Available online at www.sciencedirect.com
ScienceDirect
European Journal of Operational Research 179 (2007) 554–566
EUROPEAN JOURNAL OF OPERATIONAL RESEARCH
www.elsevier.com/locate/ejor

O.R. Applications

A (0–1) goal programming model for scheduling the tour of a marketing executive

M. Mathirajan [a,*], R. Ramanathan [b]

[a] Department of Management Studies, Indian Institute of Science, Bangalore 560 012, India
[b] Nottingham University Business School, Jubilee Campus, Wollaton Road, Nottingham NG8 1BB, UK

Received 5 March 2005; accepted 3 March 2006
Available online 12 May 2006

Abstract

This paper addresses the problem of scheduling the tour of a marketing executive (ME) of a large electronics manufacturing company in India. In this problem, the ME has to visit a number of customers in a given planning period. The scheduling problem taken up in this study is different from the various personnel scheduling problems addressed in the literature. This type of personnel scheduling problem can be observed in many other situations such as periodical visits of inspection officers, tour of politicians during election campaigns, tour of mobile courts, schedule of mobile stalls in various areas, etc. In this paper the tour scheduling problem of the ME is modeled using (0–1) goal programming (GP). The (0–1) GP model for the data provided by the company for 1 month has 802 constraints and 1167 binary variables. The model is solved using LINDO software package. The model takes less than a minute (on a 1.50 MHz Pentium machine with 128 MB RAM) to get a solution of the non-preemptive version and about 6 days for the preemptive version. The main contribution is in problem definition and development of the mathematical model for scheduling the tour.

Keywords: Goal programming; Scheduling; Tour of a marketing executive

1. Introduction

Efficient utilization of executive manpower is always a key concern in organizations. This is one of the most important means to improve productivity. Because of its importance, considerable effort has been devoted to tackling various personnel-scheduling problems in the literature. Personnel scheduling is concerned with the determination of appropriate workforce requirements, workforce allocation and duty assignments in an organization in order to meet its internal and external commitments. Not surprisingly, personnel scheduling has been the subject of much investigation in the literature over the past 30 years with at least one survey article for every decade (Baker, 1976; Tien and Kamiyama, 1982; Bedworth and Bailey, 1987; Bechtold et al., 1991; Ernst et al., 2004a,b; Alfares, 2004).

* Corresponding author. Tel.: +91 80 22932605.
E-mail addresses: msdmathi@mgmt.iisc.ernet.in (M. Mathirajan), ram.ramanathan@nottingham.ac.uk (R. Ramanathan).

0377-2217/$ - see front matter
doi:10.1016/j.ejor.2006.03.025

In this paper, we consider the problem of scheduling the tour of a marketing executive for a large manufacturer of electronic goods in India. Based on our observations in the company and the various personnel scheduling problems addressed in the literature, we feel that this problem differs significantly from many other personnel scheduling problems addressed so far in the literature. We propose a (0–1) goal programming model for solving the problem. Though this article addresses a tour scheduling problem in an industrial setting, the model proposed is applicable for a variety of cases such as periodical visits of inspection officers, tour of politicians during election campaigns, schedule of mobile courts, schedule of mobile stalls in various areas, etc.

The paper is organized as follows: Section 2 presents the problem setting and statement and assumptions. Section 3 provides a related review for the problem. Section 4 describes the development of a mathematical model. Section 5 presents an application of the model using real data from the company. Finally Section 6 presents some concluding remarks and directions for future work.

2. Problem statement

The industrial organization in which the problem was identified is a large manufacturing of electronic appliances. The company sells their products to the real consumers through various dealers (direct customers) and these dealers are scattered over several cities, within cities several areas, etc. This study is related to dealers in a city, Bangalore, India. The policy/practice of the company is to assign marketing executives to make a pre-specified numbers of visits in a planning period at equal intervals of time depending upon the business transaction with customers (dealers). With this problem setting, the problem of tour scheduling of a marketing executive (ME) of the company may be stated as follows:

We have a set of regions $\boldsymbol{R} = \{r_1, r_2, \ldots, r_m\}$ having a number of dealers (customers) in a large city. Each region has a set of customers $\boldsymbol{C} = \{c_1, c_2, \ldots, c_n\}$ and each customer has different level of business transactions with the company. Accordingly, based on the business transactions with the company, the customers are classified as A-type, B-type and C-type, which is similar to ABC-inventory classification (Silver et al., 1998). Thus class A customers have the highest level of business transaction with the company, followed by Class B and C customers.

Each region $\boldsymbol{r}_i$ is covered by a marketing executive. The ME assigned to each region has to visit periodically all the customers clustered in the region. The number of effective working days for ME in a given planning period is obtained after excluding the holidays of the company and the days in which the ME has to make full-day visits to head-office. For each ME, the head-office visit-day varies, except for the last visit, in the planning period. All the marketing executives assemble at the head-office during their last head-office visit towards the end of planning period for a common discussion on the overall marketing strategy. Accordingly, for every planning period and for every ME, the set of days not scheduled for customer visits is $\boldsymbol{M} = \{$holidays for the company, holidays for individual customers, days of full-day visits to head-office$\}$. As per the policy of the company, the number of visits made by the ME to a customer is directly proportional to the customer's level of business transaction. That is, the ME should visit class A customer more number of times in a given planning period compared to the number of visits to class B and C customers. Thus, if ME has to visit each A-type customers $\boldsymbol{N}_A$ times, each B-type customers $\boldsymbol{N}_B$ times and each C-type customers $\boldsymbol{N}_C$ times in the planning period, then $\boldsymbol{N}_A > \boldsymbol{N}_B > \boldsymbol{N}_C$. In addition to the constraint on number of visits to each customer, the company puts a condition that the ME has to maintain a pre-specified time-interval between the consecutive visits of any customer in the planning period. The time-interval between the consecutive visits is a function of effective number of working days available for the ME in the planning period and the required number of visits to a customer. Furthermore, the company specifies maximum and minimum on the number of customers to be visited per day.

3. Related work

Scheduling problems of personnel or staff or tours have been studied for many years as they contribute to the improvement of the overall performance of a system in terms of quality of service to the customer and cost