Research on the Quality of Electronic Journals Based on 2-Tuples

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Abstract. In recent years, research on the quality of electronic journals has been one of the emphases in the development of library. This paper employs the 2-tuples evaluation method to evaluate the quality of electronic journals and reaches the final evaluation results. By converting the fuzzy linguistic term set on the quality of electronic journals which is defined by different experts into 2-tuples, it makes the expression of language information in its domain continuous, thus realizes the integrity of information, which cannot be achieved by the early linguistic computational model, then do a collection computing to the converted 2-tuples in order to get their orders. Finally, a numerical example is presented to demonstrate how to use the 2-tuples evaluation method to evaluate the quality of electronic journals.

Keywords: electronic journals; 2-tuples; linguistic computational model

1 Introduction

The issuance of electronic journals based on the network has become one of the important ways of modern academic communication and issuance. But in our country, the evaluation method for the quality of electronic journals is very deficient, and cannot keep pace with the academic status of traditional publications, thus affecting the normal development of electronic journals. Therefore, it is necessary to evaluate and classify the quality of the network-based electronic journals publishing in order to maintain a long-term and dynamic development of electronic journals.

Recently, relevant literatures [1-3] have already carried out some related researches on electronic journals. For example, the link pointer within the network environment (the citation times of an article in other papers), the downloading times, etc. [2], whose unique network elements, such as the user experience, website interactivity and network promotion, etc, need experts to make evaluation. The evaluation cannot be rendered into precise numerical values, and only through linguistic evaluation can the meanings and characteristics of the above attributes be accurately embodied.

In this paper, the issue of evaluating the quality of electronic journal is attributed to a language evaluation system which is based on Multiexpert Multicriteria Decision -
Making, MEMC – DM. Language expression is the most appropriate method for the subjective judgment, when evaluating electronic journals, a subjective judgment from the experts is necessary. By converting the subjective evaluation of experts into a fuzzy linguistic term set, then use 2-tuples to aggregate the fuzzy linguistic term set to get a set of values, finally rank the numerical values and get the evaluation results.

Nowadays, we can use precise numerical values to deal with a lot of problems in many cases, but there are some problems whose characteristics cannot be quantified by specific numerical values. In the following example, the fuzzy linguistic approach can provide a very good solution. Through language variables, it can do the qualitative processing to the qualitative terms. When using the language information to solve deal with problems, you need computing with words, CW. But such kind of computing with words can result in the loss of information. However, the 2-tuples method proposed by this paper can effectively overcome the defect.

2 Analysis of Linguistic Computational Symbolic Model

In this section, we will have a simple review of fuzzy language and introduce two calculation methods for the CW processing.

2.1 Fuzzy Linguistic Approach

Nowadays, many aspects of different activities cannot be accurately quantified, and can only be described by the qualitative method. In this case, language evaluation instead of numerical evaluation is a better approach. Variables involved in these problems are estimated by the linguistic term method. CW has already been used in many fields [4]. In this paper, we focus on the use of language information. To achieve this goal, we choose appropriate linguistic descriptors for the term sets and their semantic meanings. In order to be able to do this, an important analysis factor known as “granularity of information” can be used. A simple way to produce a language set is that the linguistic evaluation terms within the language set are arranged in accordance with the order [5]. A language set containing seven terms is arranged as follows:

\[ S = \{s_0 : N, s_1 : VL, s_2 : L, s_3 : M, s_4 : H, s_5 : VH, s_6 : P\} \]

Normally, a language set should satisfy the following conditions [4]:

1) There is a negation operator: \( \text{Neg}(s_i) = s_{j} \), \( j=g-i \) \((g+1\) is the number of linguistic terms)

2) \( s_i \leq s_j \iff i \leq j \)

This paper uses triangular membership function to convert the linguistic evaluations which are given by experts into fuzzy term set \((a set of numerical values)\). Triangular membership function is fully capable of manifesting the language information in a set of numerical values. For example, we use a set of numerical values to manifest the above linguistic set \( S \), as shown in Figure 1.
H=(0.5, 0.67, 0.83) VH=(0.67, 0.83, 1) P=(0.83, 1, 1) VL=(0, 0.17, 0.33)
L=(0.17, 0.33, 0.5) M=(0.33, 0.5, 0.67) N=(0, 0, 0.17)

Normally, the smaller the value, the worse or smaller it represents, the larger the value, the better or greater it represents. From the values above, we can see that the value P (perfect) is the maximum.

