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Analysis of Professional Basic Courses of Mathematics

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Abstract:

Professional basic courses play an important role in the current college teaching, which directly determines the prospect of students' professional development. This paper will take the major of mathematics and applied mathematics as an example to analyze the interaction between the basic courses of the specialty. Based on the results obtained, we try to discover the rules of students' scores, and organize mathematics teaching more effectively.

Keywords **—Mathematical analysis, Advanced algebra, Spatial analytic geometry, Score analysis.**

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I. INTRODUCTION

Mathematics and applied mathematics is a subject offered by most universities in China. This specialty is dedicated to cultivating students to master the basic theories and methods of mathematics science, so that students have the ability to use mathematical knowledge and computer to solve practical problems, and receive preliminary training in scientific research. At present, although colleges and universities have different learning courses in the cultivation of this specialty, what they all have in common is that they take mathematical analysis, advanced algebra and spatial analytic geometry as the basic specialized courses of this specialty. They usually offer these three courses in the first semester of freshman enrollment. This is because that these three professional basic courses are the necessary foundation for learning other subsequent mathematics courses, such as differential geometry, differential equation, complex function, real function and functional analysis, calculation method, probability theory and mathematical statistics.

Mathematical analysis has scientific logic and historical inheritance, which determines the pivotal position of mathematical analysis in mathematical science. Many new ideas and applications of mathematics originate from this solid foundation. Advanced algebra has strict logic, systematic reasoning and abstract thinking, and its contents include a variety of linear systems and structures. Linearization of complex problems is a common way to solve practical problems. Advanced algebra provides preliminary answers for the preliminary solution of these problems and builds a unified solution platform. Spatial analytic geometry cultivates students' spatial imagination ability and the ability to solve practical problems with geometric knowledge and methods. Learning these courses can train students to have certain abstract thinking ability, logical reasoning ability, spatial imagination ability and operational ability.

II. SOURCE AND DESCRIPTION OF DATA

We selected 37 normal students majoring in mathematics and applied mathematics in 2012. Among them, 7 students failed to follow the class because they changed their majors or joined the army. Our analysis was based on the academic performance of 30 students who graduated as scheduled in 2016. This paper selects the scores of mathematical analysis, advanced algebra and spatial analytic geometry of these 30 students. Among them, the mathematical analysis course has 288 credits, which is divided into three semesters, and the advanced algebra course has 160 credits, which is divided into 2 semesters. Spatial analytic geometry has 48 credits, and it is offered in the first semester.

Here we mainly analyze these two problems: (1) Is there any regularity in the continuity of academic performance in the same course? (2) Is there any correlation between the subject scores of different courses? The conclusion of these conclusions will provide good decision supports for us to pay more dynamic attention to students' learning situation and set up more reasonable professional courses of mathematics and applied mathematics.

III. DATA ANALYSIS AND RESULT DESSCIPTION

We have done the performance analysis of mathematical analysis I, mathematical analysis II, mathematical analysis III, advanced algebra I, advanced algebra II and spatial analytic geometry. For convenience, we used MathAnaly I, MathAnaly II, MathAnaly III, AdvaAlge I, AdvaAlge II and SpaceA to abbreviate mathematical analysis I, mathematical analysis II, mathematical analysis III, advanced algebra I, advanced algebra II and spatial analytic geometry in this paper respectively.

The radar schematic diagram of the highest score is shown in Fig.1. Here the highest score, the lowest score and the average score of each course are given. As can be seen from Fig. 1, the score polarization is very serious in each course, especially in mathematical analysis I. In general, the average scores of the six courses are all around 70, among which the highest is advanced algebra I (80.69) and the lowest is mathematical analysis II (62.83). The difference lies in the difficulty of courses, the devotion of learning energy, and degree of difficulty for examination papers. For freshmen we found that mathematical analysis courses are the most difficultly accepted course, while advanced algebra courses are relatively less difficult to accept. In addition, advanced algebra has undergone curriculum reform and some intermediate process assessment is added, which to some extent also increases the participation of students and reduces the difference in grades. The difference in spatial analytic geometry is small, which may be related to the convergence of high school knowledge.、

