

# Research on Comprehensive Strength Evaluation of University Library ——A Case of Zhejiang Province

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**Abstract**—The article took Zhejiang province for example, combined the data of the library and information work committee of the university in Zhejiang, and used cluster analysis and factor analysis to analyze and sort the comprehensive strength of 28 university libraries in Zhejiang province. On this basis, the study put forward the corresponding countermeasures and suggestions.

**Index Terms**—university library, comprehensive strength, cluster analysis, factor analysis

## I. INTRODUCTION

The construction of library not only affects the level of scientific researching and teaching in colleges and universities directly, but affects the social influence and reputation of universities. So far, the lack of evaluation research on the construction of university libraries in China is conspicuous[1]. Both domestic and foreign scholars have carried out a lot of research on the performance evaluation of the library, including how to improve the performance of the library and the quality of service[2]. At present, the combined methods of analytic hierarchy process and fuzzy mathematics are mainly applied to evaluate the library[3]. However, this method, which requires building a large number of indicators, tends to be affected by subjective remarkably when establishing the hierarchical model and the weight matrix with the analytic hierarchy process (AHP). The result of evaluation is often affected by subjective experience too. When it comes to evaluate and compare several libraries, the feasibility and accuracy of this method will greatly decreasing[4]. This study will draw on the relevant literature to comprehensively evaluate and analyze the comprehensive strength of university libraries in Zhejiang province.

## II. EVALUATION OF COMPREHENSIVE STRENGTH OF UNIVERSITY LIBRARIES

### A. Establishment of evaluation index system

According to the related literature research, the construction of a comprehensive evaluation index system adheres to the principles of systematicness, scientificity, rationality and operability. The following six indexes which are easy to quantify are selected to make up the evaluation index system of comprehensive strength, including the annual total expenses, electronic resources purchase expense, library buildings area, literature resources purchase expense, paper-based resources purchase expense, number of staff and work.

### B. Empirical analysis

It is essential to sort and compare the indicators of the library in colleges and universities separately after establishing the evaluation system of comprehensive strength. Therefore, the universities of Zhejiang province, basing on the related literatures, are evaluated through factor analysis and cluster analysis[5].

Cluster analysis is a way to classify according to the characteristics of the target which makes a certain correlation between them. The distance used in the clustering process is Euclidean distance:

$$d(x_i, x_j) = \left[ (x_i - x_j)^T (x_i - x_j) \right]^{1/2}$$

Let's say the set of  $k$  initial points:

$$I^0 = \{x_1^0, x_2^0, \dots, x_k^0\}$$

Use the following principles to categorize:

$$G_i^{(0)} = \{x : d(x, x_i^{(0)}) \leq d(x, x_j^{(0)}), i, j = 1, 2, \dots, k, j \neq i\}$$

We get an initial classification.

$$G^{(0)} = \{G_1^{(0)}, G_2^{(0)}, \dots, G_k^{(0)}\}$$

Starting from  $G^{(0)}$ , repeat the above steps as the classification tends to be stable at  $G^{(m)} \approx G^{(m+1)}$ , and the algorithm ends.

To get the comprehensive ranking of the library, the 28 universities were clustered. Firstly, the libraries can mainly be divided into three categories. The final

clustering center was obtained by using SAS software (see TABLE I).

TABLE I.  
CLASSIFICATION OF UNIVERSITY LIBRARIES IN ZHEJIANG PROVINCE

Obs	University	Category	Distance
1	Zhejiang University	1	0
2	Zhejiang University of Technology	3	7648601
3	Ningbo University	3	7871120
4	Zhejiang Normal University	3	2111851
5	Zhejiang Sci-Tech University	3	3301927
6	Wenzhou University	3	2596877
7	Hangzhou Dianzi University	3	3868548
8	Zhejiang University of Finance & Economics	3	5037652
9	China Jiliang University	3	4655516
10	Wenzhou Medical University	2	5561617
11	Zhejiang Ocean University	2	5248820
12	Zhejiang Gongshang University	2	4844705
13	Zhejiang University of Science and Technology	2	3599237
14	Shaoxing University	2	3314354
15	Jiaxing University	2	2743914
16	Zhejiang A&F University	2	2489766
17	Zhejiang Chinese Medical University	2	2802542
18	Zhejiang Yuexiu University of Foreign Languages	2	1547589
19	Huzhou University	2	1506699
20	Ningbo University of Technology	2	1932466
21	Zhejiang International Studies University	2	2864473
22	China Academy of Art	2	3146955
23	Zhejiang University of Media and Communications	2	3260020
24	Taizhou University	2	3885601
25	Zhejiang Wanli University	2	3644881
26	Lishui University	2	4340366
27	Zhejiang Sci-Tech University	2	5913248
28	Zhejiang Police College	2	5021517

From the classification results, we can see that the libraries can be divided into 3 categories. The factor analysis seemed to be an appropriate method to obtain the specific ranking further.

In order to eliminate heteroscedasticity, the data of variables were first taken logarithm, and then correlation analysis of data was conducted factor analysis. We can see that  $MSA=0.685$ , which indicates that the selected data can be used for factor analysis[6].

From the results of TABLE II, we can know that the first factor of the characteristic value is  $\lambda_1 > 1$ , and the sample variance cumulative contribution rate is  $82.24\% > 80\%$ . Most of sample information was retained,

so we can choose the factor as a new evaluation index.

