European Journal of Operational Research 234 (2014) 830–838

Contents lists available at ScienceDirect

European Journal of Operational Research

journal homepage: www.elsevier.com/locate/ejor

Innovative Applications of O.R.

When should service firms provide free experience service?

Wenhui Zhou [a], Zhaotong Lian [b,*], Jinbiao Wu [b,c]

[a] School of Business Administration, South China University of Technology, Guangzhou, Guangdong 510640, China
[b] Faculty of Business Administration, University of Macau, Macau
[c] School of Mathematics and Statistics, Central South University, Changsha, Hunan 410075, China

ARTICLE INFO

Article history:
Received 9 December 2012
Accepted 15 October 2013
Available online 28 October 2013

Keywords:
Queueing
Revenue management
OR in service industries
Experience service
Delay-sensitive

ABSTRACT

By providing a free experience service, a service firm can attract more uninformed customers. However, it could reversely effect the delay-sensitive, informed customers' decision. In this paper, we study a priority queueing system with free experience services. We study the customer behavior in equilibrium after we derive the expected customer waiting time. We then construct the service firm's revenue function and obtain an optimal strategy for the service firm. Our results suggest that when the market size of informed customers is relatively small, the firm should consider providing free experience services for uninformed customers. Conversely, if the demand rate of potential informed customers is quite high, the firm should ignore uninformed customers.

1. Introduction

It is widely acknowledged that customer experience service is the sum of all experiences a customer receives from a supplier of services or products, over the duration of their relationship with the supplier. Customer experience has an important impact on many customer behaviors such as: discovery, attraction, awareness, joining, balking, interaction, purchase, use, cultivation and advocacy. Furthermore, it can also be considered an individual experience over one transaction. The customer experience service is a journey to make customers, according to their standards, happy, satisfied, justified, respected, served and cared for, from the minute they start a relationship with the supplier. The customer experience has emerged as the most important aspect in achieving success for companies across almost all industries, especially the service industry (Peppers & Rogers, 2005). For example, Starbucks spent less than $10 M on advertising from 1987 to 1998 yet added over 2000 new stores to accommodate growing sales (Gilland & Warsing, 2009). In addition, providing free experience service may also increase the revenue of the firm by attracting uninformed customers to purchase service, especially when there is a scarcity in informed customers. For example, video game sellers can grant consumers limited access to their products prior to its launch and enable consumers to gain partial experience (Chu & Zhang, 2011). However, it is also possible that the experience service increases the informed customers' waiting time, and may result in non-purchase.

In this paper, we consider a service firm which simultaneously provides service for informed customers and provides free experience service for uninformed customers. The informed customers are fully informed about the service and delay sensitive. We assume that the service firm is a monopoly in the sense that it provides exclusive service to a designated region, or there is little competition for the service provided. The customers in the waiting room queue up in order to receive the regular service as soon as it is unoccupied. Being uninformed about the formal service, all arriving uninformed customers will attempt to receive experience service. After the experience service, some of them depart, but the rest continue with the regular service. To simplify the model, we assume that there is only one server in the system. That is, this is an $M/M/1$ priority queueing model with informed customers and uninformed customers. The informed customers have higher priority, but cannot interrupt the uninformed customers who are receiving service (see Fig. 1). Our objective is to help the service firm figure out an optimal service strategy to maximize the expected revenue.

Our paper is related to several research streams, including: experience service and pricing with delay sensitive customers. We now briefly review each of the research streams below. When there are uninformed customers in the market, one approach that has been widely utilized in the operations literature is to provide experience service or goods for the uninformed customers. Experience service has been extensively studied from one of two viewpoints: customer learning and free riding. Ackerberg (2003), Crawford and Shum (2005), and Osborne (2005) model a customer learning process by using information transfer, in which, experience service is adopted to control the customers' valuation. The

* Corresponding author. Tel.: +853 8397 4163.
E-mail address: lianzt@umac.mo (Z. Lian).

0377-2217/$ - see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.ejor.2013.10.036

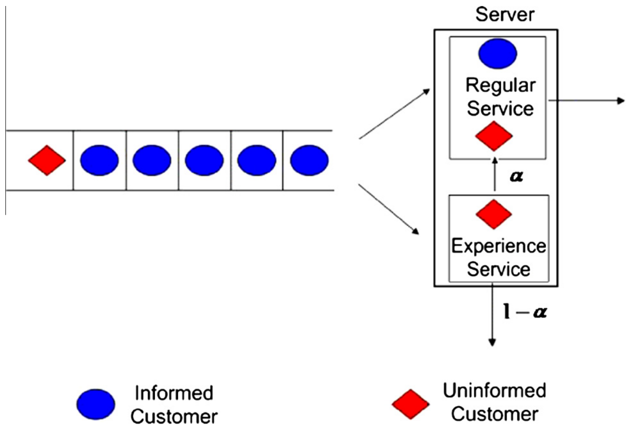

Fig. 1. The structure of the system.

other common phenomenon related to experience service is free riding defined as a customer's behavior in which he/she experiences service in one place while purchasing service in another place. For example, a customer takes experience service from the bricks-and-mortar retailer while buys the product from an online retailer. Most works claim that free riding would hurt the profit of the firm providing free experience service when there is price competition, as in Antia, Bergen, and Dutta (2004) and Carlton (2001). Shin (2007) shows that free riding can be considered as a necessary mechanism that prevents an aggressive response from another firm and reduces the intensity of price competition. As shown in all the works on service experience, providing experience service for the uninformed customers will increasing revenue of either the service provider or the free rider. On the other hand, providing experience service for the uninformed customers increases the service load, which would affect informed customers' purchasing decisions, especial when the informed customers are sensitive to the delay.

