Abstract

Food insecurity has been an increasing threat to people’s health status and quality of life. In the United States, local food banks serve the needy population to reduce food insecurity in their service area. We present and analyze several mathematical models to facilitate the equitable and effective distribution of donated food by a large local food bank among the population at risk for hunger. Demand typically exceeds the donated supply, and is proportional to the poverty population. The food bank’s supervising agencies and donors require that the food donations are distributed in an equitable manner such that each person in poverty receives the same amount of food in each period. This objective conflicts with the goal of effectively distributing donated food by minimizing the amount of undistributed food. We first develop deterministic network-flow models to minimize the amount of undistributed food while maintaining a user-specified upper bound on the deviation from perfect equity and derive closed-form optimal solutions. These deterministic models show that locations with low capacity to demand ratios, bottlenecks, constrain the entire food distribution due to the need to distribute food equitably. Therefore, counties’ capacities, which in practice are uncertain, have a direct influence on the optimal solution. In order to address stochastic capacities, we first develop a robust optimization model allowing the capacity parameters to vary within a range. We obtain conservative yet realistic solutions. We also develop a two-stage stochastic programming model under which food distribution decisions are made before capacities at the receiving locations are known. In the second stage, capacities are realized and shipment decisions made in the first stage can be corrected at additional cost. We prove that this two-stage stochastic program has a newsvendor-type closed-form optimal solution which we use to develop a myopic heuristic for the multi-period problem. We illustrate our results using historical data from our collaborating food bank.
Refreshments will be served in Daniels Hall room 428
from 11:00 a.m. to 11:30 a.m.

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Biography

Irem Sengul Orgut is a doctoral candidate in the Edward P. Fitts Department of Industrial and Systems Engineering at North Carolina State University. Prior to starting her doctoral studies, she received her B.S. degrees in Industrial Engineering and Mechanical Engineering from Bogazici University, Istanbul, Turkey in 2010. Her research interests are focused on the stochastic modeling of complex supply chains with multiple objectives and conflicting decision makers. She is interested in using mathematical modeling, robust optimization and stochastic programming to address long-term humanitarian issues and public health problems to generate applicable policies for improving people’s circumstances. She is currently the president of the INFORMS Student Chapter at NCSU, and a member of INFORMS and IIE.