Shape-Constrained Functional Estimation in Production and Beyond

BIOGRAPHY

Andrew L Johnson is a Principal Research Scientist at Amazon. Previously he was a Professor in the Wm Michael Barnes 64’ Department of Industrial and Systems Engineering at Texas A&M University. He has held visiting faculty positions at Aalto University, Osaka University, Tokyo Tech, and GRIPS. He obtained his B.S. from the Grado Department of Industrial and Systems Engineering at Virginia Tech and his M.S. and Ph.D. from the H. Milton Stewart School of Industrial and Systems Engineering at Georgia Tech. His research interests include productivity and efficiency measurement, warehouse operational design, benchmarking, functional estimation and production economics. He is a member of INFORMS, National Eagle Scout Association, and German Club of Virginia Tech.

ABSTRACT

In many applications, researchers seek to estimate functional relationships, but assumptions of specific functional forms can be overly restrictive, while fully non-parametric methods pose interpretability challenges. Shape-constrained functional estimation provides a middle ground by imposing theoretically motivated constraints without specifying an exact functional form. In this talk, I will discuss shape constraints inspired by economic theory, particularly in production settings. While monotonicity has been extensively studied, I will introduce global convexity/concavity, quasi-convexity, and S-shaped functions. I will also highlight applications of these methods using data from the Census of Manufacturing, the energy sector, and the hospital industry, demonstrating their practical relevance across diverse economic contexts.