Research on Quantitative Analysis Method of Readers' Demands in University Library

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Abstract. Readers' demands analysis is an essential part of university library management. It is the key to improve reader satisfaction in daily service work. In order to adapt to the changes of The Times, improve readers' satisfaction in an all-round way, and make university libraries provide better services for teaching and scientific research, in addition to vigorously building library books and materials, electronic resources, hardware facilities, library needs analysis is an essential part of university library management work. By using AHP method, this paper puts forward a method to quantify readers' demands. Focusing on the mapping method, the paper presents the hierarchical model and the judgment matrix of readers' demands. The values of the judgment matrix elements reflect the reader's understanding of the relative importance of various factors, and generally adopt 1-9 reciprocal scale method. With the analysis of demands expression and level transformation, the ranking scheme of readers' demands importance is present. Through this analysis and calculation, the weight index of readers' different demands can be obtained, which can be used for further quantitative analysis. The proposed method can be used in the decision-making of University Library in the daily management of books and materials, and provides a new idea for improving the quality of library work.

1. Introduction
Readers' demand refers to the goals, needs, wishes and expectations of readers [1]. These demands constitute the initial information source of readers borrowing books. The demands of readers are in the "source" position in the links of book purchase, arrangement, promotion and arrangement of university library [2] [3]. It is the basic starting point of the process of book management and the key in the reader service of university library [4]. The research on the matching method of reader demands analysis and reading demand mapping can start from ensuring readers' preference, run the service concept throughout the daily management process of university library, make the management process never deviate from readers' demand, and finally achieve the purpose of management innovation and service innovation to improve readers' satisfaction [5][6]. Based on the important role of readers' demands in the daily management of university library, how to accurately identify and obtain readers' demands is of great significance.

2. Analysis method of readers' demands
The results of a large number of surveys show that readers' demands can be divided into the following categories, the reader needs are shown in Figure 1:

(1) Direct demands: when readers are asked in time, they can say the bibliography they need without hesitation.

(2) Potential demands: usually, readers can't directly tell the bibliography they need without prompt, but can only provide fuzzy description information.
(3) General demands: readers can form clear keywords according to specific requirements. Based on these keywords, readers can quickly anchor related bibliography.

(4) Specific requirements: there are very specific requirements for bibliographic information. In general, only a small amount of specific information needs to be satisfied, and the rest information can only be expressed vaguely.

Therefore, we focus on the mapping method of readers' demands, that is, how to transform readers' demands into quantitative engineering parameters in bibliographic purchasing, and rank the importance of these characteristic parameters. In the follow-up process of library management, these characteristic values can also be used as specific guidance, and can be ranked by the importance of characteristics. Because when the readers express their needs and expectations, they use more language forms that conform to their habits. In this way, it is very difficult to determine and sort the importance of engineering parameters in mapping. For this reason, many experts and scholars have proposed the use of fuzzy set theory, rough set theory and other methods. Although these methods can determine the importance of customer demand in some cases, rough set is more suitable for the use of indistinguishable and imprecise data. In the application of fuzzy set theory, membership function is used to describe the fuzziness problem, and the membership function is too subjective and arbitrary, so its criteria are far from being standardized.
Analytic hierarchy process (AHP) is a simple, flexible and practical multi criteria decision-making method for quantitative analysis of qualitative problems. AHP is suitable for multi-objective decision-making, that is, to evaluate the advantages and disadvantages of each scheme when there are multiple impact indicators, as shown in Figure 2. When a decision is affected by multiple elements, and there is a hierarchical relationship between the elements, or there is an obvious classification, or the influence degree of each index on the final evaluation can not be directly quantified by enough data, AHP can be chosen to use. AHP not only avoids complex mathematical calculation, but also does not pay one-sided attention to behavior, logic and reasoning. Instead, it combines qualitative method with quantitative method, and combines the analysis of the investigated objects. To some extent, it eliminates the subjectivity of analysis, thus making the analysis results more objective. In the mapping process of readers' demands analysis, we can use AHP to express readers' various requirements in the form of quantity, so as to make them orderly and quantitative to avoid the contradiction between the prediction and the actual situation. In this way, the phenomenon that it is difficult for decision makers and decision analysts to communicate with each other can be avoided, the quantitative analysis of readers' personal preferences can be facilitated, and the effectiveness of decision-making can be improved, as shown in Figure 3. The judgment matrix is used to express the relationship between the evaluation indexes of each scheme.

