

## Research and Exploration of Educational Resource Balance Based on Data Analysis—A Case Study of Demonstration Schools in 13 Districts of Xi'an

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**Abstract.** According to the existing school evaluation standards, making a reasonable school resource development plan is an important guarantee to improve the competitiveness of the school and improve the teaching quality. This paper takes the schools in Xi'an as an example to expound the present situation of basic resource allocation in schools. The evaluation model is constructed based on least squares support vector machine (LS-SVM), and the resource allocation scheme is designed by particle swarm optimization algorithm. Finally, we put forward suggestions for improving the competitiveness and teaching quality of schools, and provide references for formulating scientific and reasonable school improvement plans.

### Introduction

Big data [1] is bringing great changes in human work, life and thinking, and has also strongly impacted the entire education system. It is becoming a subversive force driving innovation and reform of the education system.

Compared with the educational data collected by traditional methods, educational big data [2] has the advantages of real-time, continuous, comprehensive and natural. The data is mostly collected with the knowledge of users, and analyzed by simple statistical analysis methods. However, education big data can collect the static and dynamic data during the whole teaching process [3]. It can continuously record the data such as teaching materials, interactive reflection and students' residence time for different knowledge points without affecting normal teaching activities. And we can use different applications to analyze and process data of different complexity or depth.

Researchers consider the application of education big data from different perspectives. Professor Zhu [4] explored the scientific paradigm. Applying big data to the field of educational technology, Zhu proposes a personalized adaptive learning system supported by data. According to Zheng and Liu [5], education big data is mainly used to support education evaluation and education and teaching decisions. Hu and Wang [6, 7] believe that evaluating and predicting the changing educational forms can promote the scientific and effectiveness of educational decision-making. So that we can achieve a complete, comprehensive and dynamic quality control system. Yang [8] and other researchers believe that education big data can promote all aspects such as formulating scientific policies, balancing education in different regions, improving the quality of school education, optimizing the curriculum system and teaching effects, and promoting the individualized development of students.

Education big data brings out a new architecture and thinking mode. The method can weaken the analytical model and directly analysis the research target. It can study the law of "small phenomenon" through data aggregation, can study the multi-dimensional data fusion of individuals, and analyze the time series and spatial dimensional dynamics of target objects. Faced with various education businesses, education big data technology has exerted great influence on the management, teaching, learning, scientific research and evaluation of education.

This paper aims to use the big data to provide a strategic reference scheme to adjust the balance of educational resources from the perspective of the application of big data in education. We design an

educational resource evaluation system based on data analysis to balance the educational resource in different districts. The method applies the least square support vector machine model to evaluate schools, and then adopts Particle Swarm Optimization (PSO) to carry out balanced allocation of educational resources. The experiment uses the data of primary and secondary schools in 13 districts and counties in Xi 'an, and the results are good.

### Model Design and Experimental Analysis

Since the reform and opening, Chinese education has made great progress and brilliant achievements. However, the problems in educational practice have gradually surfaced. Education, medical care and real estate are known as the new "three mountains" for the common people. They have been criticized and questioned by theoretical circles and practical practitioners, especially the issue of educational equity, which has attracted the attention of the people all over the country. Educational resources are the basis for the survival and development of educational activities. American education administrator Rosentengel regarded school funding as "the spine of education." Students with the same ability may not enjoy the same level of education due to the unbalanced in the allocation of educational resources in different regions. Key schools and general schools are differences in some aspects, such as faculty strengths, hardware facilities construction levels, number of books, and education funding. However, the limitation of social resources determines the scarcity of educational resources. Under the premise of limited educational resources, in order to meet the demand of each component of the educational system, it is necessary to rationally and effectively allocate limited educational resources.

Therefore, we advocate a balanced allocation of resources, and allocate educational resources [9]to each school in a relatively equal way, and treat each school fairly and reasonably. China implements compulsory education for many years, but unlike the "popularization" of education in Western countries, there have been some "key schools" in China, which aggravates the competition for educational resources and unfairness. Therefore, we should focus on the transformation of compulsory education from elitism to democratization to ensure the balanced development of regions and students. Figure1 shows the number of students, teachers and student-teacher ratio in each area(district) in 2016.

