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Trends and Suggestions for China's "Double First Class" undergraduates in Further education-Grey model analysis based on data from 50 universities

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Abstract: *In order to more accurately grasp the trend of future education choices of "double first-class" undergraduates and provide a basis for the future development of China's education, the employment quality report of 50 "double first-class" universities in China from 2014 to 2021 was studied, which describes the characteristics of the proportion of overall further education, domestic further education, and overseas further education, we analyzed the trend of the overall further education, domestic further education and overseas further education in the next 5 years by using the grey model. It is found that the proportion of those who choose to pursue further studies in the next 5 years will increase, and the choice is more inclined to domestic further studies. The development of higher education in China should be promoted by enhancing the quality of postgraduate cultivation and increasing the cooperation of international education.*

Keywords: *Grey model, Higher education, Double First Class*

1. Introduction

According to the U.S. Immigration and Customs Enforcement's Annual Report on the Student and Exchange Visitor Program for 2021, the number of international students from China to the U.S. in 2021 is 8.77 percent lower than in 2020[1]. At the same time, further education in China continues to grow to record highs, with 4.57 million applicants for the national master's degree examination in 2022. So what is causing the new change in where graduates are going for further education?

Firstly, the severe employment situation is the first major reason why more fresh graduates choose to pursue further education. According to the China Statistical Yearbook 2021, the urban registered unemployment rate reached 4.24 percent in 2020[2], which is the highest unemployment rate in the past decade. At the same time, the current number of undergraduate graduates in China will exceed 10 million, while the number of jobs provided by society is far from enough, which leads to the increasingly high requirements of the job market for graduates, and the undergraduate degree is no longer competitive. Therefore, some undergraduate graduates elect to continue their further education to escape the employment pressure and enhance their competitiveness.

Secondly, in recent years, China has been expanding the scale of graduate student enrollment and improving the quality of postgraduate training, which has attracted numerous undergraduates to receive further education. From the enrollment scale, since 1978, when the postgraduate enrollment system was formally restored, the scale of postgraduate students has grown rapidly, with the number of enrollments increasing nearly 100 times from 1978 to 2021, and the admission rate has reached more than 25 percent. From the perspective of postgraduate training, China pays more and more attention to the quality of postgraduate training, and formulated several plans, for example, in 2007, China launched a quality project for postgraduate education, paying more attention to the cultivation of quality. The above two aspects show that China attaches great importance to the cultivation of graduate students and attracts more quality talents to choose to receive postgraduate education.

Thirdly, the world epidemic situation is still serious, which discourages some students from thinking about going abroad and even giving up their plans to study abroad. To avoid the spread of the epidemic, several countries strictly restrict entry and exit, even reducing the number of international flights, which raises the difficulty of cross-border mobility[3], which objectively dispels the idea of studying abroad.

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In such a context, whether to study at home or abroad will become a difficult issue for college students to choose when they graduate, and in the future, undergraduate graduates may give up studying abroad and prefer to stay at home for further study. So, it is important to research the trend of undergraduates' choice of further education in China's "double first-class" universities to help undergraduates to better plan their lives and provide empirical evidence for China to improve the corresponding policy of entering higher education.

2. Data sources

China's "double first-class" universities can represent the highest level of Chinese higher education. Therefore, this study selects 50 colleges and universities of different types and regions among 147 universities in the second round of "double first-class" construction in China for research. Based on the data in the employment quality report published on the official website of each university, the analysis of these 50 universities can roughly determine the overall situation of the national universities and provide empirical support for the improvement of the advancement policy.

In this study, the data of the domestic further study ratio of 50 "double first-class" universities in China from 2014 to 2021 are used as the research object, mainly discussing the proportion of overall further education, domestic further education, and overseas further education through calculating. The grey model was used to predict the trend for the 5 years from 2022 to 2026, and MATLAB software was introduced to analyze and test the data. Finally, conclusions and recommendations were drawn. The specific data of the 50 "double first-class" universities studied in this paper are shown in Table 1.

Table 1: The data related to the 50 "double first-class" universities for further studies.

