

A cumulative opportunities approach to facility location

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Abstract

In many applications, members of a population (“customers”) need to be associated with locations (“facilities”). While facility location optimization models that utilize a *demand allocation* perspective have allowed for a customer to be assigned to multiple facilities (such as competitive facility location models utilizing gravity-based demand), models that address a *service provision* perspective typically assume that a customer is served by a single (typically, the closest) opened facility (such as the p –median model). In this study, we introduce a new facility location model to optimize the cumulative opportunity measure, an accessibility metric frequently utilized by urban planners that counts the (distance-weighted) number of opportunities available within some predefined threshold distance of a customer. We further account for service equity considerations by use of a constraint bounding the Gini coefficient value for cumulative opportunities available across customers.

We provide analytical results and conduct a numerical study to benchmark our model against three common facility location models (p –median, p –center and maximal covering). The analytical results show that the cumulative opportunities-maximizing solution can differ greatly from those obtained by the traditional facility location models. The computational results demonstrate that our equity-constrained model returns solutions that are similar in many respects to the maximal covering model. We conclude that our modeling approach could help to increase policymakers’ willingness to rely on optimization modeling to inform decision making in areas such as improving health care access for underserved populations, since our approach utilizes a metric that is well-understood in the urban planning community.

Keywords: Facility locations, accessibility metrics

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