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Sorting Online Reviews by Usefulness Based on the VIKOR Method

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Abstract: Online review is a hot topic in the field of electronic commerce. In this paper, a framework for evaluating the quality of online reviews is proposed. First, the features of online reviews are analyzed. And then, the VIKOR method is chosen to evaluate the online reviews, which are then sorted by the evaluating results. Finally, an example is given to illustrate the method.

Keywords: Electronic Commerce, Online Review, Information Quality, VIKOR

1. INTRODUCTION

With the increasing number of e-commerce websites and types of goods, more and more people choose to shop on the e-commerce websites. However, faced with hundreds of products of the same type, most consumers will be confused and overwhelmed by the possible choices. In order to assist consumers with the decision making, almost all the e-commerce websites offer the online review service system, through which users can post their positive or negative comments about the related goods. Electronic commerce online review system mainly has two impacts on consumers’ decision making:

1. For consumers with no target good, online review can provide him/her with valuable advice of which one to choose. For example, a man who intends to buy a laptop could refer to and compare the online reviews of all kinds of laptops, and then choose the most proper one.

2. Typically, consumers can only acquire the basic features and some advantages of the products from the official source, which rarely release negative information about their goods. In comparison, online review system will tell not only the merits but also the shortcomings of the products. Therefore, consumers will understand the product in a comprehensive way.

Although online review system partly solves the problems of product information and choice, the number of online reviews of some products is too large to be read by consumers. To solve this problem, many electronic commerce websites offer voting function-- Is this review helpful to you? The consumers can click the buttons below each review. If you find the review useful, you can click “yes”, otherwise, click “no” However, most of the online reviews do not get any votes or get very few votes, so the usefulness voting function of online review cannot take effect. As a result, consumers still have to spend much time reading the online reviews.

Consequently, this paper proposed a method to order the online reviews according to their usefulness degree. This method considers not only the number of votes, but also the information quality of the online reviews. Even if there are no “useful” votes, this method can also take effect.

2. THE FEATURES OF ONLINE REVIEW

There are many literatures studying information quality [1-10], but only a few literatures focus on the quality of online reviews [1]. In this paper, according to the literatures, we select some information quality features which are suitable for online reviews.

* Corresponding author. Email: hhbbs@live.cn(Shi Huibin)
Table 1. The features of online reviews

<table>
<thead>
<tr>
<th>Review quality(A)</th>
<th>Intrinsic review quality(B1)</th>
<th>Contextual review quality(B2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Believability(C1)</td>
<td>Timeliness(C5)</td>
</tr>
<tr>
<td></td>
<td>Objectivity(C2)</td>
<td>Completeness(C6)</td>
</tr>
<tr>
<td></td>
<td>Reputation(C3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relevancy(C4)</td>
<td></td>
</tr>
</tbody>
</table>

Believability (C1)

This factor is a measurement about what extent an information item is credible. As Jindal and Liu [11] observed, the comments that are rated extremely high or extremely low, would possibly have suggestive information. Therefore, we presume that the deviation of product rating of reviewer be the indicator of believability.
- The product rating deviation of a review (D1).

Objectivity (C2)

This factor is a measurement about what extent an information item is biased. As is well-known, the subjectivity and sentiment of comments impact the reader’s decision-making. Therefore, we use the positivity and negativity of comment’s sentiment as the indicator of this factor.
- The number of positive sentences (D2)
- The number of negative sentences (D3)
- The number of neutral sentences (D4)

Reputation (C3)

This factor is a measurement of what extent the review’s author is trusted. The professional reviewers take the guide role in consumer’s decision-making. So we take the reviewer’s publications and recommended ranking given by the e-commerce websites.
- The number of reviews written by the reviewer (D5)
- The ranking of the reviewer (D6)

Relevancy (C4)

This factor is a measurement about what extent a review impacts decision-making. Although there is a large information diversity of reviews, helpful product review means this review provides the information some specific reader wants to know. Therefore, we use the following quantity to measure the relevance of a review.
- The number of times of the product name (D7)
- The number of times of brand names (D8)
- The number of times of website names (D9)
- The number of times of other product names (D10)

Timeliness (C5)

This factor is a measurement about what extent the review’s information is up-to-date. The expired or duplicate reviews would provide garbage information and also the readers will filter them out automatically.
- The degree of duplicate on of a review (D11), defined as the maximum cosine similarity between the tf-idf vectors of the review to those of reviews published previously.
- The interval (in terms of the number of days) between the current review and the first review of the product (D12).

