

Diagnosis of Modern Higher Education

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Abstract: As a petri dish for talents, the role of higher education system is self-evident. Looking at the world, each country has its own unique higher education system and has its own advantages and disadvantages. In order to evaluate and measure the health and sustainability of these higher education systems, we identified and quantified six indicators that affect the health status of the higher education system. After that, we established principal component analysis model (PCA) to reduce the dimension, and constructed multiple linear regression model to fit a regression equation so that we can evaluate the health of the higher education system.

Keywords: Higher Education System; Principal Component Analysis; Multiple Linear Regression Model

1. Introduction

Higher education is the last stage of formal learning after the completion of basic education. This stage will shape a person's academic, spiritual and most solid and durable foundation. At present, there are many different styles of higher education systems in the world, such as American, British, Chinese and so on. Almost every country has its own unique higher education system. In order to measure and evaluate the health status of higher education systems in various countries, we decided to establish a set of mathematical models to quantitatively analyze the original vague concepts.

2. Preliminary confirmation of evaluation indexes

We refer to the introduction of higher education in one of the documents of the 1998 UNESCO World Conference on higher Education: higher Education in the 21st Century: world Declaration on Vision and Action^[1]. It is preliminarily determined that the evaluation indicators of the higher education system are personnel training, academic level, financial investment, teacher construction, international exchange, and then further quantify:

1. Personnel training: It is reflected that the quality of talent training in colleges and universities is highly recognized by the society, and the employment rate of graduates of colleges and universities can be used as a quantitative index, which we set it as X_1 ;

2. Academic level: Universities all over the world often take scientific research and academic research as their own responsibility, and the annual update of the academic ranking of universities around the world has also attracted much attention. Because the evaluation of the list is mainly based on academic achievements, including the number of alumni and teachers who have won Nobel Prizes and Fields Prizes, and the number of papers included by SCIE and SSCI, it can directly reflect the academic level of colleges and universities. Therefore, this paper takes the number of the top 1000 (ARWU) academic rankings of world universities in 2020 as a quantitative index, and sets it as X_2 ;

