Stochastic programming approach for the coupled problem of pre-positioning and distributing resources for disaster response under uncertain demand and travel times

Nicolas Puerto*[1,2] and Camilo Gomez†‡[1,2]

[1]Center for Applied Optimization and Probability – Colombia
[2]Department of Industrial Engineering - Universidad de los Andes [Bogota] – Colombia

Abstract

Resource allocation and planning for disaster preparedness and response are essential to prevent loss of life and economic impacts as well as to efficiently provide relief in a timely manner. We consider the problem of locating and allocating resources for disaster response, as well as its relationship with resource distribution in a set of uncertain disaster scenarios. In this sense, we propose a model in which different realizations of a network are obtained for each of a set of scenarios representing possible disasters in the context of a large urban concentration. Each disaster realization leads to different travel times along network edges (e.g., due to road closures) and a different demand for resources and services at nodes. A two-stage stochastic programming approach is proposed in which the first stage addresses the location/allocation of resources for disaster response while the second stage concerns the distribution of these resources by means of a vehicle routing problem. Besides typical installation and distribution costs, we incorporate the expected delay in distribution and the expected unsatisfied demand as possible risk measures. The proposed hybrid methodology uses an optimization approach that allows disaster preparedness policies to be obtained and evaluated in terms of both risk measures and logistical aspects (e.g., costs).

*Corresponding author: ne.puerto10@uniandes.edu.co
†Speaker
‡Corresponding author: ch.gomez171@uniandes.edu.co