When facing delay-sensitive customers, not only the price but also the delay of the service system affect customers' purchase decision. In this case, the service firm should carefully post price and control service load. Naor (1969) was first to study the interaction between the price and queueing effect. In the precursory work, Naor studied an observable $M/M/1$ queueing system with a single class of customers and assumed that the customers have a constant perceived value for the service and a constant unit delay cost. Furthermore, the author showed that the social optimality, the individual optimality of the customers, and the revenue-maximizing strategy of the firm do not align with each other, and the monopolistic firm would set a higher price than the one under social optimality. Knudsen (1972) generalized Naor's result to multi-servers queue with a nonlinear waiting cost function. Edelson and Hildebrand (1975) investigated Naor's model with an unobservable queue, i.e., customers cannot observe the current state of the queue and make their purchasing decision based on their expected waiting time. Other extensions of Naor's model include De Vany (1976), Lippman and Stidham (1977), and Hassin (1986). For a comprehensive review on pricing with queueing effect, the reader may refer to Hassin and Haviv (2002) and Stidham (1992). Chen and Frank (2004) gave an optimal pricing strategy for the monopoly service firm by assuming that there are only informed customers in the market. Afèche and Mendelson (2004) investigated a uniform price and priority auction with continuum classes of informed customers that have different service values and delay costs. Gilland and Warsing (2009) studied two priority queues with continuum classes of informed customers and no balking, and presented the optimal priority decision under the assumptions of self-interest customers and coordinated customers. Guo, Sun, and Wang (2011) gave the equilibrium joining behavior of the customer in a queueing system, when the customers have partial information on service times distribution such as moments and the range. Economou and Kanta (2011) and Wang and Zhang (2013) studied the customer equilibrium and socially optimal balking behavior for unobservable and observable single-server retrial queues. Boudali and Economou (2012) investigated the balking strategies of the customer in a Markovian queue with catastrophes. In their work, the customers not only care about the waiting time in the system, but also concern the unreliable server.

In this paper, we assume that there are both informed and uninformed customers in the system, and the informed customers are sensitive to the delay. As a result, there is an interaction between the informed customers and the uninformed customers. That is, the purchase decision of an informed customer will be affected by the uninformed customers who cause the additional delay of the former. We first develop a priority queueing model to get the expected waiting time of informed customer, and then construct a game model to analyze the equilibrium customer behaviors. Based on this, we study the optimal strategy for the firm. In contrast to the previous literature on the interaction with price and congestion, we focus on the interaction between informed and uninformed customers. Our work can be considered as an extension of Chen and Frank (2004) and Gilland and Warsing (2009). Similar to their works, we also consider a pricing problem of a monopoly firm. Additionally, we study the firm's optimal decision on providing experience service. To our best knowledge, our paper is probably the first one addressing the issue involving both service pricing and experience service with sensitive customers. The main contribution of this paper is that we have answered the following questions: In what case should a service firm provide the uninformed customers with free experience service? If the firm is not supposed to provide free experience service, should the firm provide regular service to all potential informed customers or only part of them, and what is the optimal service rate and what is the optimal service price? The main results are given in Theorem 2.

The rest of the paper is organized as follows. In Section 2, we describe the system as a mathematical model. In Section 3, we analyze the priority queueing system and derive the expected waiting time of the informed customers. In Section 4, we present the results on the optimal strategy of the firm, which are presented for the two cases separately. Numerical examples are given in Section 5 and we conclude the paper in Section 6. All the proofs of the lemmas, theorems and propositions are in Appendix A.

2. Model description

In practice, it is more common to model the system as a queueing network service system with multiple servers (for example, Gong, Lai, & Wang, 2008). To simplify the model, we follow the assumption of many other references, for example, Chen and Frank (2004), Gilland and Warsing (2009), and Economou and Kanta (2011), etc. We consider a capacity-constrained service firm in the market, which can be modeled as an unobservable $M/M/1$ queueing system with service rate μ_n. The firm posts a uniform price p for the customers who require service. There are two classes of customers: informed and uninformed customers. Similar to Chen and Frank (2004), we assume that the informed customers have sufficient knowledge about the service and have the same perceived value on the service, say, R. Furthermore, the informed customers are sensitive to delays and the delay cost is in proportion to the waiting time in the system. Denote by d the delay cost per unit of time for an informed customer. The potential informed customers arrive according to a Poisson process with rate Λ.