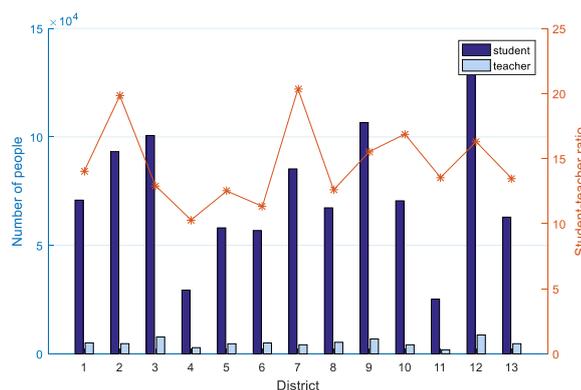


Fig. 1 The number of students, teachers and student-teacher ratio in each district in 2016

According to the figure1, the data set is a three-dimensional data, which is the number of students, the number of teachers, and the student-teacher ratio. There is no correlation between the data of each area(district) and no relationship between the number of students and the number of teachers. The student-teacher ratio is a relationship between the number of students and the number of teachers.

This paper uses LIBSVM [10] to build the evaluation system and realize resource classification evaluation. LIBSVM is a widely used SVM software package developed by Professor Chang and Lin from Taiwan University. It is easy to use and can be used to solve classification problems, regression

problems and distribution estimation problems. It is easy and convenient to use and to solve classification problems, regression problems and distribution estimation problems. It has been widely used in the industry.

LIBSVM is widely used in model building, sample training and prediction. And the selection of parameters has a significant impact on the training results, among which the parameters C and g are the most important. The grid search algorithm is used in the LIBSVM software package to optimize the combination of C and g. The classification evaluation model is established based on LIBSVM.

The top 101 records are used as the training data set, and the last 25 data are used as the test data set of the verification model. First, we need to normalize the data with svm-scale, and the feature values are processed on the interval [0, 1]. Then we apply grid.py to find the optimal values of parameters C and g, and poll the optimization to obtain the optimal parameters as  $c = 358.7321$ ,  $g = 30.45905$ . Finally, several experiments were conducted to obtain the optimal evaluation function and kernel function. Nu-svc was selected as the evaluation function and RBF kernel function was selected as the kernel function to establish the LIBSVM evaluation model.

We applied the LIBSVM evaluation model based on the training data set and the test data set respectively. The evaluation results are shown in table 1.

Table 1. Model evaluation results

| Experimental data | Accuracy | Relative error |
|-------------------|----------|----------------|
| Training data set | 83.1683% | 16.8317%       |
| Test data set     | 92%      | 8%             |

In Table 1, although the evaluation model still not optimistic, it can serve as a reference value. Next, we optimize the evaluation model above based on a set of real data to realize a balanced resource strategy. Figure 2 shows the statistics of the number of high school students, teachers and the number of books in each district of Xi 'an.

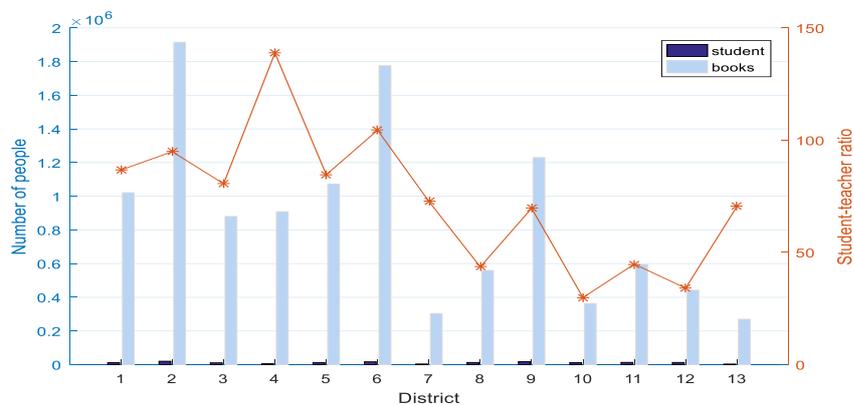


Fig.2 Statistics of the number of high school students, teachers and number of books in each district of Xi 'an

The student-teacher ratio represents the ratio of the number of students to the number of teachers. In theory, we prefer a lower value. The number of books per capita represents the ratio of the total number of books to the number of students. We would like a larger value in theory. As can be seen

from Figure 4, the student-teacher ratio and the number of books per capita are both belong to the imbalanced distribution of educational resources.

