

SEMINAR SERIES
Department of Quantitative Analysis and Operations Management
College of Business Administration
University of Cincinnati

**Closed Loop, Real-Time Integration of Warehouse Withdrawals and Warehouse
Consignments**

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In this talk, we propose a solution to a warehouse inventory control and truck consignment problem encountered in the consumer packaged goods industry. Trucks—arriving randomly in real-time—must be assigned to warehouses to unload item arrays that exhibit inter-item production dependencies. Warehouse withdrawals are a stochastic function of final demand and exhibit both serial and contemporaneous correlation. The solution integrates withdrawal dynamics and multi-item forecasts in a unified state-space model that yields (near optimal) closed-loop, feedback control by combining saturated variational optimization and a hybrid annealing-genetic algorithm. In simulation, the variational optimization performs precisely when the state weighting matrix is set to the variance-covariance matrix of disturbances. The annealing-genetic algorithm comes within 1.72% of the global optimum in a large-scale numerical experiment. (Errors range from 0%–6%.) The overall system—running in completely automated mode—keeps inventory levels within 12% of their targeted levels when averaging across 27 items in 3 warehouses. The presentation will explain how the model (s) to solve this problem were formulated and discuss solution techniques, simulation methods, and results. The talk will conclude by outlining implications for improving the efficiency of various interfaces in the supply chain.

David J. Curry is Professor of Marketing and Director of the Center for Integrated Research Systems, the University of Cincinnati. He received his Ph.D. in Business with an emphasis in psychometrics from the University of California, Berkeley. His recent research focuses on the use of analytical techniques, such as state-space models and variational optimization, for point-of-sale (scanner) data and other transaction level data sources with applications to category management, pricing, forecasting, and real-time control of supply-chain activities. Dr. Curry has published in several journals including *Journal of Marketing Research*, *Journal of Consumer Research*, *Marketing Letters*, *Journal of Retailing*, *Journal of Forecasting*, *Decision Sciences*, *Transportation Research Record*, *Multivariate Behavioral Research*, *Organizational Behavior and Human Performance*, *Applied Psychological Measurement*, *Educational and Psychological Measurement*, and the *American Philosophical Quarterly*. He has also served as a consultant to companies in the U.S. and Australia, including Information Resources Incorporated, the A.C. Nielsen Corporation, Kraft USA, the Kroger Company, the HON Corporation, Conzinc Riotinto Australia, Telecom Australia, and Australian Guarantee Corporation. His book *The New Marketing Research Systems* reviews the impact of large-scale databases and modern computer technology on the changing practice of marketing research.