Path to Purchase: A Mutually-Exciting Point Process Model for Online Advertising Responses

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Abstract

This paper investigates the effects of consumer's sequential interactions with major online advertising vehicles (e.g., paid search and display banner ads) on their purchasing conversion. For example, an early click on a display banner ad may not directly lead to a purchase. However, it may cause subsequent internet searches, which in turn leads to a conversion. Hence, it calls for elaborate modeling approaches in order to properly attribute the conversions across the entire history of consumer interactions with different online advertising vehicles. We develop a mutually exciting point process model to analyze data on online advertising intervention and consumer purchase. An event (e.g., a click on a banner ad or a purchase) is modeled as a random point on the time line. The occurrence of every point influences the likelihood of the future occurrence of points of the same or different types. We also account for consumer heterogeneity and hence develop a hierarchical Bayesian model for the mutually exciting point process. We show that the effectiveness of display banner ads can be underestimated unless such sequential effects are properly accounted for. We also show that our proposed model has good predicative performances.

Keywords: point process; mutually exciting; online advertising; purchasing conversion; Bayesian inference