Now there are 1000 high school teachers and 100,000 new books to be distributed. In order to achieve the balanced development of regional education resources, we should balance the student-teacher ratio and the number of books per capita in each district. We should supplement teachers with a high student-teacher ratio and supplement books in schools with a low number of books per capita.

The gap in student-teacher ratio is quite large in each district, and it is urgent to solve the problem of imbalanced educational resources in each region.

Although the demonstrative school cannot be determined solely by the educational resources, the balanced development of education is related to the overall strategy issue of China's basic education development in the coming period. To achieve balanced development of educational resources, we should allocate students in a balanced way first; Next the balanced educational resources can determine the average level of basic education. According to the above demonstrative school test model, we adopt particle swarm optimization strategy [10]to construct a balanced distribution model of educational resources. The process design is shown in figure 6.

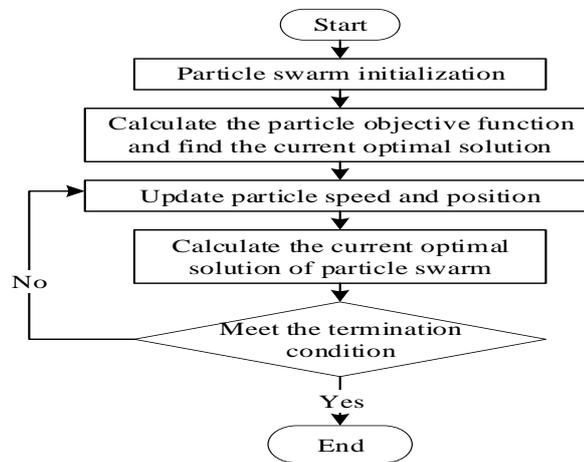


Fig. 3 Educational resource allocation model flow chart

Then taking the number of high school students, teachers and books in each district of a city as an example, we apply particle swarm optimization algorithm to allocate the 1000 teachers. The purpose is to balance the current situation of student-teacher ratio in each district, so we urge deal with the problem of high student-teacher ratio in some areas. Figure 4 shows the change trend chart of student-teacher ratio before and after the distribution.

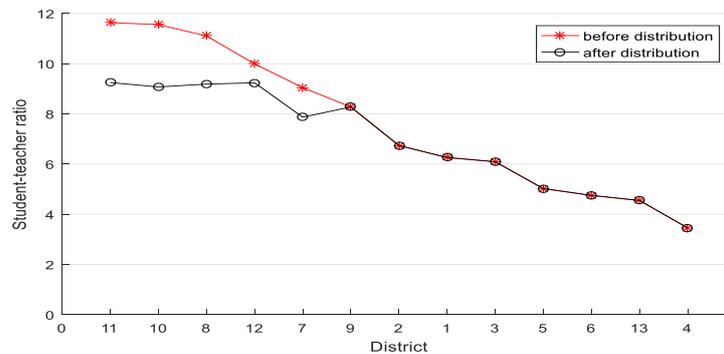


Fig. 4 The change trend of the student-teacher ratio in Xi'an

From the distribution result data, it is known that the five districts with the highest student-teacher ratio have been assigned new teachers. By assigning teachers, the student-teacher ratio in these five

regions has dropped significantly. From figure 4, the strategy of allocation by particle swarm optimization algorithm can indeed improve the problem of regional education resource imbalance. With the balanced allocation of new teachers every year, the student-teacher ratio in each district will inevitably reach equilibrium, and then decrease in a coordinated manner.

Next, we allocate 100,000 books, and the number of books per capita in each district is arranged in descending order, as shown in figure 5.

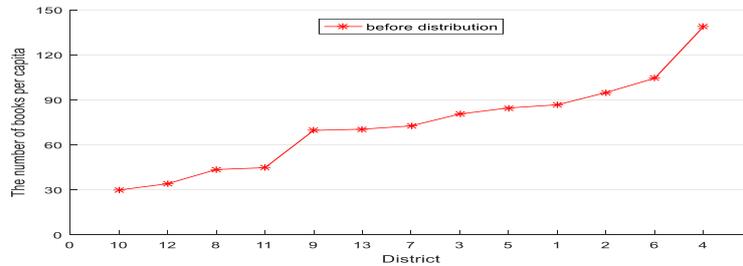


Fig. 5 The number of books per capita in each district of Xi'an

As can be seen from Figure 5 that the number of books per capita varies greatly among different districts, with the maximum four times of the minimum. The imbalance of educational resources is very serious, so we use the particle swarm optimization strategy to allocate 100,000 books to improve the unbalanced status of per capita books in the region. Table 3 shows the distribution results.

