

Online Purchase Paths and Conversion Dynamics across Multiple Websites[☆]

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Abstract

Low transportation costs online allow shoppers to visit multiple e-commerce sites for a purchase decision. This research investigates online shoppers' visit and purchase behaviors across competing websites. To consider that shoppers' longitudinal cross-site visit data may consist of several unobserved shopping episodes, we propose a modeling approach to probabilistically clustering and relating online visits to latent shopping episodes, based on the temporal patterns of the visit events. The inferences are then used to examine shoppers' visit-to-purchase behavior across websites. Using Internet clickstream data on individual-level browsing and transaction records at major air travel sites, we find that online shoppers' cross-site visit patterns tend to be clustered and the purchase propensity is significantly higher at later visits within a visit cluster, compared to earlier visits. As our results suggest the possibility that visit clusters can serve as a reasonable proxy for shopping episodes, we look further into shoppers' website choice and purchase behaviors within a cluster. We discuss how the cluster-based analysis can help managers tailor online marketing and advertising strategies based on shoppers' cross-site visit and purchase patterns.

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Introduction

With the phenomenal popularity of the Internet, consumers have been actively utilizing online channels for their shopping. Naturally, e-commerce has grown into a significant portion of the retail business. Global online retail sales are estimated to be \$1.671 trillion in 2015, accounting for 7.4 percent of total retail sales, and projected to reach \$3.578 trillion by 2019 with a 21 percent compound annual growth rate, outpacing brick-and-mortar sales growth by a more than three-to-one margin (*eMarketer* 2015).

The remarkable success of online retailing has motivated substantial research on it. Prior studies examine online shoppers' purchase behavior by accounting for the sequence of pages viewed or tasks completed at a website (e.g., *Montgomery et al. 2004; Sismeiro and Bucklin 2004*), the cumulative effect of visits made between purchases (e.g., *Moe and Fader 2004*), shoppers'

cognitive style and website design (e.g., *Hauser et al. 2009*), the effect of consumer reviews (e.g., *Zhu and Zhang 2010*), the association of visit patterns and purchase behavior (e.g., *Park and Park 2016*), and the effect of search refinement tools (e.g., *Chen and Yao 2016*). While existing studies shed light on our understanding of online shopping behavior, the majority of them use data pertaining to a single retailer and hence focus on customer behavior at the website. Accordingly, there is a dearth of research on how Internet users browse and shop across competing websites, despite the fact that online shoppers often visit multiple e-commerce sites for a purchase decision. This research addresses this void by utilizing cross-site Internet clickstream data and examining online shoppers' visit-to-purchase behavior across websites.

Consider an example of online shopping behavior, depicted in *Fig. 1*. The figure illustrates a series of visit and purchase events, made by an individual, at three websites that market consumer products in the category considered in this research. A ● symbol indicates that the individual visited an online store, and a P symbol indicates that she made a purchase at a given visit. As shown in the figure, the online shopper repeatedly visited the websites by turns over time. Apparently, data collected only at a single

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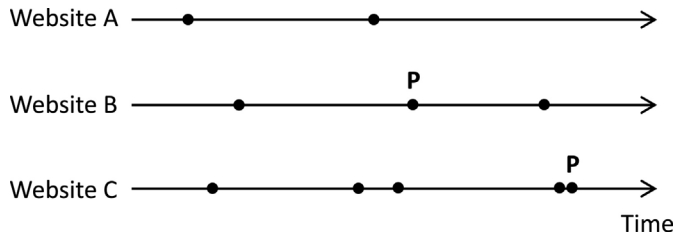


Fig. 1. Online shopping behavior across websites.

website are incomplete and would provide a limited picture of the individual's shopping behavior. In particular, if the shopper visited different websites for the same purchase decision, the effects of those visits may accumulate and her purchase propensity would evolve as she progresses through the visits made within the shopping episode. Accordingly, accounting for the cross-site shopping dynamics could help better understand and predict the shopper's purchase behavior.