\[
F = \begin{bmatrix}
  x_{11} & x_{12} & \ldots & x_{1m} \\
  x_{21} & x_{22} & \ldots & x_{2m} \\
  \vdots & \vdots & \ddots & \vdots \\
  x_{n1} & x_{n2} & \ldots & x_{nm}
\end{bmatrix}
\]

\[
W = (W_1, W_2, W_3, \ldots, W_m)^T
\]

(1)

3. Readers' demands Expression
There are many ways to investigate readers' demands, such as questionnaire, on-the-spot inquiry, telephone interview, network consultation and so on. No matter what kind of investigation method is used, we must make a reasonable choice according to the factors such as the investigation object, location and so on. The research process is shown in Figure 4. In the process of information acquisition, it is necessary to comprehensively collect the readers' demands, and comprehensively grasp the readers' demand intensity and satisfaction for all kinds of books. In the collection process of readers' demands, the information expressed by readers will be more or less different, or some readers have no clear understanding of their own needs, so it is necessary to communicate with readers effectively and make reasonable suggestions on readers' demands, which will greatly improve the effectiveness of information collection. On this basis, AHP method is used to carry out hierarchical mapping analysis on readers' demands. The factors most concerned by readers are extracted from the hierarchical model, and a judgment matrix is established. The principles are shown in Table 1. The values of judgment matrix elements reflect the reader's understanding of the relative importance (or advantages and disadvantages, preferences, strength, etc.) of various factors, and generally adopt 1-9 reciprocal scale method. When
the importance of the comparative factors can be explained by the ratio of practical significance, the value of the corresponding elements of the judgment matrix can take this ratio.

### Table 1. Readers’ demands expression

| Relative importance | Definition                  | Explanation                                      |
|---------------------|-----------------------------|--------------------------------------------------|
| 1                   | Equally important           | Goal i and j are equally important               |
| 3                   | Slightly important          | Goal i is slightly important than j              |
| 5                   | Very important              | Goal i is more important than goal j             |
| 7                   | Obviously important         | Goal i is obviously more important than goal j   |
| 9                   | Absolutely important        | Goal i is absolutely more important than goal j  |
| 2,4,6,8             | Between neighboring        |                                                 |

Figure 4. Reader data express process

4. Importance Ranking of Readers’ demands

Assuming that the factor at the current level is related to the factor at the next level C, then for this factor C, all factors \((A_1,A_2\cdots A_n)\) can be compared in pairs to get the value \(a_{ij}\), indicating the relative importance of the factors. Note that the maximum eigenvalue of the judgment matrix \(A\) is \(\lambda_{\text{max}}\), and the normalized eigenvector of the judgment matrix \(A\) is \(w = (w_1,\cdots, w_n)^T\), then \(w_1,\cdots, w_n\) gives a ranking of the factors according to the importance degree relative to the factor C. The ranking of the relative importance of all factors at the same level to the highest level (overall goal) is called the overall ranking of levels. This process is carried out layer by layer from the highest level to the lowest level. If the upper level contains \(m\) factors \(A_1,\cdots A_m\), the total ranking weights of the levels are \(a_1,\cdots a_n\), the lower level B contains \(n\) factors \(B_1,\cdots B_n\), and their single ranking weights for the factors are \(b_{1j},b_{2j}\cdots b_{nj}\) (when \(B_k\) is no connection with \(A_j\), \(b_{kj} = 0\)), then table 2 can be obtained. Through this analysis and calculation method, the weight index of readers’ different demands can be obtained, as shown in Table 3, which can be used for further quantitative analysis.
Table 2. Importance ranking

