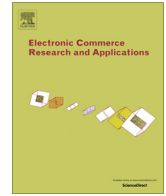




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Improving the multidimensional sequencing of hotel rooms on an online travel agency web site



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ABSTRACT

The focus of this study is customer behavior during the process of booking a hotel through online travel agencies (OTAs). We developed a stochastic programming model to design the optimal sequence of hotels that enables customers to find hotels at the minimum search cost and maximum utility gained from hotels. The number of available hotels in the sequence was strategically decided to minimize search cost. We considered the multidimensional preferences of customers, including price, star rating, review rating, and reservation price. We collected customer information through a survey and took hotel information from a selected OTA. This information was then used through numerical simulations to test the performance of the modeling approach. The results suggest that hotels with higher utility, review rating, star rating, and price should be ranked in the upper position of the sequence. We highlight an application of the proposed model that can help improve hotel performance in today's competitive market.

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1. Introduction

The tourism industry has driven economic activity in many countries. The [World Travel and Tourism Council \(2015\)](#) reported that the tourism industry contributed 9.8% of the GDP in 2014, a figure that is forecasted to reach 10.5% by 2025. Online travel agencies (OTAs) have been a major channel for travel distribution, representing 38% of the global online market and 13% of the total market ([PhoCusWright, 2014](#)). A hotel is a top tourism product sold through the online channel, and its online sales have accounted for US\$164 billion with a 23% penetration rate ([Euromonitor International, 2014](#)).

In recent years, the Internet has changed the way customers behave when they search for travel information ([No and Kim, 2015](#)). Due to the intangibility of a travel product prior to purchase, and to the complex choice involved, customers must deal with perceived risk from a poor purchase decision that may result in an unfavorable experience ([Lin et al., 2009](#)). Moreover, the information overload on OTAs can lead to ineffective decision making. These problems significantly affect the online travel booking experience, especially when the price of a travel product is expensive.

Perceived risks in the purchase of online travel products includes performance risk, financial risk, physical risk, psychological risk, social risk, time risk, and security risk ([Lin et al., 2009](#)).

In our study, we investigated customer behavior in the process of booking a hotel through OTAs. OTAs present a sequence of available hotels along with hotel information and online reviews. The hotel sequence is normally sorted by one-dimensional attributes such as price, distance, and review rating. The current sorting procedure of most OTAs is somewhat limited when it comes to meeting the expectations of customers because each customer will have multiple, highly specific preferences (price, star rating, review rating, reservation price, etc.). The position of hotels in the sequence has an effect on the booking decision, as the hotels placed at the top positions are the preferable choices. Customers evaluate the online product on the basis of the presentation of the product list and the information available on the web page. Thus, ineffective sequencing of hotels can lead to an unfavorable hotel experience if customers unknowingly book an unfavorable hotel. Moreover, a large number of available hotels on OTAs increases the search cost and exceeds the limits of human cognition. In practical terms, this means a customer may fail to notice a satisfactory hotel if that hotel is placed at the bottom of a long sequence. The number of hotels in the sequence has to be strategically optimized in such a way as to balance the quality of available hotels with the search cost.

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To address these issues, we propose a new approach to understand what customers need and have designed an optimal sequence with the optimal number of hotels to meet the multidimensional preferences of different customers. OTAs can adopt the proposed method and implement in their hotel sequencing mechanism to improve customer searching experience. For a hotel, maintaining a competitive advantage is the key to surviving in today's market. Performance improvement, while necessary, takes a lot of effort, has a long lead time, and requires a large investment. It is essential to develop a decision tool to evaluate the marketing position and suggest possible ways to improve the performance. Our model can help a hotel analyze its competitive position in the market and thus provide useful guidelines for improving the performance so that the reservation rate can be increased.

In summary, this research aims to present a theoretical work to optimize the experience of customers who visit OTAs. We expect that it can promote a more accurate understanding of profitable design for OTAs. Even though our work falls into a category of a theoretical study, we incorporate the important parameters derived from several surveys including the one we conducted to reflect actual behavior of customers at online hotel booking sites. Another objective aims to apply the proposed model to provide improvement suggestions to hotels competing in today's online market. Thus, this research aims to meet the expectations of the current tourism industry.

Many researchers have studied hotel selection factors. The importance of hotel attributes in terms of the booking decision varies depending on the type of traveler (Yavas and Babakus, 2005), the region (Li et al., 2013), customer characteristics (Prud'homme and Raymond, 2013), and gender (McCleary et al., 1994). Chu and Choi (2000) found that business travelers concentrate on room and hotel appearance while leisure travelers focus more on security. Interesting analyses of the influence of hotel attributes on the selection of a hotel can be found in Masiero et al. (2015) and in Chu and Choi (2000). Sohrabi et al. (2012) pointed out that protection and security, promenade and comfort, network, staff and services, news and recreational information, pleasure, cleanliness and room comfort, expenditure, room facilities, and car parking are all perceived as major attributes for hotel selection.

