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Discrete Optimization

Narrowcasting of wireless advertising in malls

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Abstract

Wireless devices are personal, and the advertiser can schedule ads to reach the prospect at the proper time and place, which makes wireless advertising an ideal direct marketing tool. Industry associations, fearing a backlash from uncontrolled spam, have been careful to emphasize opt-ins. Yet the market has been more promise than reality. In spite of the possibilities of personalization, one of the major complaints has been that the ads are not relevant. Proper targeting and scheduling of wireless ads can go a long way to alleviate this problem. In a recent paper [De Reyck, B., Degraeve, Z., 2003. Broadcast scheduling for mobile advertising. Operations Research 51(4), 509–517] discuss a real implementation of wireless advertising in a shopping mall in London, and provide an integer programming model to schedule ads to various segments of prospects over a week. This model was found to be very effective in increasing response rates without saturating the devices with too many ads. We show in this paper that De Reyck and Degraeve's model can be made more effective by utilizing information that is readily available to the advertiser. Our test runs show an improvement in the sum of ad priority value of about 150%, depending on the type of traffic in the mall. We provide two enhanced integer programming models that incrementally use additional contact history information to better scheduling of ads. Results from extensive runs are presented and managerial insights discussed.

Keywords: Integer programming; Optimization; Wireless Advertising; Mobile Commerce

1. Introduction

Rapid growth in technology of wireless networks and mobile devices has fueled an increase in subscriber base laying the foundation for mobile commerce. Mobile commerce applications include mobile financial applications, mobile inventory management, product locating and shopping, wireless engineering, mobile auctions, wireless data centers and mobile advertising (Malloy et al., 2002; Balasubramanian et al., 2002). Many signs indicate that mobile advertising does have a bright future and may be inevitable. Short Messaging Service (SMS), a versatile tool for mobile marketing has tremendous popularity among mobile subscribers. There

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are 2.5 billion SMS messages sent each month in the US (Mobile Marketing Association, 2005), and this number is growing rapidly. Barwise and Strong (2002) report that the low cost and high penetration of SMS among wireless subscribers makes it an attractive tool, not only for ad deliveries but also for most other mobile commerce applications such as mobile auctions, mobile inventory management, etc. (Malloy et al., 2002). Further, market studies have shown that consumers are also willing to participate in permission based wireless advertising (Andersson and Nilsson, 2000; Barwise and Strong, 2002).

Mobile advertising provides an unprecedented level of personalization (Lee and Benbasat, 2003) which is simply not possible when dealing with old media, such as print, TV and even deskbound web surfing. Ironically, one of the major complaints of consumers is that the advertising that is sent to them is not relevant. Even if spam advertising is eliminated, opt-in ads need to be seen as useful and relevant. In a recent work, Haghirian et al. (2005) investigate the factors contributing to the perceived advertising value of mobile marketing by consumers. They argue that the message content turned out to be of greatest importance for the perceived advertising value, while a high frequency of message exposure has a negative impact on it. Marketing research literature is rich in models for optimal mailing and advertising frequency to maximize consumer response (see, for example Piersma and Jedid-Jah, 2004), but these have not been addressed in the context of wireless advertising to date. Marketing research dealing with target marketing issues (Kollat and Willett, 1967; Smith and Cooper, 1997; Stern, 1962) can be related to similar issues in wireless advertising.

Broadcast advertising is not a new problem for advertising industry. There is a rich literature in marketing (e.g. Mahajan and Muller, 1986) and management science (Horen, 1980; Bollapragada and Garbiras, 2004) to deal with issues in scheduling broadcast advertising. However, very little research is available to address challenges in ad broadcasting to *mobile clients*. Since technological developments[1] have provided a means to deliver location specific wireless ads to take advantage of the proximity of the prospects (Varshney, 2003; Rao and Minakakis, 2003), advertisers attempt to deliver time and location specific ads to reap higher benefits (Tripathi and Nair, 2006). Location and time based targeting may be an ideal direct marketing tool for advertisers but, broadcasting ads to mobile customer segments brings unprecedented challenging issues.

Tripathi and Nair (2006) present Markov decision models to schedule wireless ads using customer's real-time locations, historical mobility patterns, available network capacity and a fee structure agreed upon for ad deliveries. In another recent paper, De Reyck and Degraeve (2003) (hereafter, DR&D) discuss a real implementation of wireless advertising in two shopping malls in London. A similar campaign was run in the Palisades Center mall in West Nyack, New York involving 50 retailers (Computer Letter, 2000). The DR&D paper explains that the service provider acted on behalf of the retailers in the mall, and registered 80,000 customers who opted to receive wireless ads after providing information on their demographics and preferences. Customers announced their arrival to the mall and their departure from the mall by sending a text message to the company. In the intervening time, they would receive ads from retailers in the mall every hour on the hour. Since the customers logged on and off the system, it was a fully permission based system. The DR&D paper provides an integer programming model to schedule ads to various segments of prospects over a week. This model was found to be very effective in increasing response rates without saturating the devices with too many ads.

The models we present in this paper improves on the DR&D model by using information that is available in their framework but not made use of in their model. We will show that our enhancements of their model can improve effectiveness, as measured by their metric of total ad priority value, on average by about 150%. We also discuss the impact of traffic patterns, customer types, etc., on the amount of improvement that can result from using our model.

In Section 2, we present the DR&D model and then present two enhanced models. These models leverage information on traffic patterns (visitor counts) to ensure that the same visitor is not repeatedly shown the same ad. The DR&D models also enforce these repetition constraints, but take a conservative approach, since they do not track visitor counts. In Section 3, we explain our model further using a numerical example. In Section 4, we present results and sensitivity to different traffic patterns and repetition constraints. We state our conclusions from this research and provide directions for future work in Section 5.

[1] Snap Track (http://www.snaptrack.com), Cell-Loc (http://www.cell-loc.com), etc.