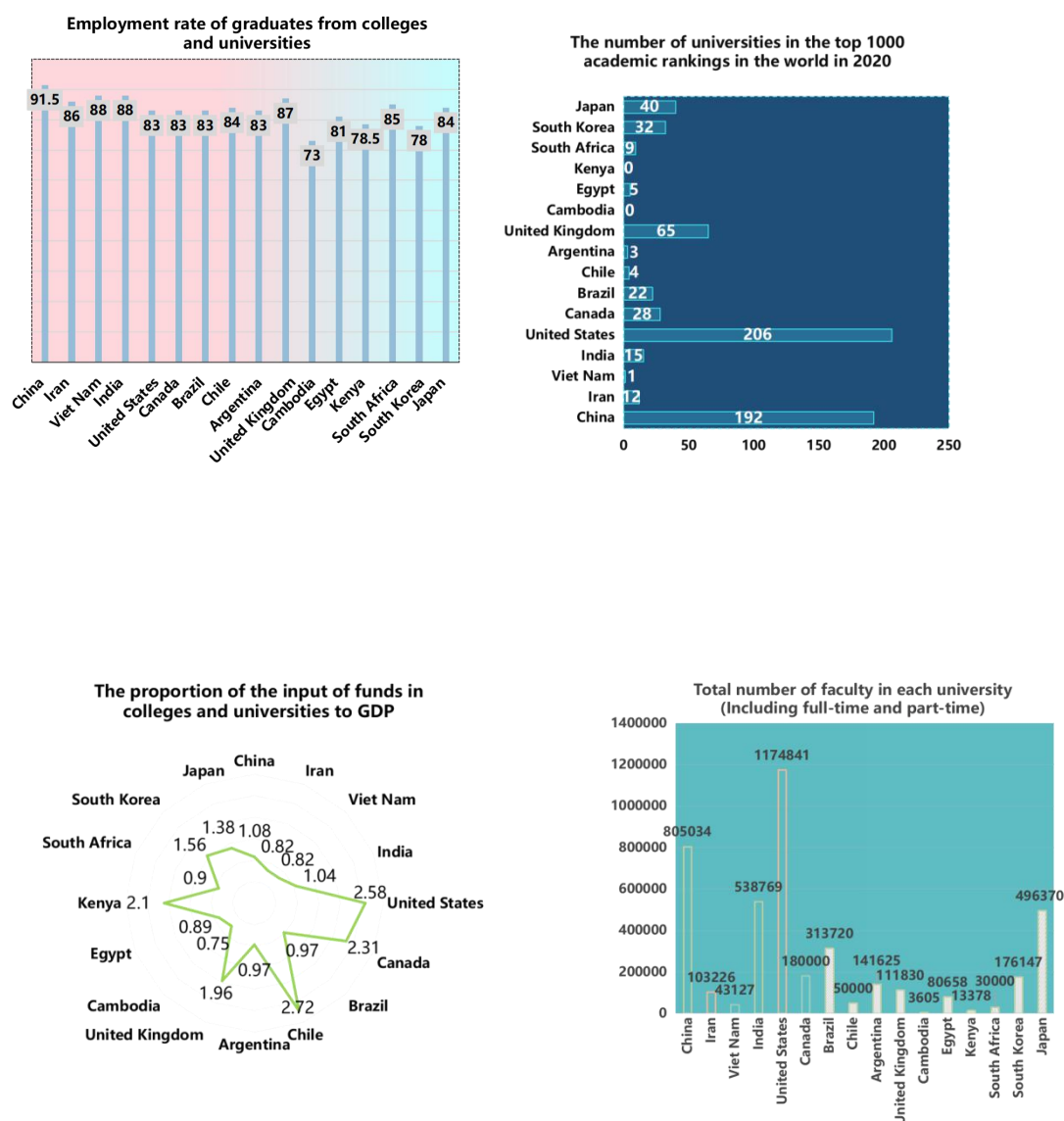
3. Financial investment: The proportion of funds input in colleges and universities in GDP is taken as a quantitative index, and it is set as X_3 ;

4. Teacher construction: the contingent of teachers is undoubtedly the foundation and guarantee of a country's higher education system. This paper takes the total number of teaching staff in colleges and universities (including full-time and part-time) as a quantitative index, and sets it as X_4 ;

5. International exchange: colleges and universities in various countries often carry out academic cooperation through joint training of students and joint scientific research on key problems. This paper takes the number of overseas floating students (foreign students from specific countries) as a quantitative index and sets it as X_5 ;

6. Popularization: internationally, the gross enrollment rate of higher education (the ratio of the number of students in higher education to the population of the right age) is often used to measure the popularity of higher education. Professor Martin Trow, an American scholar, proposed that it belongs to the popularization stage of higher education when the gross enrollment rate reaches more than 50%. Therefore, this paper takes the gross enrollment rate of colleges and universities in various countries as the quantitative index, and sets it as X_6 .

By consulting the OECD website, the UNESCO website and ARWU, we can get detailed data on the relevant indicators of the higher education systems of 16 countries, including China, Iran, Vietnam, India, the United States, Canada, Brazil, Chile, Afghanistan, South Korea, Japan, the United Kingdom, Cambodia, Egypt, Kenya and South Africa, as shown in the following figure:



