Reducing Simulation Model Risk via Input Model Averaging

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Abstract

“Input modeling” is the simulation term for fitting the probability distributions that represent real-world uncertainty, such as arrivals of demands, failures of machines and bed occupancy times of patients. While the software for fitting distributions to data has improved, the underlying approach of Maximum Likelihood Estimation followed by goodness-of-fit assessments has not advanced much since 1922. Input uncertainty is an aspect of simulation model risk that arises because the fitted distributions are imperfect representations of reality. While there has been significant progress on quantifying and hedging against input uncertainty, there has been no direct attempt to reduce it. In this talk we show that frequentist model averaging can be a provably effective way to create input models that better represent the true, unknown input distributions, thereby reducing model risk. Input model averaging builds from standard input modeling practice, and requires no change in how the simulation is executed nor any follow-up experiments. We provide theoretical and empirical support for our approach.

This is joint work with Alan T K Wan of City University of Hong Kong, Xinyu Zhang of the Chinese Academy of Sciences, and Xi Jiang of Northwestern University.

Biography

Barry L. Nelson is the Walter P. Murphy Professor of the Department of Industrial Engineering and Management Sciences at Northwestern University and a Distinguished Visiting Scholar at Lancaster University in England. His research focus is on the design and analysis of computer simulation experiments on models of discrete-event, stochastic systems, including methodology for simulation optimization, quantifying and reducing model risk, variance reduction, output analysis, metamodeling and multivariate input modeling. His application areas are manufacturing, services, financial engineering and transportation. He has published numerous papers and three books, including Foundations and Methods of Stochastic Simulation: A First Course (Springer, 2013). Nelson is a Fellow of INFORMS and IIE. In 2006, 2013 and 2015 he received the Outstanding Simulation Publication Award from the INFORMS Simulation Society, and in 2009, 2011 and 2015 he was awarded the Best Paper–Operations Award from IIE Transactions. His teaching has been acknowledged by a Northwestern University Alumni Association Excellence in Teaching Award, a McCormick School of Engineering & Applied Science Teacher of the Year Award, and the IIE Operations Research Division Award for Excellence in the Teaching of Operations Research. Further information, including a complete CV, can be found at www.iems.northwestern.edu/~nelsonb/.