



The influence of reviewer engagement characteristics on online review helpfulness: A text regression model[☆]



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ABSTRACT

The era of Web 2.0 is witnessing the proliferation of online social media platforms, which develop new business models by leveraging user-generated content. One rapidly growing source of user-generated data is online reviews, which play a very important role in disseminating information, facilitating trust, and promoting commerce in the e-marketplace. In this paper, we develop and compare several text regression models for predicting the helpfulness of online reviews. In addition to using review words as predictors, we examine the influence of reviewer engagement characteristics such as reputation, commitment, and current activity. We employ a reviewer's RFM (Recency, Frequency, Monetary Value) dimensions to characterize his/her overall engagement and investigate if the inclusion of those dimensions helps improve the prediction of online review helpfulness. Empirical findings from text mining experiments conducted using reviews from Yelp and Amazon offer strong support to our thesis. We find that both review text and reviewer engagement characteristics help predict review helpfulness. The hybrid approach of combining the textual features of bag-of-words model and RFM dimensions produces the best prediction results. Furthermore, our approach facilitates the estimation of the helpfulness of new reviews instantly, making it possible for social media platforms to dynamically adjust the presentation of those reviews on their websites.

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1. Introduction

In the era of Web 2.0, emerging online social media platforms build new business models based on their capabilities for leveraging user-generated content. Online platforms collect, aggregate, process, and present user-contributed information, which has an important bearing on product preferences and company image [4]. Online social media afford consumers the opportunity to voice their opinions and learn from their peers on products and services of interest. This new channel of user-generated information greatly empowers the customers, who engage in the activities facilitated by the online platforms [52]. Online platforms employ and apply text mining algorithms, which can help unearth new knowledge about not only customer behavior, but also about customer attitude and sentiment.

While there are many forms of user-generated content, reviews still constitute the bulk of user-generated content [20]. Online customer reviews are “a type of product information created by users based on personal usage experience” ([5], p. 477) or “peer-generated product

evaluations posted on company or third party websites” ([31], p. 186). They contain valuable information about a product or service. Studying online reviews can help manufacturers better understand consumer responses to their products and thereafter enhance their products [21]. Online reviews not only enhance consumer awareness, but also serve as a reliable source of information about the quality of the product or service of interest [22].

While most review opinion mining studies have concentrated on sentiment analysis (thumbs up or down) [23,37], the issue of review quality is often ignored, which leads to retrieving useless or even noisy documents [3]. Mudambi and Schuff [31] have stated that what makes customer reviews helpful is an important research question. Similarly, Cao et al. [2] have raised the research question as to why some reviews receive many usefulness votes while others receive few or no votes at all. Why some reviews are rated as helpful while others are not is therefore an important and interesting empirical question.

Major websites such as Amazon.com and Yelp.com provide a “Most Helpful First” option in sorting and presenting customer reviews. They usually ask a question like: “Was this review useful?” The customer reviews can then be ranked on the “usefulness” dimension based on the number of readers who voted “yes”. This community-based voting technique is called “social navigation” [12], which is widely used to help readers address the information overload problem, especially for products that have hundreds of online reviews. However, newly written reviews do not get sufficient time to accumulate helpfulness votes and,

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therefore, should not be ranked based on readers' votes [11,19]. Automatic helpfulness estimation methods could be employed to address this problem.

In general, predictive analytics involve constructing and evaluating models for the purpose of making empirical predictions [45]. We employ the predictive analytics approach for this study. More specifically, we model the prediction of review helpfulness as a regression problem. The goal is to estimate or predict the value of review helpfulness. In websites such as Yelp.com, the helpfulness information is provided in the format of “y readers found the review useful” for existing reviews. For newly written reviews for which readers did not have sufficient time to provide ratings, our study provides an effective way to rate those reviews. This research can provide significant benefits to social media platforms by helping them rate new online reviews instantly and adjust their presentation efficiently. But to do that, we need to build a prediction model based on existing reviews whose helpfulness is known. We adopt the raw number of positive helpful votes of a review, or y in the example above, as the measure of helpfulness. The larger the number y , the more helpful the review appears to readers.

In this study, we propose a new hybrid model, which incorporates both the vector space model (VSM) representation of review text and a reviewer's engagement profile. We address three important research questions in this study. We first examine if the VSM representation of review text improves the prediction of review helpfulness over a baseline model. Second, we examine if the hybrid model is better than using VSM alone for the prediction of review usefulness. Third, we examine whether the hybrid model is better than using a reviewer's engagement profile alone for predicting review helpfulness.

This research makes important contributions to the literature. First, we propose and empirically validate hybrid text regression models that incorporate both review textual features and reviewer engagement characteristics. Second, we creatively adapt the RFM (Recency, Frequency, and Monetary Value) analysis [29] to the domain of online social media and demonstrate that the hybrid approach with reviewers' RFM dimensions produces the best results, overall.

