

# Analysis of Social Influence in Online Book Reviews

Patty Sakunkoo and Nathan Sakunkoo

Stanford University, Stanford, CA 94305

{psak, sakunkoo} @ stanford.edu

## Abstract

It has been widely recognized that online opinions constitute important informational sources for consumers and producers. The open nature of communication supported by social media, however, raises an important yet unsettled question of whether and how earlier opinions affect those that come after. This poster presents a model to illustrate the relationship between existing and new reviews. Based on 12,500 Amazon reviews, our choice model shows support for the idea that social contagion may be an important mechanism guiding behaviors of online reviewers. The results thus offer novel insights toward a better understanding of contagious behaviors, as well as minority influence, among social media users.

## Introduction

The rise of social media has virtually eliminated the barrier for users to seek and share opinions with others. Indeed, it has been widely recognized that opinions published by users constitute an important informational source for others to make a diverse range of decisions (e.g. Hu et al. 2006; Jurca and Faltings 2008). Nevertheless, the open nature of social media raises a question of whether they reflect truthful individual attitudes and whether there are regularities in the opinion patterns. For instance, how do online opinions evolve over time? More precisely, if a book on Amazon.com has received ratings of 5, 5, 5, 3, and 2 in the past, would the next reviewer be more likely to give a four star (the average), a one star (a declining trend), a five star (the majority), or simply an independent rating?

Scholars who try to answer this realm of questions have adopted several rationales. The brag-and-moan model proposes that only people with strong predilection and intense enmity will choose to express their opinions. Another line of work propounds that people seek to establish legacy by maximizing their impact. Because polarization from the average opinion renders the highest impact, it in turn provides an incentive for a reviewer to invest his time and efforts to write a polarizing review (Riker and Ordeshook 1968; Wu and Huberman 2008).

As part of the larger effort to examine the interactions among social media users and how opinions evolve, this poster explores a new interpretation by developing and testing a model for socially-influenced online reviews. The results challenge existing theoretical conjectures above by providing an illustration of how the observed trend can be explained by a *contagious* tendency.

## Methods

For preliminary investigation of the aggregate patterns, a simulation was conducted to test whether the existing opinions may prompt or provide bases for a potential reviewer to write a new review. A result from this investigation at the macro level suggests that it seems reasonable to consider the proposed contagious model, in which existing opinions constitute the pool for new reviews to deviate from, with a normal distribution. Figure 1 compares the simulated result with the actual review pattern based on the average rating of 16,454 books on Amazon.com.  $n$  denotes the  $n^{\text{th}}$  review. The parameter  $\sigma$  is estimated by minimizing the sum of  $\chi^2$  differences.

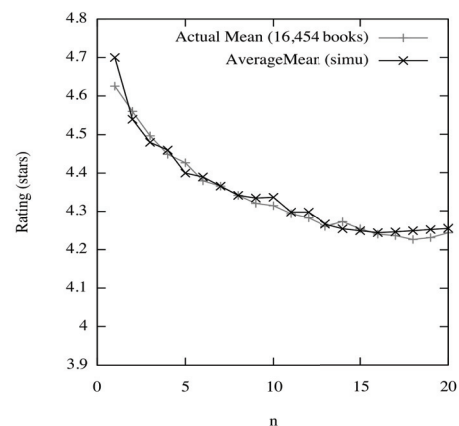


Figure 1: Predicted  $EX_n$  from 2000 contagious-model simulations vs. observed  $EX_n$  from 16,454 books.  $\sigma = 0.6$ ,  $\chi^2 = 0.1$ , d.f. = 18.

To gain further clarity and distinguish between competing mechanisms, we then make an empirical investigation at the individual user level. In this poster, we adapt the exponential (logit) probabilistic choice model (Luce 1959; Tversky 1969) to model reviewer rating choices. In order to predict a reviewer's tendency to give a particular rating (1-5), we assume that each rating alternative can be characterized by a utility (e.g. happiness derived from making a five-star review.) Further, we suppose that choice probabilities of these rating alternatives follow the exponential version of the Luce choice rule (Luce 1959). That is, the probability that a reviewer gives a k-star rating to a book is a function of his utilities  $U_1, U_2, U_3, U_4$ , and  $U_5$ , where  $U_k$ 's are functions of positive ranges. The models are summarized below.

Model 1: The log likelihood for the data may be written as:

$$LL = \sum_{r=1}^n \sum_{k=1}^5 I_k \log(P_{k,r}), \text{ where}$$

$n$  is the number of observations (i.e. observed reviews)

$I_k \in \{0,1\}$ ,  $I_k = 1$  when the observed rating equals  $k$ , and 0 otherwise.

$P_{k,r}$  = the probability of reviewer  $r$  giving a  $k$ -star rating

$$P_{k,r} = \frac{U_{k,r}}{\sum_{j=1}^5 U_{j,r}}; k \in \{1,2,3,4,5\}$$

Each utility function  $U_{k,r}$  is derived from contagious factors, based on star - ratings of existing reviews, and a constant value.

$$U_{1,r} = e^{c+hi_{1,r}+qi_{5,r}}; U_{k,r} = e^{a_k+b_k i_{k,r}}; k \in \{2,3,4\}$$

$U_{5,r} = e^{g+di_{5,r}+fi_{1,r}}$ , where  $i_{k,r}$  denotes the number of existing  $k$ -star ratings prior to review  $r$ .