Year	2014	2015	2016	2017	2018	2019	2020	2021
overall further education ratio	41.706	43.753	45.382	47.562	47.358	49.277	49.507	50.904
domestic further education ratio	28.366	29.540	30.272	32.167	32.790	33.664	35.598	39.856
overseas further education ratio	30.509	31.135	31.139	31.342	30.075	30.857	26.472	21.838

3. Research Process

3.1. Principle of grey model construction

Grey system theory was first proposed by Julong Deng in 1982. This theory is to take "small data" with "partly known information and partly unknown information" as the research object and uses the known and favorable information to achieve the correct portrayal of the unknown information[4]. The grey model has a wide range of applicability, and it is feasible to apply this model to analyze the trend of further education.

3.2. Prediction and test of enrollment proportion

3.2.1. The proportion of overall further education

According to the grey model, the results shown in Table 2 can be obtained:

Table 2: Fitting results of overall further education proportion model.

Year	Original value	Predicted value	Residuals	Relative Error
2014	41.706	41.706	0.000	0.000%
2015	43.753	44.394	-0.641	1.465%
2016	45.382	45.445	-0.063	0.140%
2017	47.562	46.522	1.040	2.187%
2018	47.358	47.624	-0.266	0.561%
2019	49.277	48.752	0.525	1.066%
2020	49.507	49.906	-0.399	0.807%
2021	50.904	51.088	-0.184	0.362%

Based on the data obtained from the above table, model tests were conducted as Table3:

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Table 3: Results of the overall further education ratio model test.

Mean Squared Error Ratio C	Small error probability p
0.18527	1

The mean squared error ratio of the above model $C=0.18527<0.35$ and the small error probability $p=1>0.95$, compared with the accuracy test table, the model accuracy is better and suitable for predicting future data.

This leads to the conclusion in the following Table 4:

Table 4: Projected results of overall further education ratio.

Year	2022	2023	2024	2025	2026
Predicted value	52.298	53.537	54.805	56.103	57.432

3.2.2. The proportion of domestic further education

According to the grey model, the results shown in Table 5 can be obtained:

Table 5: Fitting results of domestic further education proportion model.

Year	Original value	Predicted value	Residuals	Relative Error
2014	28.366	28.366	0.000	0.000%
2015	29.540	28.887	0.653	2.212%
2016	30.272	30.274	-0.002	0.008%
2017	32.167	31.729	0.438	1.362%
2018	32.790	33.253	-0.463	1.411%
2019	33.664	34.850	-1.186	3.524%
2020	35.598	36.524	-0.926	2.601%
2021	39.856	38.279	1.577	3.956%

Based on the data obtained from the above table, model tests were conducted as Table 6:

Table 6: Results of domestic further education ratio model test.

Mean Squared Error Ratio C	Small error probability p
0.26336	1

The mean squared error ratio of the above model $C=0.26336<0.35$ and the small error probability $p=1>0.95$, comparing with the accuracy test table, the model accuracy is better and suitable for predicting future data.

This leads to the conclusion in the following Table 7:

Table 7: Projected results of domestic further education ratio.

Year	2022	2023	2024	2025	2026
Predicted value	40.118	42.045	44.064	46.181	48.400

3.2.3. The proportion of Overseas further education

According to the grey model, the results shown in Table 8 can be obtained:

Table 8: Fitting results of overseas further education proportion model.

Year	Original value	Predicted value	Residuals	Relative Error
2014	30.509	30.509	0.000	0.000%
2015	31.135	32.958	-1.823	5.854%
2016	31.139	31.536	-0.397	1.276%
2017	31.342	30.176	1.166	3.720%
2018	30.075	28.874	1.201	3.993%
2019	30.857	27.628	3.228	10.463%
2020	26.472	26.437	0.035	0.134%
2021	21.838	25.296	-3.458	15.836%

Based on the data obtained from the above table, model tests were conducted as Table 9:

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Table 9: Results of the test of the model of the proportion of overseas further education.

Mean Squared Error Ratio C	Small error probability p
0.64638	0.75

The mean squared error ratio of the above model $C=0.64638<0.65$, which indicates that the model accuracy is barely qualified, and the small error probability $p=0.75$, which also indicates that the model accuracy is barely qualified, i.e., the model is not suitable for predicting the data of overseas further education.

