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A Conditional Monte Carlo Method for Estimating the Failure Probability of a Distribution Network with Random Demands (joint with Jose Blanchet and Marvin K. Nakayama)

Abstract: We consider a model of an irreducible network in which each node is subjected to a random demand, where the demands are jointly normally distributed. Each node has a given supply that it uses to try to meet its demand; if it cannot, the node distributes its unserved demand equally to its neighbors, which in turn do the same. The equilibrium is determined by solving a linear program (LP) to minimize the sum of the unserved demands across the nodes in the network. One possible application of the model might be the distribution of electricity in an electric power grid. This paper considers estimating the probability that the optimal objective function value of the LP exceeds a large threshold, which is a rare event. We develop a conditional Monte Carlo algorithm for estimating this probability, and we provide simulation results indicating that our method can significantly improve statistical efficiency.