Model 2 adds the average rating  $\bar{X}_n$  prior to the  $(n+1)^{th}$  rating as another parameter in  $U_{k,r}$ ,  $k \in \{1,2,3,4,5\}$

The data were retrieved from 12,500 reviews—the first 25 ratings of each of Amazon's top 500 books (09/08). The models were then estimated using Maximum Likelihood.

## Methods

The results suggest that when  $k$ -star ratings rise in number, it becomes more likely that a new review is another  $k$ -star. In other words, the likelihood of having a new  $k$ -star rating is proportionate to the proportion of  $k$ -star ratings that already exist. Nonetheless, a 2-star rating is not contagious in this regard. Further, the chance of a new rating being a 5-star increases with the mean, while a high mean inhibits the genesis of a 1-star rating. The insignificant polarization coefficients suggest that polarization seems untenable. Why do individuals care about existing opinions? A possibility is that people tend to look for consistency and turn to others for confirmation. Asch (1956) demonstrated that people are willing to acquiesce to obviously incorrect judgments in order to maintain an opinion in line with a majority. Since the maintenance of an opposing view could be mentally disturbing, compliance reduces mental stress associated with maintaining an opposing view. Hence,

**Table 1 ML Estimation of Rating Choice Model (n=12,500)**

Independent Variables	Model 1	Model 2
<i>5-Star-Rating</i>		
Individual Tendency for 5	1.9196 ***	0.7372 ***
Contagion with 5's ( $d$ )	0.0318 ***	0.0077 **
Polarization of 1's ( $f$ )	-0.1822 ***	-0.0009
Mean Rating ( $m5$ )		0.6500 ***
<i>4-Star-Rating</i>		
Individual Tendency for 4	0.1016 *	1.8744 ***
Contagion with 4's	0.1972 ***	0.1554 ***
Mean Rating ( $m4$ )		-0.6223 ***
<i>3-Star-Rating</i>		
Individual Tendency for 3	-0.6900 ***	2.5637 ***
Contagion with 3's	0.3240 ***	0.2134 ***
Mean Rating ( $m3$ )		-0.3477 ***
<i>2-Star-Rating</i>		
Individual Tendency for 2	-1.0514 ***	3.4865 ***
Contagion with 2's	0.3116 **	0.0109
Mean Rating ( $m2$ )		-0.0132
<i>1-Star-Rating</i>		
Individual Tendency for 1	-0.7356 ***	1.7570 ***
Contagion with 1's ( $h$ )	0.2743 ***	0.2522 ***
Polarization of 5's ( $q$ )	0.0007	-0.0003
Mean Rating ( $m1$ )		-0.1848 ***
LL	-12107	-12086
AIC	24238	24206
BIC	24308	24305

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$

12,500 reviews from top 500 business books as of 09/08/08

users with a different view may, by intention or not, refrain from expressing opinions or exhibit belief change. People whose attitudes are confirmed with the presence of similar reviews may be motivated to initiate an affirmative review.

But if conformity rules, how, then, could a 1-star maverick influence others to follow suit, given that previous ratings are swarming with 5 stars? Interestingly, our analysis shows that, despite the prevailing highly positive opinions, a minority negative opinion can also magnetize others.

This interpretation is informed by research in social psychology, which maintains that the presence of a committed and confident minority can prompt an individual to make a bold move (Mackie and Hunter 1999). This stream of literature helps explain why a 1-star rating is contagious but a 2-star rating is not (Model 2). Perhaps, a 2-star review is perceived as lukewarm and thus is not as persuasive as a temerarious 1-star stance.

Because it seems tenable that socially-influenced self selection triggered by a tendency to seek cognitive consistency and by majority/minority influence, as well as internalized attitude change, may underlie the process of publishing online reviews, one practical implication is that we should treat public opinions with circumspection. Individual reviewers should note the powerful influence of earlier reviews and might wish to be aware of their own opinions prior to and after reading existing reviews. For social media seeking to provide accurate public opinions, transparency of individual opinions, as opposed to mere

summary measures, should facilitate diversity of future reviews and elicit more genuine responses.

Overall, this poster presents an early-stage effort to provide a refreshing insight and quantifiable explanation into the dynamics of online opinions, even in absence of personal ties. Rather than viewing social media users as living in social vacuum or treating them as rational machines, we highlight social influence regularities that run through one of the world's largest loci of social interactions, Amazon.com.

## References

- Hu, N., Pavlou, P., Zhang, J. 2006. Can online reviews reveal a product's true quality? *ACM EC'06*.
- Jurca, R. and Faltings, B. 2008. Incentives For Expressing Opinions in Online Polls. *ACM EC'08*.
- Luce, R. D. 1959. *Individual choice behavior*. Wiley.
- Mackie, D.M. and Hunter, S. B. 1999. *Social Identity and Social Cognition*. Blackwell Publishers.
- Riker, W. and Ordeshook, P. A. 1968. Theory of the Calculus of Voting. *American Political Science Review*, 62, pp. 25-42.
- Tversky, A. 1972. Elimination by aspects: A theory of choice. *Psychological Review*, 79, 281-299.
- Wu, F. and Huberman, B. 2008. How Public Opinions Forms. HP Laboratories.