



Modeling brand post popularity dynamics in online social networks



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ARTICLE INFO

Available online 13 May 2014

Keywords:

Online social networks
Social media marketing
Crowdsourcing
Brand post popularity
Brand-generated content
Hawkes point process

ABSTRACT

Today's social media platforms are excellent vehicles for businesses to build and foster relationship with customers. Companies create official fan pages on social network websites to provide customers with information about their brands, products, promotions, and more. Customers can become fans of these pages, and like, reply, share or mark the brand post as favorite. Marketing departments are using these activities to crowdsource marketing and increase brand awareness and popularity. Understanding how crowdsourcing oriented marketing and promotion evolves would be helpful in managing such campaigns. In this paper, we adopt a multidimensional point process methodology to study crowd engagement activities and interactions. Specifically, we investigate the brand post popularity as a joint probability function of time and number of followers. One-dimensional and two-dimensional Hawkes point process models are calibrated to simulate popularity growth patterns of brand post contents on Twitter. Our results suggest that the two-dimensional point process model provides a good model for understanding such crowdsourcing behavior.

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1. Introduction

The emergence of Internet-based social media has started a new kind of conversation among consumers and companies, challenging traditional ideas about marketing and brand management while creating new opportunities for organizations to understand customers and connect with them instantly [56]. Research firm Chadwick Martin Bailey in partnership with Constant Contact conducted a study that analyzed the behavior of 1491 consumers ages 18 and older throughout the U.S., and revealed that a whopping 77% of consumers interact with brands on Twitter or Facebook primarily through reading posts and updates from the brands. They also noted that 60% of social customers are more likely to recommend a brand to a friend after following the brand on Twitter or Facebook, and 50% of them are more likely to buy from that brand as well. When it comes to “Liking” brand posts on Facebook, the reasons are varied, but for the most part, respondents said they like a brand on Facebook because they are a customer (58%) or because they want to receive discounts and promotions (57%) [21].

Today, the customer experience shared through social media, blogs and discussion forums is becoming a major driver of purchasing decisions, because these platforms provide consumers a more influential voice in effecting changes in their own customer care [15]. Barnes' research [9] indicates that 70% of consumers use social media platforms “at least some of the time” to learn about the customer care offered by a

company before they make a purchase. Furthermore, of them, 74% of customers choose companies based on customer care experience shared by others in online forums.

Over the past few years, big brands have started taking social media seriously, and social media marketing has been an inevitable part of their marketing plan. For example, Coca-Cola, one of the world's most recognizable brands, had 800 fans on Facebook in 2007, 16.5 million in 2010, and it has currently crossed over 62.3 million “likes”. In 2012, in honor of the Coca-Cola Facebook page becoming the first retailer brand to receive 50 million “likes”, Coca-Cola developed a new Facebook application to identify and support individuals developing, influencing and shaping ideas and ask them to collaborate with the Facebook community to spread them globally. Through this application, Coca-Cola teaches the world to sing in perfect harmony, mobilizes millions of people behind their favorite cause, and encourage them to become more active and socially involved. As an end result, consumers become involved in suggesting modifications of products and services and the distribution of these innovations [11,12].

Starbucks, as one of the top ten most followed brands on Twitter, uses tweets to share knowledge with customers and promote their latest products, campaigns and events [20]. With an average of ten tweets per day on Twitter, Starbucks extracts relevant knowledge from a network of current and prospective customers around the globe who express their expectations, likes and dislikes about the brand [20,48].

In 2010, Delta Airlines launched the first social media “ticket window” on Facebook which allows customers to book a flight without having to go to any other website. Delta pointed out Facebook is being used by more customers while in flight than any other Web site, making

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it a “natural launching point” for its initiative [8]. Access to OSNs on mobile devices has certainly accelerated the popularity of OSNs.

As more and more major brands have established their communities and fan pages within online social networks (OSNs) and started offering commerce opportunities delivered through social media platforms, crowdsourcing applications have become some of the most engaging tools in digital marketing realm, enabling brands to realize the potential for their fans' input into the product development and the market development processes [36]. Such innovative and creative initiatives enable businesses to improve their products, get brand recommendations, increase brand awareness and popularity, find new customers or even excite a specific demographic. In many cases where fans within social media are particularly passionate about a brand and its products, there will be a clear desire to become part of the product itself, have input as a group and energize the brand and its product lines [57].