Distribution of books in balanced the number of books per capita in each district of Xi'an.

Table 2. Distribution of teachers in balanced student-teacher ratio in each district of Xi'an

| Area (district) | Number of students | Number of books (before allocation) | Books per capita (before allocation) | Allocation of books | Number of books (after allocation) |
|-----------------|--------------------|-------------------------------------|--------------------------------------|---------------------|------------------------------------|
| 1               | 11779              | 1021446                             | 86.717                               | 0                   | 86.717                             |
| 2               | 20185              | 1914772                             | 94.861                               | 0                   | 94.861                             |
| 3               | 10925              | 880434                              | 80.589                               | 0                   | 80.589                             |
| 4               | 6546               | 908681                              | 138.815                              | 0                   | 138.815                            |
| 5               | 12678              | 1072874                             | 84.625                               | 0                   | 84.625                             |
| 6               | 17008              | 1776209                             | 104.434                              | 0                   | 104.434                            |
| 7               | 4179               | 303686                              | 72.670                               | 0                   | 72.670                             |
| 8               | 12850              | 559515                              | 43.542                               | 598                 | 43.589                             |
| 9               | 17665              | 1230236                             | 69.643                               | 0                   | 69.643                             |
| 10              | 12158              | 363090                              | 29.864                               | 79020               | 36.364                             |
| 11              | 13288              | 594900                              | 44.770                               | 433                 | 44.802                             |
| 12              | 12988              | 442549                              | 34.074                               | 19949               | 35.610                             |
| 13              | 3830               | 269879                              | 70.464                               | 0                   | 70.464                             |

Table 3 shows that 100,000 books are allocated to the three districts with the lowest number of books per capita. According to the line chart of the number of books per capita before and after the

distribution in Figure 6, we can observe that only one district has a significant increase in the number of books per capita.

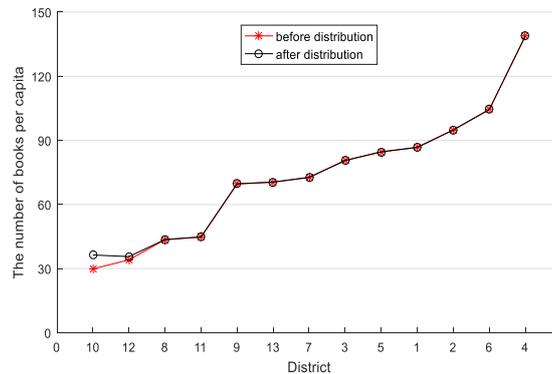


Fig. 6 The number of books per capita in each district of Xi'an

After the allocation of 100,000 books, the district 10 with the lowest number of books per capita have improved significantly, while the number of books per capita in district 12 and 8 does not changed obvious from Figure 6. The main reason is that the book base of these two districts is too large, and the newly added 100,000 books account for a small proportion of the base. Therefore, it is difficult to significantly improve the imbalance of the number of books per capita through these newly added books. To fundamentally solve the problem of resource imbalance, we should develop each district in a balanced way in the infrastructure construction of educational institutions, instead of making up for it after the unbalanced educational resources. At the same time, in the process of the development of educational institutions, each district should also strive to solve its own problems and cannot rely on the resources allocated by higher education departments to change the status quo.

## Conclusion

The balanced allocation of basic education resources is a hot issue that the whole society concerns to. All parts of the country are exploring according to actual conditions, but there is no unified model. The main reason is that there are great differences in the regional area, economic and social development status, comprehensive level of education and other factors. This paper takes the education equilibrium allocation of each district and county in Xi'an as a specific case, establishes a classification evaluation model based on LIBSVM, and evaluates whether the school is a demonstration school based on the data of school infrastructure resources. According to the above measured model, the particle swarm optimization strategy is adopted to construct a balanced allocation model of educational resources, and the solution of resource balanced distribution is obtained.

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