![Interval Values of Triangle Membership Function Conversion](image)

**Fig. 1. Interval Values of Triangle Membership Function Conversion**

### 2.2 Linguistic Computational Model Based on the Extension Principle

Extension principle applies mathematical descriptor to the fuzzy term set, that is converting the language information into numerical information. Extension computing based on the extension principle increases so many fuzziness of the results that could cause the mismatch of the original language information, that is, the loss of information. Therefore, the use of linguistic approximation function is necessary, it will match the extension descriptor results with the terms within the original language information domain, thus will avoid the loss of information.

A formula of linguistic set descriptor based on the extension principle is as follows:

\[
S^0 \xhookrightarrow{F(R)} \xhookrightarrow{\text{app}_{\subseteq}(\cdot)} S
\]

\(S^0\) stands for the n-dimensional Cartesian product of S, F stands for the set descriptor based on the extension principle, F (R) stands for the fuzzy sets affiliated with the real number set, \(\text{app}_{\subseteq}(\cdot)\) stands for the linguistic approximation function. The linguistic approximation function would produce a label from the original language set S, and this label would match with the label of set S that is closest to it.

### 2.3 Linguistic Computational Symbolic Model

The second computing method for language information is symbolic model, whose main content is computing the index of the subscripts of the terms which belong to the linguistic term set S. Normally, an ordered set of linguistic terms is necessary. For example, in \(S = \{s_0, \ldots, s_g\}\), when \(s_i \leq s_j, \ i \leq j\), the result calculated by the symbolic model is a numeric result \(\alpha \in [0, g]\), and \(\alpha\) must match with every step of the
calculation of the approximation function $app_2$. Approximation function $app_2$ will
get a numeric value, which is associated with the index of terms of the original language
set. The above process is according to the following formula:

$$C \stackrel{app_2}{\rightarrow} \{0, \ldots, g\} \rightarrow S$$

$C$ stands for linguistic combination descriptor, $app_2$ stands for linguistic
approximation function, and $S$ stands for original language set.

But the results calculated by model B and C are not unique, which would have a
certain impact on the choice of the results. The results calculated based on the 2-tuples
descriptor are unique, which will be introduced in the following section.

3 2-Tuples Information Model Based on the Symbolic Translation

We call a pair of numerical values $(s, \alpha)$ 2-tuples, $S$ is a certain term of the term set,
$\alpha$ is the symbolic translation of relevant terms [6].

3.1 Definition of Symbolic Translation

Suppose $S = \{s_0, \ldots, s_g\}$ is a linguistic term set, when do set computing to the
linguistic information set $S$ using symbolic descriptor method, we get a numerical
value $\beta$, $\beta \in [0, g]$. and $\beta \notin \{0, \ldots, g\}$, the linguistic approximation function
$app_2(\bullet)$ would be used to express the index of each term of set $S$.

Definition 1: Suppose $\beta$ is the numerical value obtained from a certain set
descriptor, such as a numerical value obtained from the symbolic set descriptor.
$\beta \in [0, g]$, $g+1$ is the number of terms in the term set $S$. Suppose $i = \text{round}(\beta)$ and
$\alpha = \beta - i$, $i \in [0, g]$ and $\alpha \in [-0.5, 0.5]$, $\alpha$ is called symbolic translation. To
put it simply, $\alpha$ is $\beta$ represents the deviation between $\beta$ and the index of the closest term
in set $S$.

Definition 2: Suppose $S = \{s_0, \ldots, s_g\}$ is a linguistic term set, $\beta$ is the result
computed by using the symbolic set descriptor, 2-tuples is represented by the following
functions:

$$\Delta : [0, g] \rightarrow S \times [-0.5, 0.5]$$
\[ \Delta(\beta) = (s_i, \alpha), \text{ with } \{ \begin{array}{l}
  s_i = \text{round}(\beta) \\
  \alpha = \beta - i
\end{array}, \quad i \in \{-0.5, 0.5\} \] 
round is a rounding operator, the index of \( s_i \) is closest to \( \beta \), \( \alpha \) is the symbolic translation.