Completeness (C6)

This factor is a measurement about what extent the review’s information is complete. The active reviewers
will provide informative reviews to cover various aspects of products, such as features and specifications of different products.

- The number of different product features (D13)
- The number of brand names (D14)
- The number of websites (D15)
- The number of product names (D16)

3. ORDERING METHOD

In order to evaluate each review quality, we choose VIKOR method which was proposed by Opricovic in 1998 [12, 13]. The VIKOR method is a compromising multicriteria decision method of complex systems. It is not only an optimization method of compromise, but also based on TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method. The VIKOR method first computes the positive ideal solution and negative ideal solution, and then computes the assessed value of each alternatives using compromise optimization method, finally sorts the alternatives according to the distance between assessed value and ideal solution. This method uses linear standardization, and also considers decision makers’ utility preferences. This method compromises the maximizing group benefit and the minimizing “personal regret” of dissenting opinion, so the VIKOR is an optimal compromise solutions method of multicriteria decision making.

The VIKOR method uses an aggregate function which is developed from Lp-metric. It is shown as follows:

\[
L_p = \left\{ \sum_{i=1}^{n} \left[ w_i (f_i^* - f_j^*)/(f_i^* - f_i^-) \right]^p \right\}^{1/p} \\
1 \leq p \leq \infty, \quad j = 1, 2, \ldots, J, \quad i = 1, 2, \ldots, n. \quad L_{pj} \text{ represents the distance between alternative } a_j \text{ and ideal solution. The compromise solution of the VIKOR method can be shown as figure 1, compromise solution } F^c \text{ is the closest to the optimal solution } F^*, \text{ it is the compromise result between the two criteria } (f_1^*, f_2^*), \text{ corresponding compromising measures are } f_1^* - f_1^c \text{ and } f_2^* - f_2^c.\]

![Figure 1. Ideal and compromise solutions](image)

The procedure of the VIKOR method is as follows:

Step 1: Compute the positive ideal solution \( f_i^* \) and negative ideal solution \( f_i^- \).

\[
f_i^* = \left[ \max_j f_{ij} \mid i \in I_1 \right], \left[ \min_j f_{ij} \mid i \in I_2 \right]
\]
\[ f_i^* = \left[ \min_{j} f_{ij} \mid i \in I_1 \right] \left( \max_{j} f_{ij} \mid i \in I_2 \right) \]  

(2)

Where \( f_{ij} \) represents the value of \( i \)th criterion function for the alternative \( a_j \), \( I_1 \) represents the benefit criterions set, \( I_2 \) represents the cost criterions set.

Step 2: Compute the group utility value \( S_j \) and individual regret value \( R_j \).

\[ S_j = \sum_i w_i (f_{i1} - f_{ij}) / (f_{i1} - f_{j1}) \]

(3)

\[ R_j = \max_i \left[ w_i (f_{i1} - f_{ij}) / (f_{i1} - f_{j1}) \right] \]

(4)

where \( w_i \) represents the weight of the \( i \)th criterion.

Step 3: Compute the ratio values \( Q_j \), \( j = 1, 2, \ldots, J \).

\[ Q_j = v(S_j - S^-) / (S^+ - S^-) + (1 - v)(R_j - R^-) / (R^+ - R^-) \]

(5)

where \( S^- = \min_j S_j \); \( S^+ = \max_j S_j \); \( R^- = \min_j R_j \); \( R^+ = \max_j R_j \). \( v \) is introduced as weight of the strategy of “the majority of criteria” (or “the maximum group utility”), here \( v = 0.5 \).

Step 4: Rank the alternatives, sorting by the values \( Q_j \), \( R_j \) and \( S_j \), in decreasing order.

Step 5: When the following two conditions are satisfied, the compromise solution sorted by \( Q \) is the best alternative, the less \( Q \) is, the better the alternative is.

Condition 1: \( Q(a^\nabla) - Q(a^\Lambda) \geq 1 / (J - 1) \)

where \( a^\nabla \) represents the second best alternative sorted by \( Q \), \( a^\Lambda \) represents the best alternative sorted by \( Q \), \( J \) is the number of alternatives.