| Arrangement A | \( A_1 \) | \( \cdots \) | \( A_m \) | Importance ranking |
|---------------|---------|---------|---------|-------------------|
| Arrangement B | \( a_1 \) | \( \cdots \) | \( a_m \) |                   |
| \( B_1 \)     | \( b_{11} \) | \( \cdots \) | \( b_{1m} \) | \( \sum_{j=1}^{m} a_j b_{1j} \) |
| \( \vdots \)  | \( \vdots \) | \( \vdots \) | \( \vdots \) |                   |
| \( B_n \)     | \( b_{n1} \) | \( \cdots \) | \( b_{nm} \) | \( \sum_{j=1}^{m} a_j b_{nj} \) |

Table 3. Calculating scores

| Reader | A1 | A2 | A3 | A4 | A5 | A6 | B11 | B12 | B13 | B21 | B22 | B23 | B31 | B32 | B41 | B42 | B51 | B61 |
|--------|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1      | 8  | 2  | 4  | 2  | 8  | 0  | 6   | 8   | 6   | 4   | 0   | 0   | 2   | 4   | 0   | 2   | 8   |
| 2      | 10 | 8  | 2  | 8  | 10 | 2  | 6   | 10  | 4   | 8   | 0   | 10  | 6   | 2   | 6   | 8   | 8   | 8   |
| 3      | 8  | 4  | 8  | 6  | 8  | 8  | 8   | 8   | 8   | 4   | 8   | 6   | 6   | 10  | 6   | 8   | 6   |     |
| 4      | 8  | 8  | 8  | 0  | 0  | 8  | 0   | 6   | 6   | 0   | 0   | 4   | 2   | 6   | 6   | 2   | 4   | 6   |
| 5      | 10 | 10 | 8  | 6  | 8  | 10 | 10  | 10  | 0   | 8   | 10  | 0   | 10  | 8   | 4   | 10  | 8   | 10  |
| 6      | 10 | 8  | 4  | 10 | 10 | 10 | 10  | 10  | 0   | 8   | 10  | 6   | 10  | 4   | 10  | 8   | 10  | 10  |
| 7      | 10 | 8  | 4  | 8  | 8  | 8  | 10  | 10  | 0   | 10  | 10  | 6   | 10  | 4   | 10  | 8   | 8   |     |
| 8      | 8  | 4  | 8  | 6  | 6  | 6  | 6   | 8   | 6   | 4   | 0   | 4   | 6   | 2   | 4   | 8   | 4   | 6   |
| 9      | 10 | 10 | 8  | 8  | 8  | 2  | 6   | 8   | 10  | 8   | 10  | 6   | 10  | 6   | 0   | 4   | 8   |     |
| 10     | 10 | 2  | 4  | 6  | 6  | 0  | 2   | 6   | 4   | 2   | 0   | 4   | 6   | 6   | 0   | 8   | 6   |     |
| W      | 0.08| 0.07| 0.02| 0.03| 0.04| 0.06| 0.07| 0.05| 0.01| 0.05| 0.06| 0.09| 0.09| 0.01| 0.03| 0.10| 0.11| 0.07|

5. Conclusions

The analysis of readers’ demands in university library is one of the keys to library service. This paper puts forward a quantitative method of mapping readers’ demands to reading requirements based on AHP, and expounds from the aspects of readers’ demands information collection, readers’ demands information analysis, readers’ demands information expression, readers’ demands information quantification, readers' demands importance ranking and so on. The application of this method can not only improve the ability to grasp the needs of readers, but also help us accurately transform the needs of readers into the process of reader service to make the library books more suitable for the use of readers, so as to improve the work efficiency.

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