PROFIT-MAXIMIZING SERVICE SYSTEM DESIGN WITH ELASTIC DEMAND AND CONGESTION

Robert Aboolian, Department of Information Systems and Operations Management, Cal State San Marcos, 333 S. Twin Oaks Valley rd, San Marcos, CA 92096, 760-750-4221, raboolia@csusm.edu
Oded Berman, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, Ontario, Canada, M5S 3E6, 416-978-4239, berman@rotman.utoronto.ca
Dmitry Krass, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, Ontario, Canada, M5S 3E6, 416-978-7180, krass@rotman.utoronto.ca

ABSTRACT

The service system design problem seeks to locate a set of service facilities, allocate enough capacity for the customer demand to each of them so as to maximize facilities overall profits. Demands for service that originate from the nodes are assumed to be Poisson distributed and the servers provide service time that is exponentially distributed. Average demand rate at each node is assumed to be a decay function of travel time and waiting time in the facility. Price offered by the facilities are considered to be uniform and known in advance. Facilities revenue is the product of price and the overall demand captured by facilities and facilities cost is the sum of fixed costs of opening facilities and acquiring service capacity. Each facility is expected to ensure that the waiting time in each facility will not increase an acceptable level. This problem (without elastic demand assumption) is commonly known in the location literature as the facility location problem with immobile servers, stochastic demand and congestion. It is often set-up as a network of M/M/1 queues and modeled as a nonlinear mixed-integer program. The problem is formulated and analyzed and exact and approximate solution approaches are developed.