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Ambulance Location under Stochastic Demand: A Sampling Approach

Stefan Nickel[a,b], Melanie Reuter-Oppermann[a*], Francisco Saldanha-da-Gama[c]

[a] *Institute for Operations Research, Karlsruhe Institute of Technology (KIT), Germany*
[b] Fraunhofer Institute for Industrial Mathematics (ITWM), Kaiserslautern, Germany
[c] *Department of Statistics and Operations Research & Operations Research Center, Faculty of Science, University of Lisbon, Lisbon, Portugal*

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Abstract

In this paper, we investigate the problem of choosing the location and number of ambulances and their bases in a certain region. The goal is to minimize the total cost for installing (and maintaining) these facilities but assuring a minimum coverage level. Demand is assumed to be stochastic. A scenario-indexed formulation is considered for the problem. By using a small illustrative example we show that even when demand can be captured by a finite number of scenarios, rapidly the number of scenarios becomes too large, thus preventing the effective use of the model. We also show that the possibility of considering just one sample of scenarios can lead to a totally misleading solution. These insights motivate the development of a sampling approach in which we draw several samples of scenarios and solve the restricted model associated with each of them. The sample of optimal values obtained by this procedure can be combined in order to estimate the optimal value of the original problem. The same happens with the sample of optimal solutions obtained, which can be combined heuristically to produce a feasible solution to the whole problem. We test the new approach using a set of random instances.

Keywords: Ambulance location, Stochastic demand, Scenario sampling

1 Introduction

Emergency Medical Service (EMS) systems worldwide share one goal: to serve as many emergencies as possible within a maximum pre-specified time. One of the main problems in an EMS is to determine the number and location of ambulances for covering some region such that the calls for emergencies can be answered as effectively as possible. This is the topic investigated in this paper. In particular, we consider the use of Operations Research models and methods for dealing with this type of problem.

* *Corresponding author. E-mail address*: melanie.reuter@kit.edu

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