Condition 2: Acceptable stability in decision making

The \( S \) value of the best alternative must also be better than the second best alternative. Or The \( R \) value must also be better than the second best alternative. When there are more than two alternatives, it is need to compare all the alternatives in turn to check if they match condition 2.

If the best alternative and the second best alternative sorted by \( Q \) satisfy condition 1 and condition 2, the best alternative sorted by \( Q \) will be the optimal solution; if the best alternative and the second best alternative sorted by \( Q \) only satisfy condition 2, all of the two alternatives will be the optimal solution.

4. EXAMPLE

Three online reviews are selected from Amazon.cn as follows.

58/59人认为此评论有用.

三星 MOTO ME525(移动3G)“三防”智能手机(黑色)(手机)

这款黑色的是非定制机还是非定制机呢？希望国行能考虑下，希望国行是不是定制机？能不能下错了。希望国行的用户也吱一声，谢谢！现在非定制机非定制机，不敢下错了。希望国行考虑下一下。
4.1 Confirming the features of each review

The features of each review are extracted as follow tables. If the values of a criterion of the three reviews are all zero or one, the criterion will not be considered.

<table>
<thead>
<tr>
<th>Table 2. The values of the features of the online reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Review 1</td>
</tr>
<tr>
<td>Review 2</td>
</tr>
<tr>
<td>Review 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3. The values of the features of the online reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>D7</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Review 1</td>
</tr>
<tr>
<td>Review 2</td>
</tr>
<tr>
<td>Review 3</td>
</tr>
</tbody>
</table>

And then the data should be normalized.

<table>
<thead>
<tr>
<th>Table 4. The normalizing values of the features of the online reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Review 1</td>
</tr>
<tr>
<td>Review 2</td>
</tr>
<tr>
<td>Review 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5. The normalizing values of the features of the online reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>D7</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Review 1</td>
</tr>
<tr>
<td>Review 2</td>
</tr>
<tr>
<td>Review 3</td>
</tr>
</tbody>
</table>
4.2 Sorting the reviews

Yes, it can be used as a process-oriented design framework for system developers, or a product-oriented evaluation framework for system users/buyers. The common concept of system performance connects the two fields: generally designers want to produce high performance systems, and likewise users want to buy them.

\[ f^* = [1, 1, 1, 1, 1, 1, 1, 1, 1, 1] \]

\[ f^- = [0.25, 0, 0, 0.5, 0, 0.5, 0, 0.64, 1, 0, 0] \]

We assume that all the criteria are equally important, then according to equation, \( S_j \) and \( R_j \) can be obtained.

<table>
<thead>
<tr>
<th>Table 6</th>
<th>The S, R, Q values of the online reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review 1</td>
<td>Review 2</td>
</tr>
<tr>
<td>S</td>
<td>3.58</td>
</tr>
<tr>
<td>R</td>
<td>1</td>
</tr>
<tr>
<td>Q</td>
<td>0</td>
</tr>
</tbody>
</table>

And then the three reviews can be sort by S, R and Q.

<table>
<thead>
<tr>
<th>Table 7</th>
<th>The sorted results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review 1</td>
<td>Review 2</td>
</tr>
<tr>
<td>S</td>
<td>1</td>
</tr>
<tr>
<td>R</td>
<td>1</td>
</tr>
<tr>
<td>Q</td>
<td>1</td>
</tr>
</tbody>
</table>

\[ Q_3 - Q_1 = 0.26 - 0 = 0.26 < 1/(3-1) = 0.5 \]

\[ S_1 < S_3 \]

It can be seen that review 1 and review 3 only satisfy condition 2, so the final order is:

Review 1 \( \rightarrow \) Review 3 \( \rightarrow \) Review 2

That is to say, review 1 and review 3 are more useful than review 2.

5. CONCLUSIONS

In this paper, we proposed a framework to evaluate and sort the quality of online reviews. First, the features of online reviews are found out, and then the VIKOR method is used to evaluate and sort the online reviews, and finally, an example is given to illustrate the effectiveness of the method.

In the future work, there are two aspects can be improved: improving the features of online reviews to ensure that these features can be easily gotten through crawling algorithms; choosing proper classification algorithm to sort the online reviews according to usefulness.

ACKNOWLEDGEMENT

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