For example, do set computing to a term set \( S = \{ s_1, \cdots, s_k \} \), and the value of \( \beta \) is 2.8, and then obtain the following calculation results by means of 2-tuples method (as shown in Figure 2): \( \Delta(2.8) = (s_3, -0.2) \)

![Fig. 2. Example of Symbolic Translation Computing](image)

Definition 3: Suppose \( S = \{ s_0, \cdots, s_k \} \) is a term set, \( (s_i, \alpha) \) is a 2-tuples. There is an inverse function \( \Delta^{-1} \) which can convert it into a corresponding \( \beta \), as shown in the following formula:

\[ \Delta^{-1} : S \times [-0.5, 0.5] \rightarrow [0, g] \]

\[ \Delta^{-1}(s_i, \alpha) = i + \alpha = \beta \]

Note: It can be seen from the definition 1, 2, and 3, in the process of converting language information to 2-tuples, the symbolic translation \( \alpha \) is 0.

\[ s_i \in S \Rightarrow (s_i, 0) \]

3.2 Linguistic Information Computing Based on 2-Tuples

In this section, basic introduction of 2-tuples computing will be made:

1) Comparison of 2-Tuples

Suppose \( (s_1, \alpha_1) \) and \( (s_2, \alpha_2) \) are two 2-tuples, if \( k < 1 \), \( (s_k, \alpha_k) < (s_k, \alpha_1) \); If \( k = 1 \), \( \alpha_1 = \alpha_2 \), then \( (s_k, \alpha_1) \) and \( (s_k, \alpha_1) \) represent the same information, if \( \alpha_1 < \alpha_2 \), then \( (s_k, \alpha_1) < (s_k, \alpha_1) \), and vice versa.
2) Set Computing of 2-Tuples

Arithmetic mean descriptor is a classic set descriptor and this paper uses it for the computing of 2-tuples.

Definition 3: Suppose \( x = \{ (r_1, \alpha_1), \ldots, (r_n, \alpha_n) \} \) is a group of 2-tuples sets, the computing of its arithmetic mean value is as follows:

\[
x' = \Delta(1/\sum_{n}^1 \Delta^{-1}(r_i, \alpha_i)) = \Delta(1/n \sum_{n}^1 \beta)
\]

The computing process of arithmetic mean descriptor will not cause the loss of information.

4 Analysis of Examples

This paper carries out a qualitative evaluation in terms of four electronic journals (x1, x2, x3, x4), and invites four experts (p1, p2, p3, p4) to evaluate each electronic journal. \( S = \{ s_N, s_{VL}, s_L, s_M, s_H, s_{VH}, s_P \} \) represents the evaluation set, \( N \) represents no value, \( VL \) represents very poor, \( L \) represents poor, \( M \) represents medium, \( H \) represents good, \( VH \) represents very good, \( P \) represents perfect. Convert the rating set above into 2-tuples, as shown in Table 1:

<table>
<thead>
<tr>
<th></th>
<th>x₁</th>
<th>x₂</th>
<th>x₃</th>
<th>x₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>p₁</td>
<td>(VL,0)</td>
<td>(M,0)</td>
<td>(M,0)</td>
<td>(L,0)</td>
</tr>
<tr>
<td>p₂</td>
<td>(M,0)</td>
<td>(L,0)</td>
<td>(VL,0)</td>
<td>(H,0)</td>
</tr>
<tr>
<td>p₃</td>
<td>(H,0)</td>
<td>(VL,0)</td>
<td>(M,0)</td>
<td>(M,0)</td>
</tr>
<tr>
<td>p₄</td>
<td>(H,0)</td>
<td>(H,0)</td>
<td>(L,0)</td>
<td>(L,0)</td>
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</tbody>
</table>

We use arithmetic mean descriptor to do set computing to the information list above, and what we get is as shown blow in in Table 2:

<table>
<thead>
<tr>
<th></th>
<th>x₁</th>
<th>x₂</th>
<th>x₃</th>
<th>x₄</th>
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</thead>
<tbody>
<tr>
<td>p₁</td>
<td>(VL,0)</td>
<td>(M,0)</td>
<td>(M,0)</td>
<td>(L,0)</td>
</tr>
<tr>
<td>p₂</td>
<td>(M,0)</td>
<td>(L,0)</td>
<td>(VL,0)</td>
<td>(H,0)</td>
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<tr>
<td>p₃</td>
<td>(H,0)</td>
<td>(VL,0)</td>
<td>(M,0)</td>
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<tr>
<td>p₄</td>
<td>(H,0)</td>
<td>(H,0)</td>
<td>(L,0)</td>
<td>(L,0)</td>
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As can be seen from above, x1 is the best journal.
5 Conclusions

In terms of the problem of quality evaluation for electronic journals, by means of 2-tuples, this paper converts the linguistic evaluation given by experts into fuzzy linguistic evaluation information (a set of interval numbers that the triangle membership function presents), then do an average calculating operation on the 2-tuples set, and get a set of numerical values. At last, get the best solution according to the comparison of 2-tuples. A brief demonstration with an example is presented in this paper.

This approach has a broad range of use, which is not only applicable to the quality evaluation of electronic journals, but also applicable to the quality evaluation of engine room servers and operating systems.

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References