Today's openness and flexibility of OSNs provide brands with a huge opportunity to get in touch with customers, crowdsource marketing tasks and enhance brand awareness. Understanding the structure and behavior of the fans on OSNs is important to the content providers to enable better organization of brand post information, design of effective online communities and for implementing successful marketing campaigns. In examining the online social interaction structures, the formation of relationships and interactions, how information moves on social media platforms, and how users respond to various stimuli like video, contests, or posts are not clearly understood. The answers to these questions will offer a more complete picture of the social dynamics of networking and how individuals manage their virtual relationships and follow their favorites or brand communities, or how they influence their friends to become followers as well. In this paper, we model the spread of information across Twitter, the most popular and widely used micro-blogging online social network [37] and analyze the data from a number of brand posts to discover what rules might govern the spread of information online. By understanding these behaviors, companies can become more effective in designing marketing campaigns. Being able to analyze a social network of customers, how customers interact on this type of platforms, and what rhythm and timing of the most engaging postings look like provides brands a competitive advantage through forecasting the spread of brand influence, and intervening at times with promotions to foster relationship with customers.

The timing pattern of human communication in online social networks is not random. It has been shown that the communication is explained by emergent statistical laws such as non-trivial correlations and clustering [55]. With the possibility of analyzing the multivariate distribution of the occurrences of activity on OSNs, we can add to our understanding of these interactions.

Standard models assume a Poisson distribution for events occurrence, which is an unrealistic assumption in many social systems. Point process has shown promise for modeling social event patterns where the occurrence of an event increases the likelihood of subsequent events [22]. It is a novel way of modeling and clustering high frequency and irregular data in time. It uses a branching structure that corresponds to background events and offspring events and is able to capture bursts of activity, dynamics and reactions over time.

In this paper, we model the popularity of a brand post or more generally an online content on online social networks. The popularity of an online content is not a well-defined, but a highly subjective term [39]. Brand post popularity can be defined as a mixture of various factors such as vividness, interactivity, the content of the brand post (information, entertainment), and number of times the brand post is mentioned by fans [25]. We take the position of an individual user's eyes who conjectures the popularity of a brand's tweet from publicly observable data by associating the number of impressions it has received (including total number of retweets, replies, favorites) or the lifespan of threads over its entire timeline. A tweet is considered a popular tweet if it receives a certain amount of retweets, replies, and favorites that are

no less than a certain threshold over its lifespan [40,43]. Our goal is to develop a mechanism for capturing the evolution of the online content popularity posted by brands on OSNs. In our approach, a model is specified via the conditional intensity for each event. This provides a powerful and more natural modeling framework for multivariate social network event data. Specifically, the current study examines the influence of user activities on the timing and frequency of a brand post. The self-exciting Hawkes point process and the ETAS (Epidemic Type Aftershock Sequences) models are used to analyze data on brand posts popularity. Unlike Poisson processes, Self-exciting Hawkes point process and ETAS are classified as counting processes which are basically a continuous-time non-Markov chain due to the dependence on the history of the process (i.e. H_t) to the extent to which having states 0, 1, 2, ... moving from state n to state $n + 1$, where $n \geq 0$. In case of the content popularity problem, each state indicates total number of users who hit the content by time t , and $\lambda(t)$ is the transition rate of moving from one state to another state.

The remainder of the paper is organized as follows. The next section starts with a discussion of online social networks (OSNs). We also review literature about stochastic point processes and their many uses. The following section describes how we map the content popularity to the point processes framework. Also, we introduce brand post data collected from Twitter and the assumptions necessary to proceed with analysis. In Section 4, we fit competing models to data and then compare the accuracy and complexity of models in capturing the burst of activity on OSNs. The managerial implications of our findings, limitations and possible directions for future work are discussed in Section 5. The final section presents a general conclusion of the paper.

2. Review of the literature

2.1. Online social networks

During the past few years, millions of people have used social media applications (Facebook, Twitter, YouTube, Google +, etc.) as a part of their daily online activities [30]. In 2011, more than half of social media users followed brands on social media sites, and brands are increasingly investing in social media to crowdsource marketing activities, indicated by worldwide marketing spending on social networking sites of about \$4.3 billion [25].

Today companies develop official fan pages and online communities within online social networks to understand customers, connect with them instantly and provide them with information about their brands, products, promotions and more. Meanwhile, brand fans can like, comment and share brand posts. Users of Twitter can retweet, which is much like a Facebook share. Followers retweet the tweets of those they are following to propagate information to other people. People respond to popular users by “replying” and/or “mentioning” [7]. Followers can also mark the content as favorite which is functionally similar to the “like” action on Facebook. The “like” and “retweet” buttons are the easiest ways for Facebook and Twitter users respectively to join in on the brand conversation and give feedback. Comments/replies on brand posts can be positive, neutral or negative. In most cases, social media users who choose to become fans of a product are those who are particularly passionate about a brand and its products and enjoy having input or being a member of a group of like-minded fans. The brand benefits from these fans because they help communicate with a diverse audience of other consumers.

Such individual activities associated with a brand post are visible to network friends and many times influence friends to retweet, like, or mention. If a company produces fan page updates that earn high quality scores, they will reap the benefits of greater exposure and possibly an increased fan base because other network members will see in their news feed. Jansen et al. [38] discuss OSNs as a form of electronic word of mouth (eWOM) for sharing consumer opinions concerning brands and as a part of an organization's marketing strategy. This openness

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