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# Competitive Facility Location with Random Attractiveness

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## Abstract

Customers' perception of a particular facility's attractiveness is likely to be heterogeneous. However, existing competitive facility location models assume that facilities' attractiveness levels are fixed. We extend the gravity model assuming randomly distributed facilities' attractiveness. We propose two effective solution methods. One is based on discretizing the attractiveness level distribution. The second is based on the concept of an "effective" attractiveness. Effective attractiveness approximates the calculated market share captured assuming random attractiveness. We show how effective attractiveness is calculated.

Key words: Competitive location; Random attractiveness; Discretizing distributions; Effective attractiveness.

## 1 Introduction

Retail facilities operate in a competitive environment with profit and market share maximization objective. Early competitive location models [11, 13] assume that customers patronize the closest facility, implicitly assuming that all facilities are equally attractive. In reality, customers are willing to travel an extra distance to a more attractive facility.

The basic competitive location problem is finding the optimal location of one or more new facilities in a market where competition already exists or will exist in the future. The objective is to locate the new retail outlets at locations which maximize their chain market share. For a recent review of competitive location models see [9].

A commonly used approach for estimating market share is the gravity model [14, 15, 21] also referred to as the Huff model. According to the gravity model, the probability that a customer patronizes a facility is proportional to its attractiveness and declines according to a distance decay

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