TABLE II.  
EIGENVALUES OF THE CORRELATION MATRIX

Eigenvalues of the Correlation Matrix: Total= 6 Average = 1				
	Eigenvalue	Difference	Proportion	Cumulative
1	4.93439864	4.34077481	0.8224	0.8224
2	0.59362383	0.32387594	0.0989	0.9213
3	0.26974788	0.09455095	0.0450	0.9663
4	0.17519693	0.15308964	0.0292	0.9955
5	0.02210729	0.01718186	0.0037	0.9992
6	0.00492543	0.00023016	0.0008	1.0000

The former factor loading was rotated in order to better describe the significance of the factors (The method of maximum variance rotation was used in this paper). The contribution rate of the eigenvalue and the accumulative variance after rotation was shown in Figure 1.

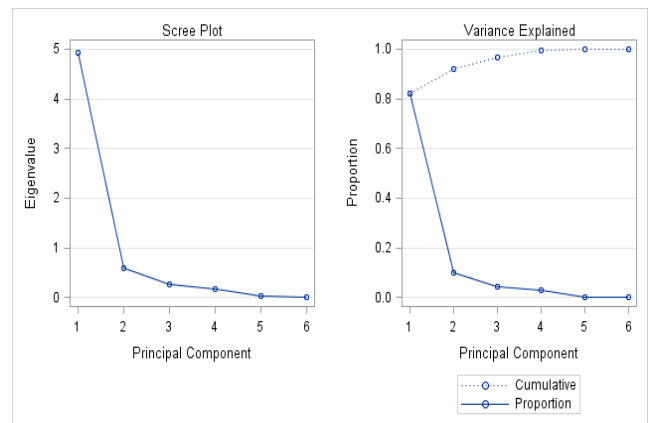


Figure 1. Scree plot and variance explained.

The composition matrix after factor rotation is shown in TABLE III.

TABLE III.  
COMPONENTS AFTER ROTATION OF FACTORS.

	Factor Pattern			
	Factor1	Factor2	Factor3	Factor4
Inx1	0.6010	0.6892	0.2630	0.2832
Inx2	0.3372	0.7928	0.4323	0.2550
Inx3	0.2221	0.3017	0.8886	0.2639
Inx4	0.6847	0.6044	0.2737	0.2939
Inx5	0.9043	0.2903	0.2132	0.2256
Inx6	0.3764	0.3428	0.4542	0.7311

In the  $F_1$ , paper resources purchase fee  $x_5$  takes the largest factor loading. Finally, the factor scores of university libraries are shown in TABLE IV.

TABLE IV.  
FACTOR ANALYSIS SCORES.

Obs	University	Factor1	Obs	University	Factor1
1	Zhejiang University	2.18698	15	Zhejiang University of Media and Communications	0.12546
2	Zhejiang International Studies University	1.21233	16	Huzhou University	0.11242
3	Zhejiang Yuexiu University of Foreign Languages	1.14687	17	Jiaxing University	-0.16363
4	Zhejiang Ocean University	1.04328	18	Zhejiang Gongshang University	-0.28193
5	Zhejiang University of Science and Technology	0.97640	19	Ningbo University of Technology	-0.34929
6	Zhejiang University of Technology	0.79976	20	Wenzhou University	-0.44361
7	China Academy of Art	0.64156	21	Zhejiang A&F University	-0.57909
8	Wenzhou Medical University	0.56499	22	Zhejiang Normal University	-0.71161
9	Ningbo University	0.54728	23	Zhejiang Wanli University	-0.78559
10	Zhejiang Sci-Tech University	0.49794	24	Zhejiang Chinese Medical University	-1.19258
11	Zhejiang University of Finance & Economics	0.46570	25	Lishui University	-1.43413
12	China Jiliang University	0.37888	26	Taizhou University	-1.61838
13	Shaoxing University	0.30949	27	Zhejiang University of Water Resources and Electric Power	-1.72053
14	Hangzhou Dianzi University	0.26487	28	Zhejiang Police College	-1.99383

III. SUMMARY AND SUGGESTIONS

Through the analysis of the construction actuality and the related literatures, the paper uses the cluster analysis and factor analysis to evaluate the comprehensive strength of the university libraries in Zhejiang province, and obtains the following conclusions:

- The comprehensive strength of the 28 university libraries in Zhejiang province makes a big difference. According to the clustering analysis, the 28 university libraries can be divided into three classes. The developmental level of each class is different.

- The results of factor analysis shows that Zhejiang university has the strongest comprehensive strength. Zhejiang International Studies University is number two, and the last one is Zhejiang police academy.

- Through the model specification and the related significance test in the factor analysis, it is easy to find that the paper-based resources consumption of the load capacity is the largest. That is to say, its impact on the investment performance of university library is the most remarkable.

According to the results of the research, the following suggestions which is aimed at the government departments and other relevant departments were proposed:

- The government should increase the funds for colleges and universities, and increase the proportion of research funding. At the same time, the university library should cooperate intimately with each other to integrate the resources of the university libraries and achieve a win-win situation.

- The university library should strengthen the cooperation with other interdisciplinary positively and change ideas. Meanwhile, further study of the readers' demands and the targeted services should be attached to great importance.

- Facing with numerous books and complex retrieval methods, the university library should liberate themselves from the development limitations and strengthen digital technology so that readers can consult the literature and books expediently.

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