is co-author of the textbook *Fundamentals of Supply Chain Theory*, published in 2011 by Wiley, which won the IIE/Joint Publishers Book-of-the-Year Award in 2012; a second edition was published in 2019. He has served on the editorial boards of *Transportation Science*, *IISE Transactions*, *OMEGA*, and the Wiley Series on Operations Research and Management Science. He previously served as a Senior Research Fellow–Optimization for Opex Analytics. For more information, visit coral.ise.lehigh.edu/larry.