At the same time, we can see that the change in the proportion of further studies abroad is not an obvious pattern, not showing a monotonic increase or decrease, so this study only predicts the change of foreign promotion, not the value.

By analyzing the proportion of further studies abroad from 2014 to 2021, it can be found that the proportion of further studies abroad from 2014 to 2019 is relatively stable and does not change much. However, there is a significant decline in the data from 2020 to 2021, and it is mainly due to the global spread of the new crown epidemic. Therefore, it is expected that the proportion of further education abroad will still be dominated by a decreasing trend in the future.

3.3. Study results

Based on the prediction method of the gray model described above, the results predicted by MATLAB software are shown in tables 4 and 7, from which we can find that the overall proportion of these 50 "double first-class" universities will further increase, and is expected to rise to about 57 percent by 2026, i.e. more than half of the graduates choose to higher education to improve their competitiveness.

According to the data of the gray model, the proportion of graduates from these 50 "double first-class" universities to higher education in China will continue to rise in the next few years and will rise to about 52 percent in 2026. This is in line with the trend of expanding the scale of postgraduates in China. It is expected that the scale of postgraduate enrollment will be reasonably adjusted with the increase in the number of postgraduate candidates.

According to the test results of the gray prediction model, the accuracy of the model of the proportion of further education abroad is low, and it is not suitable for prediction by using the gray prediction model, therefore this study only predicts its future trend. It is expected that during the period when the epidemic situation is not yet improved, the proportion of studying abroad will still have a decreasing trend. Until the international COVID-19 epidemic situation improves, the proportion of further education abroad will stabilize. However, due to the demand of undergraduates to study abroad to enrich their experience and enhance their competitiveness[5], the proportion of further education abroad will not drop to a very low level and may remain at about 20 percent.

Therefore, this study shows that more undergraduate graduates will be more inclined to choose domestic further education. Under such conditions, universities should actively improve the talent cultivation mode, promote the development of higher education in terms of postgraduate training and discipline construction, and reserve strong talent strength for the future development of China.

4. Research recommendations

4.1. To improve the quality of postgraduate training and accumulate excellent talent power for national construction

With the increasing proportion of undergraduates from 50 "double first-class" universities choosing to further education in China, the cultivation of postgraduate talents will become an extremely important part of Chinese higher education. Therefore, universities should not only attach importance to the growth of the number of graduate students but truly improve the ability of graduate students.

Firstly, a scientific cultivation system should be formed to seize the key cultivation links such as teaching, internship, scientific research, dissertation defense, etc., and implement the responsibilities of each link to promote the development of postgraduate cultivation. Secondly, universities should strengthen the supervision of the cultivation quality of each link of postgraduates. Finally, universities should draw on the excellent foreign postgraduate cultivation mode, while retaining the advantages of

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Chinese cultivation mode, critically absorbing the excellent foreign cultivation mode, and promoting the integration of localization and internationalization of the postgraduate education mode.

4.2. To increase international educational cooperation and promote the internationalization of education

According to the internationally recognized 2022 QS World University Rankings, there are only 12 Chinese schools in the top 100 in the world, which shows that there is still a gap between the education level of China's universities and the world. And this is also a driving force for the graduates of "double first-class" schools to choose to receive international education. Therefore, promoting China's higher education to connect with the world is necessary. On the one hand, it is important to promote the internationalization of China's education and promote the construction of educational power. On the other hand, strengthening the exchange and cooperation with the world's education is conducive to expanding the international vision of graduate students and enhancing their competitiveness.

Firstly, it is necessary to implement a series of international cooperation programs and explore new modes of cooperation in mutual recognition of credits, daily management, teaching, and lectures between the two sides. Secondly, when the international COVID-19 epidemic situation improves in the future, some undergraduates will still choose to study abroad, and the country should encourage these students to go abroad. Such as establishing channels of communication with the international community through various exchange programs, learning from the excellent achievements of the world, and attracting these international students to return to China to contribute to the development of the country. Finally, universities should create a favorable atmosphere by improving the treatment of international talents and providing favorable policy conditions to attract international teachers to participate in teaching and research in China.

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