Online reviews play an important role in travel planning, as well. A survey by Gretzel et al. (2007) revealed that 97% of respondents read online reviews, with 58.1% of the reviews being those on sites managed by OTAs. The readers of online travel reviews have indicated that the reviews are quite important when it comes to making their hotel booking decision. For example, it helps them increase their awareness of the hotel, compare hotel choices, avoid unsatisfactory choices, narrow down choices, and perceive credibility (Cantalops and Salvi, 2014; Gretzel et al., 2007). The quality of a hotel can be evaluated by its star rating and review rating, in which the review content provides the details of previous customers' experiences (Fang et al., 2016). The review rating, scored on a scale of 1–5, presents a summary of traveler votes. It has been effectively used in the process of hotel evaluation in many studies. For example, a positive relationship between review rating and online hotel sales was reported by Singh and Torres (2015). Ögüt and Taş (2012) found that a 1% increase in a review rating could increase the online sales of a hotel up to 2.68% in Paris and 2.6% in London.

The overall review rating is perceived as the most important factor determining hotel performance, in which the ratings for money value, location, and cleanliness are the key attributes (Xie et al., 2014). Using the eye-tracking approach, Noone and Robson (2014) found that a customer looks at the hotel information and review rating during the process of hotel evaluation. Moreover, Casaló et al. (2015) found that the review rating list has an effect

on the customer's booking attitude in the sense that hotels appearing in the best hotel rating list are perceived as having a higher booking intention. Review ratings are typically more useful and credible when they appear on well-known online travel communities such as Trip Advisor. The effect of online reviews has been analyzed in many studies. Sparks and Browning (2011) revealed that the valence of a positive review increases the booking intention and trust in a hotel. However, a consumer is more influenced by early negative information, especially when the valence of reviews is negative. The work of Casaló et al. (2015) also supports the finding that negative reviews have a significant effect on travelers with higher risk aversion.

Product sorting and recommendation tools have been mentioned in many studies. Effective design and presentation of product lists on an online shopping web site is quite important (Hong et al., 2004), and product lists and web interface design play a key role in online shopping behavior because customers evaluate the products on the basis of information available on the sites (Bettman et al., 1990; Tam and Ho, 2005). Most customers generally search for a few choices on a list of available choices in which a choice ranked on the upper position is more attractive (Tam and Ho, 2005). The importance of order effect (e.g., the effect of position and sorting) on online retailing and search behavior has been discussed in many studies (Cai and Xu, 2006; Diehl and Zauberman, 2005).

It is also important to note that human attention is limited when faced with a long list of available choices. Recommendation systems are useful for recommending the most attractive choices. They can facilitate the processing of information, resulting in shorter lead time for a booking and a tailoring to the customer's preference (Nilashi et al., 2015). Senecal and Nantel (2004) found that online product recommendations influence customer choices and also that online retailer recommender systems have a greater effect on the potential choices than recommendations from human experts or other customers. Tam and Ho (2005) found that the presence of sorting could attract customer attention: specifically, 37.50% of target objects were clicked when they were on the top of the sorting cue while only 15.19% of the same objects were clicked when no sorting was in place.

Various approaches for developing a sequencing and recommendation system can be found in the literature. Ghose et al. (2012) proposed a hotel ranking system that mines user-generated and crowd-sourced content to recommend the best value hotel. Ngai and Wat (2003) proposed a hotel advisory system that takes a fuzzy expert approach to hotel selection. Liu et al. (2013) proposed a novel recommendation algorithm based on the analysis of online reviews in the restaurant industry. Nilashi et al. (2015) developed a multi-criteria collaborative filtering recommender system for hotel recommendation using a Gaussian mixture model with an expectation maximization algorithm and an adaptive neuro-fuzzy interface system. Other approaches for developing a recommendation system can be found in Ładyżyński and Grzegorzewski (2015) and in Vansteenwegen and Souffriau (2010). There is also the recommendation approach of Liu and Yang (2015) and Mao et al. (2015), which is mainly based on ranking algorithms. Web site design is considered a key factor determining online hotel booking intention, customer satisfaction, and e-Trust on OTAs. Another major component for a quality web site design is the utilitarian feature, which refers to the efficiency of supporting and fulfilling what the customer needs (Bilgihan and Bujsisic, 2015).

However, prior studies on recommendation systems have ignored the recommendation of set size. The number of available choices is related to cognitive load and the decision process. This is quite important, especially on OTAs, as they collect the information of millions of hotels around the world. The suitable number of

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