



Chapter XIII

Integrating GIS and Maximal Covering Models to Determine Optimal Police Patrol Areas

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Abstract

This chapter presents a new method for determining the most efficient spatial distribution of police patrols in a metropolitan region, termed the police patrol area covering (PPAC) model. This method employs inputs from geographic information systems (GIS) data layers, analyzes that data through an optimal covering model formulation, and provides alternative

optimal solutions for presentation to decision makers. The goal of this research is to increase the level of police service by finding more efficient spatial allocations of the available law enforcement resources. Extensions to the model that incorporate variations in the priority of calls for service based on the type of crime being committed, and the need for an equitable distribution of workload among police officers are discussed. Examples of the inputs from – and outputs to – GIS are provided through a pilot study of the city of Dallas, Texas.

Introduction

Virtually all metropolitan police departments in the U.S. create a geographic division of their area for the purposes of administration and patrol. The way in which this spatial division is made influences the provision of police services. An optimal spatial division could equitably distribute limited police resources throughout the city, reduce response times, save money through efficient deployments, and create a fair division of risk among police officers.

The primary goal of this research is to provide suggestions that will lead to an increase in the level of police service by finding more efficient spatial allocations of law enforcement resources. We take care to note here that efficiency can be a broadly defined term – with multiple metrics – and we restrict ourselves to the spatial efficiency of the patrol-area boundaries. The resulting alternatives take the form of optimal solutions to maximal covering problems, which delineate police patrol areas. These problems must be solved in the context of a major metropolitan area, with a large population and a concomitantly large number of potential police patrol areas. It is proposed that covering models hold the greatest promise for determining optimal solutions to the problem of delineating police patrol areas. Given the difficulties inherent in optimally solving large instances of such problems, both GIS and integer programming software must be integrated in order to allow these problems to be re-examined when the initial conditions change. Given the many people and organizations who must approve the changes suggested by the optimal solutions that are found, the results must be presented as a series of alternatives from which a best arrangement can be selected that satisfies the greatest number of people and that can be efficiently implemented.

The relevant literature that forms the basis for this research falls into three major categories: the discipline of location science and its integration with GIS, the determination of police patrol areas, and the formulation of covering models for service provision to geographic areas. In addition to these three categories, there

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