The paper is organized as follows. We first survey the relevant literature on review helpfulness. Then we present the research model, followed by a description of the collected data and experiments. Next, we report the findings from the experiments and discuss the implications of those findings. Finally, we conclude the paper and identify future directions.

2. Literature review

Table 1 summarizes the main findings of past studies on review helpfulness. Formulating it as a regression problem, some studies tried to rank the reviews based on helpfulness or utility. For example, with radial basis function (RBF) regression, reviewer's expertise, writing style, and timeliness of the review are identified as important factors for predicting the helpfulness of IMDB movie reviews [25,26]. Yu et al. [53] found that writing style, as reflected in part-of-speech tags, is effective in predicting movie review quality using support vector regression. Kim et al. [19] found that simple TF/IDF (Term Frequency/Inverse Document Frequency) weights of lemmatized unigrams, the length of the review, and product rating (number of stars) are the most important features in their Support Vector Machine (SVM) regression. Zhang and Varadarajan [55] found more sophisticated linguistic style cues (e.g., counts of words, sentences, wh-words such as which and where, and comparatives) to be the most effective. Ghose and Ipeiritos [9] found that the standard deviation of the sentence subjectivity scores and readability scores significantly influence the helpfulness rank, and suggests that extreme reviews are the most helpful.

Chen and Tseng [3] found that high-quality reviews are those with in-depth comments on several product features, and are subjective as well. Cao et al. [2] also found that reviews with extreme opinions are more likely to be perceived as being more helpful. Moreover, semantic characteristics are more important than basic and stylistic features.

Taken together, these studies indicate that both the relevant key topics (substance) and subjective opinion are important for predicting review helpfulness.

In addition to review textual features, some reviewer characteristics have also been examined for review usefulness evaluation. Writer authority as a baseline feature was used in the classification models to predict the quality of user-generated documents [15]. Adopting the data quality framework proposed by Wang and Strong [49], Otterbacher [36] treated the reviewer's reputation as a dimension of intrinsic quality in a study of Amazon review helpfulness. The reviewer's reputation was measured by helpful votes received, total reviews written, “top reviewer” badge, and reviewer's rank in the community. The mean helpfulness of a reviewer's past reviews (a reputation feature) was found to be the strongest single predictor of the helpfulness of his/her current review [34,35].

In a recent empirical study aiming to understand what factors drive consumers to contribute in online platforms, reputation, sense of belonging, and enjoyment of helping other consumers were found to be significant motivations [6]. Identifying reputable online reviewers enables members to decide whose reviews they should trust [21].

In an empirical investigation of the impact of online reviews on product sales [17], the results showed that consumers not only pay attention to review ratings (number of stars), but also to the reviewer's reputation and reviewer exposure (how many reviews the reviewer has posted on the review website). Reviews written by reputable and voluminous reviewers are received more favorably by the market. To identify experts in online knowledge communities, a novel algorithm, ExpertRank, was recently proposed and tested [48]. The experimental results demonstrate that both document-based relevance and a member's authority in the knowledge community are important factors.

To address the research problem of automatic helpfulness regression/classification, some studies concentrated on various textual and linguistic features (see Table 1). Other studies demonstrated that reviewer characteristics are relevant for review usefulness prediction, but none of them employed the lens of RFM to model reviewer characteristics. To the best of our knowledge, none of the prior studies has evaluated the predictive power of combining both textual features and reviewer engagement characteristics. While acknowledging the potential utility of textual features, we argue that reviewer engagement characteristics would also influence readers' perception of review helpfulness. In this study, we develop a hybrid text regression model, which combines review textual features and reviewer engagement characteristics. Moreover, we empirically compare the predictive power of the proposed hybrid model with those of the textual features only model and the reviewer characteristics only model.

3. Conceptual model development and research questions

In this section, we first review the work in VSM, and then describe RFM analysis and review its applications. We explain the application of RFM analysis to represent a reviewer's engagement profile and make the argument that engagement is associated with review helpfulness. Next, we describe the development of the text regression models, and then elaborate on the specific research questions addressed in this study.

3.1. Vector space model

In the literature on information retrieval [41,42] and text categorization [43], unstructured text is often represented by a vector space model (VSM). In VSM, the values of the elements are derived from event frequencies, such as the number of times a certain word appears in a particular document [47]. “The novelty of the VSM was to use frequencies in a corpus of text as a clue for discovering semantic information” ([47], p. 143). This fundamental insight can be expressed as the *statistical semantics hypothesis*: the statistical patterns of human word usage can be exploited to figure out what people write or talk about [47].

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