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Iterative Projection approach for solving the Territorial Business Sales optimization problem

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Abstract

A well designed territory enhances customer coverage, increases sales, fosters fair performance and rewards systems and lower travel cost. This paper considers a real life case study to design a sales territory for a business sales plan. The business plan consists in assigning the optimal quantity of sellers to a territory including the scheduling and routing plans for each seller. The problem is formulated as a combination of assignment, scheduling and routing optimization problems. The solution approach considers a meta-heuristic using stochastic iterative projection method for large systems. Several real life instances of different sizes were tested with stochastic data to represent raise/fall in the customers demand as well as the appearance/loss of customers.

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1. Introduction

Companies are using more analytics to enable better sales force decisions, for example, the sales territory design, or the way in which the responsibility for accounts is assigned to salespeople or sales teams.

The distribution of customer workload and opportunity across the sales force has a direct impact on salespeoples ability to meet customer needs, realize opportunities, and achieve sales goals.

According to Zoltners [1], territory design optimization can increase sales by 2 to 7%, without any change in total resources or sales strategy. Territory Design is the problem of grouping small geographic areas (so called basic areas) into a fixed number of larger clusters, in a way that the latter are acceptable according to relevant planning criteria, like balance, compactness and contiguity [2].

During this process, commercial territories are delimited in order to help agents to sell more efficiently. Delimitation is done by allocating a number of existing and potential clients to each distribution representative acting in a given area, usually, but not always, established on geographical criteria.

This research considers a real life case design of territory business plan. The plan should consider three main aspects. First, the grouping of customers located in a certain region to a sellers with capacity limitations. Second,

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the weekly schedule plan for visits to fulfill the demand of the customers. Due to customers requirements, the visits should be spread over the week. Finally, the daily route of the seller to visit the customers.

The districting problem considers the location of the customers (such as points in the area or nodes of a network) with a given distance between every pair of points. We wish to find a cluster of customers using the nearest neighbor approach. Therefore, each cluster will represent a seller in the solution. This objective can be interpreted as the tightest cluster of m points. This is similar to the one facility version of the max-cover problem (for a network or discrete formulation [3], for planar models [4], for one facility [5], and for several facilities [6]) where we wish to find the location of several facilities which cover the maximum number of points within a given distance.

Gonzalez-Ramirez [7] analyze a logistics districting problem for package pickup and delivery within a region, motivated by a real-world application. The region is divided into districts, each served by a single vehicle that departs from a central depot. The districting process aims to optimize two criteria: compactness and workload balance, but the problem is formulated as a single objective problem, with the weighted sum of the two criteria under consideration. The authors propose a heuristic solution approach combining elements of Grasp and Tabu Search. This approach doest not consider the scheduling of visits in a given period of time.

Effective scheduling systems aim at matching demand with capacity so that resources are better utilized and waiting times are minimized. Tuga and Emre [8] provide a comprehensive survey on appointment scheduling in outpatient services. The underlying problem applies to a wide variety of environments of outpatient scheduling, and is modeled using queuing system representing the unique set of conditions for the design of the patient appointment. The authors present a complete survey of problem definitions and formulations considering the nature of Decision-Making and Modeling of Clinic Environments. In addition, they mention a variety of performance criteria used in the literature to evaluate appointment systems, which are grouped as: a)Cost-Based Measures, b)Time-Based Measures, c)Congestion Measures, and d) Fairness Measures.

Finally, the goal of the problem described above is to optimize the distribution process from depots to customers (routing design). The main goal is that customer's demand of goods is satisfied without violating any problem-specific constraint. In the literature, these kind of logistic problems are known as Vehicle Routing Problems (VRP). Typically, the objective function is the minimization of the complete distance traveled by the vehicles while servicing all the customers. The VRP is an interesting problem in operations research due to its practical relevance and the difficulty to be optimally solved. Moreover, it is one of the most demanding NP-hard problems [9]. In reality, the task of finding the best set of vehicle tours by solving optimization models has a high computational cost, prohibitive for medium and large real applications.

Caceres et al. [10] present a survey on VRP's applied to real life problems. The authors call these VRP's as Rich (realistic) VRP's (RVRP's) and classify their variants according to the company decision levels and the routing elements involved. A classification that applies for this case study is Multi-Period/Periodic VRP with Multiple Visits/Split deliveries. In this classification, the clients are visited several times as vehicles may deliver a fraction of the customer's demand. Moreover, optimization is made over a set of days, considering a different frequency of visits to each client.

The mathematical formulation of the problem combines objectives and constraints of three classical approaches, the clustering of customers (districting), the scheduling of visits, and the routing plan. Particularities of the modeling approach include scheduling constraints of visits spread over the week, service and traveling times; as well as time capacity to ensure the fulfillment of the customer's demand.

The paper is organized as follows. A general mixed integer linear programming (MILP) formulation for the problem is presented in section 2. Section 3 describes a projection method for large systems of linear equations and two optimization models to cut the problem size and to reduce the solution time. In section 4, the models are tested for different scenarios. Finally, conclusions are presented in section 5.

2. Mathematical Formulation

Consider a set of customers $C = \{1, 2, ..., N\}$ and a set of potential sellers $S = \{1, 2, ..., |S|\}$ dispersed in a given region with geographical coordinates $(long, lat)$. It is desired to design a business plan that defines a minimum number of sellers required to fulfill the customer's demand β. The sellers will attend the demand of customers