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Optimal delivery service strategy for Internet shopping with time-dependent consumer demand

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Abstract

This study attempts to optimize a delivery service strategy for Internet shopping by considering time-dependent consumer demand, demand–supply interaction and consumer socioeconomic characteristics. A nonlinear mathematical programming model is formulated for solving the optimal number and duration of service cycles for discriminating strategy by maximizing profit subject to demand–supply interaction. An example is employed to demonstrate the application of the model. Results suggest that discriminating service strategy is a better strategy in response to time-dependent consumer demand than uniform strategy. Finally, the proposed model is demonstrated to yield more profit than models that do not consider variations in consumer demand or demand–supply interaction.

Keywords: Internet shopping; Time-dependent consumer demand; Logistics cost; Demand–supply interaction

1. Introduction

Electronic data interchange (EDI) and related technologies have made it more efficient to transmit information to suppliers. At the same time, information flow-based Internet shopping has markedly improved consumer service by reducing order processing time and providing delivery

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information. Since real-time consumer demand is processed via the Internet, operator inventory costs are reduced by ordering goods from wholesalers or manufactures and shipping them directly to consumers. However, high order frequency and small order quantity that characterize consumer Internet shopping behavior make it expensive to deliver goods to individual consumers (Huppertz, 1999). With fixed transportation costs for each shipment, the average logistics cost per item decreases with increasing shipment size. Therefore, a larger quantity of goods will accumulate with longer shipping cycles, which also results in an increased delay in receiving ordered goods, thus reducing consumer intention to shop via the Internet. The above process involves a trade-off between consumer demands and operator logistics costs.

The goal of delivery strategies is to reduce logistics costs and satisfy consumer needs. A crucial factor in optimizing a delivery service strategy is consumer demand. The assumption of constant demand is highly controversial, since in reality demand varies with time, space, and consumer socioeconomic characteristics. For example, peak demand for food products is likely to occur at lunchtime. Serving consumers via uniform shipping cycles without considering variations in cumulative quantities ordered during each shipping cycle may result in high logistics costs under time-dependent consumer demand. Conversely, shipping cycle has a dramatic influence on consumer intention to shop via the Internet because it determines delay in receiving ordered goods. When a consumer orders goods from an Internet store, they typically receive delivery information with respect to each service cycle, which is posted on the Internet. Upon the completion of the service cycle, the goods ordered during that cycle are shipped to consumers. Thus, service cycles coincide with shipping cycles for Internet store operators. In addition to time-dependent consumer demand, consumer demand for Internet shopping is also characterized by socioeconomic characteristics, and temporal and spatial variations. Even when served by the same service cycles, consumers with different characteristics perceive Internet shopping differently, which may further influence consumer demand for Internet store goods and, thus, profit. In summary, how to determine an optimal delivery service strategy for Internet shopping by considering demand–supply interaction, time-dependent consumer demand and consumer characteristics has become important.

Previous empirical studies have investigated the impacts of delivery-related issues on consumer satisfaction with Internet shopping (e.g., Rabinovich, 2004; Esper et al., 2003; Rabinovich and Bailey, 2004). Studies of consumer choices between shopping modes focused primarily on investigating the influences of demand and supply attributes on consumer intention to shop via the Internet (e.g., Sim and Koi, 2002; Bhatnagar and Ghose, 2004). Some studies have quantified consumer demand for Internet store goods and costs under different shipping strategies (Khouja, 2001; Hsu et al., 2003; Chen, 2001). However, few have integrated issues such as consumer socioeconomic characteristics, time-dependent consumer demand, demand–supply interaction and the 24-h nature of Internet shopping into their models.

Discriminating service strategy proposed in this study differs significantly from the traditional and typical uniform service strategy in which all consumers are served according to the same delivery cycle. Periods with considerable consumer demand suggest that frequent and short service cycles are suitable and may stimulate consumer demand for Internet store goods because of reduced delay in receiving ordered goods; this perspective also implies that long service cycles are suitable when demand is very low. Such an approach would reduce logistics costs and boost profit. The Internet store in this study is assumed to operate as a retailer, ordering a batch of goods from