Given the advance of information technology, online shoppers' browsing records across websites have become increasingly available (e.g., Danaher 2007; Park and Fader 2004). Yet, a genuine challenge arising in analyzing the cross-site shopping data is that we do not observe the underlying shopping motivations of individuals that have driven their online visits and hence which visits constitute a certain shopping episode. For example, in Fig. 1, we do not know whether the shopper's first two visits to websites A and C were made within the same shopping episode (i.e., for the same purchase decision) or the visits were driven by different shopping goals. Because we do not observe at which visit each shopping episode begins and ends, it is questionable how a series of online visits by an individual should be partitioned and attributed to purchase transactions, which is an essential aid to the investigation of her visit-to-purchase behavior.¹

To consider that online shoppers' cross-site visit data may consist of multiple unobserved shopping episodes, we propose a modeling approach that probabilistically clusters and relates online visits to latent shopping episodes, based on the temporal patterns of the visit events. Extending the framework developed by Park and Park (2016) who utilize shoppers' visit patterns at a single website to a multi-site context, our approach is based on the notion that, in an individual's visit process to a set of competing websites, the overall visit rate is higher while she is in an active shopping mode within a shopping episode, compared to the visit rate between different episodes (i.e., between the last visit in one shopping episode and the first visit in the subsequent episode). Accordingly, given that the shopper's website visits that constitute the same shopping episode are likely to appear as a cluster of visits in her visit process, we infer the formation of visit clusters at the individual level and use the inferences to examine cross-site visit and purchase dynamics.

¹ One way of identifying visits made within the same shopping episode would be to look into the content of webpages or URLs viewed by a shopper at her visits to all websites. However, as Moe and Fader (2004) have pointed out, in practice, it is very costly and difficult to maintain and manipulate such sizable databases.

To demonstrate the applicability of our model, we use Internet clickstream data on users' browsing and transaction records at major air travel sites. Our analysis of the data reveals that online shoppers' cross-site visit patterns tend to be clustered with considerably higher visit rates (the mean intervisit time of 11.4 min) within a visit cluster and lower visit rates (the mean intervisit time of 29.7 days) between clusters. Using the inferred formation of visit clusters, afforded by our model, we find that the conversion rates are higher at later visits within a cluster, compared to earlier visits. Along this line, we also find that taking the clustered patterns of cross-site visits into account helps better predict online shoppers' purchase decision at a website.

As our results support the efficacy of the proposed approach to clustering cross-site visits to consider online shoppers' multi-site visit tendency for a purchase decision, and suggest the possibility that visit clusters can serve as a reasonable proxy for unobserved shopping episodes, we look further into individuals' cross-site shopping behavior within a visit cluster. We find that shoppers' choice likelihood of websites, as well as the purchase propensity at each website, varies substantially across visits within a cluster, indicating that different websites play different roles on shoppers' purchase paths. Based on the results, we discuss how our cluster-based analysis of cross-site shopping behavior can help managers tailor online advertising and communication strategies at both the website and individual shopper levels.

In sum, our research contributes to the literature by investigating online shoppers' visit-to-purchase behavior across competing websites, an underexplored area of research despite the prevailing tendency of Internet users to browse multiple websites for shopping. Given that shoppers' cross-site visit process may consist of several unobserved shopping episodes and their multi-site visit tendency for a purchase decision is likely to result in clustered visit patterns, we propose a modeling approach to probabilistically relating online visits to each other, based on the temporal patterns of the events. We demonstrate the usefulness of the resulting inferences on visit clusters in examining shoppers' cross-site visit and purchase behaviors, understanding the roles of competing websites on the conversion process, and thereby developing and customizing online marketing approaches.

The remainder of this article is organized as follows. First, we provide the conceptual background that motivates our modeling approach. We next formally lay out the model. This is followed by a description of data used in our empirical analysis and a discussion of model results. We conclude with the limitations of this research and directions for further work.

Conceptual Background

One of the prominent characteristics of online shopping, compared to its offline counterpart, is the low transportation costs required to visit a retailer's website (e.g., Bakos 1997; Moe and Fader 2004). As it is significantly cost-efficient to browse into an online store, shoppers often visit multiple websites for a single purchase decision, and conduct various types of preparatory activities, such as comparing the specification and price

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