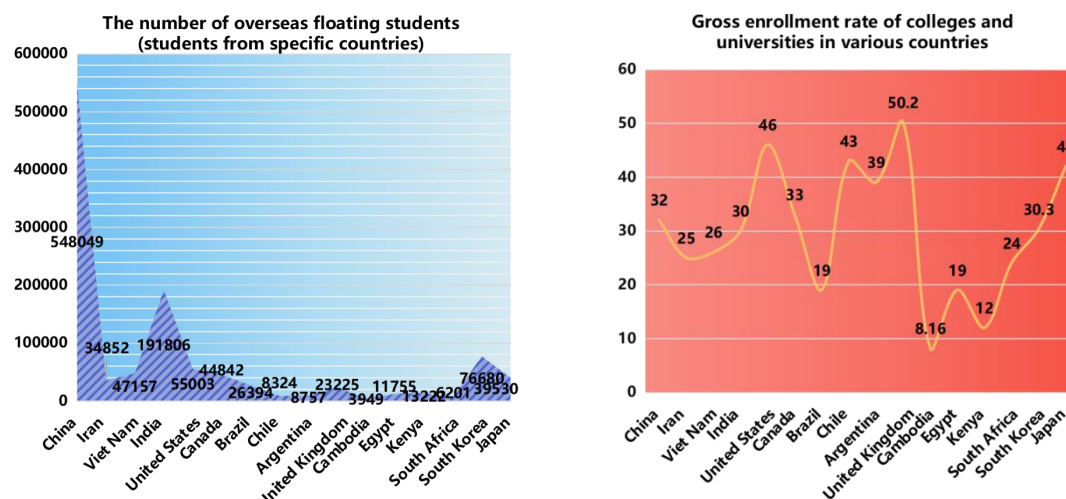


Figure 1: Data graph of each index

3. Dimensionality reduction by principal component analysis

After going through a tortuous and difficult process of data collection, several key questions have caused us to ponder: Can all these indicators we collect play a decisive role in the model? Can we reduce the difficulty of data collection at the same time ensure the accuracy of the evaluation model? So we consider using principal component analysis to reduce latitude. Before using principal component analysis, we use SPSS software to evaluate the correlation among the six indicators. The results shows that the correlation between each index is higher, and since both the and the significance test P value of Bartlett's Test of Sphericity are less than 0.001, which also shows that the accuracy of principal component analysis will be higher, so we start the principal component analysis with confidence. We use Matlab software to calculate the contribution rates of each index. Among them, the cumulative contribution rate of the first three indicators is more than 85%, so we determine that the number of principal components is 3, which is X_1 , respectively, X_2 and X_3 , and then according to the selected principal components, we get the comprehensive evaluation value of the higher education system of each country:

Table 2: Comprehensive score of each country

Country	China	Iran	Viet Nam	India
Score	1.3929	-0.4496	-0.3812	0.2335
Country	United States	Canada	Brazil	Chile
Score	1.949	0.2931	-0.5768	0.6241
Country	Argentina	United Kingdom	Cambodia	Egypt
Score	-0.1426	0.9555	-1.7625	-0.9088
Country	Kenya	South Africa	South Korea	Japan
Score	-0.857	-0.5687	-0.2967	0.4958

4. Multiple linear regression model

In order to make our model convenient and accurate to evaluate the higher education systems of all countries in the world, we further construct a multiple linear regression model. In the previous step, we identified three principal components that affect the health of the higher education system, and reduced the strict requirements for complex data by reducing dimensionality. Now we use these three principal components as independent variables to construct a multiple linear regression model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon, \varepsilon \sim N(0, \sigma^2)$$

Among them, β_0 and β_1 , β_2 , and β_3 are all unknown parameters that have nothing to do with X_1 , X_2 and X_3 . Using the relevant data of the three principal components and the comprehensive score calculated by Matlab software, we use SPSS software to fit a ternary linear regression equation to evaluate the health degree of higher education system:

$$Y = -9.300 + 0.097X_1 + 0.002X_2 + 0.614X_3, R = 0.963, F_{3,12} = 50.815, P < 0.001$$

Where R is the multiple correlation coefficient, F is the F value obtained by the F test, and P is the significant level. according to the R value close to 1, we can know that the fitting degree of the linear equation is very high.

5. Conclusion

In this paper, we establish a model to measure and evaluate the health and sustainability of the higher education system from a national point of view, which will help it to establish a state of healthy and sustainable development. People can apply this model to specifically evaluate one country's higher education system and put forward some improvement policy plans for it.

References

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