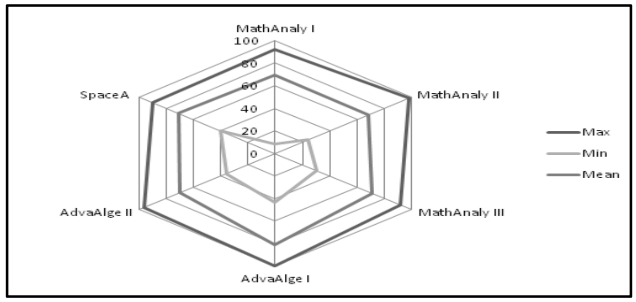

Fig. 1. Radar Chart of Scores of Six Courses

To further visualize the fluctuations of the six courses, we present histograms of the mean and standard deviation of the six courses (Fig. 2). We found that the volatility was not very different, and two semesters of advanced algebra showed similar volatility. Mathematical analysis of the first two semesters has greater volatility compared with that in the third semester. By inspecting the difficulty of examining papers in the third semester is far below those in the former semesters. And it may be explain the decline of volatility.

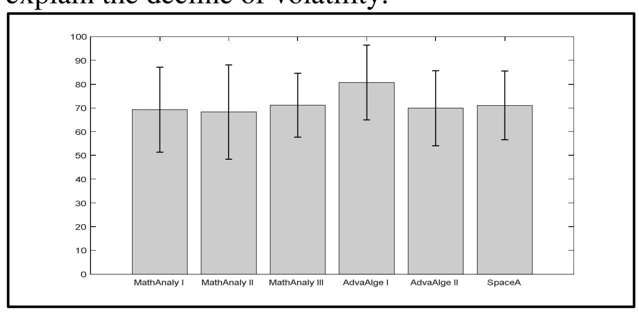

Fig. 2. Mean and variance of fractions of six courses

The following figure gives the distribution curve of the scores of 6 courses for 30 students (Fig. 3). We find that there are great differences in the scores of students, but most of the students' scores are consistent, that is to say, students with poor grades tend to have poor scores in all 6 courses, and students with good grades also have outstanding scores in all 6 courses. This shows that learning attitude is an important factor in determining academic performance. At the same time, we found that most of the lowest scores in the six courses were in mathematical analysis I and II, which again reflected the difficulty of mathematical analysis.

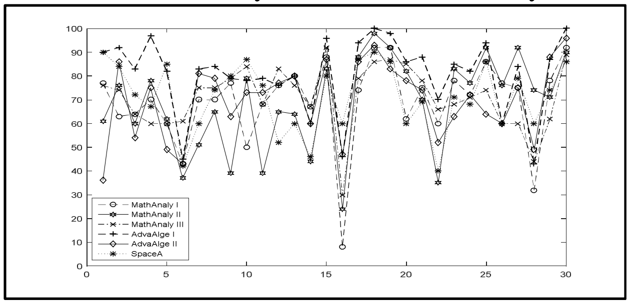

Fig. 3 Curves of scores of six courses

In order to further reflect the correlation between different courses, we first used the correlation coefficient to analyze the correlation coefficient between six courses, and the results are shown in TABLE I. For each course, the highest correlation coefficient is shown in bold, while the lowest on is shown in Italic.

TABLE II Correlation coefficient between six courses

Course	Math AnalyI	Math AnalyII	Math AnalyIII	Adva Alge I	Adva Alge II	SpaceA
Math AnalyI	1	0.5816	0.7512	**0.7852**	0.5850	*0.4362*
Math AnalyII	0.5816	1	0.4729	**0.6405**	*0.5785*	0.5812
Math AnalyIII	**0.7512**	0.4729	1	0.7112	0.6207	*0.4002*
Adva Alge I	**0.7852**	*0.6405*	0.7112	1	0.6657	0.7010
Adva AlgeII	0.5850	0.5785	0.6207	**0.6657**	1	*0.3642*
SpaceA	0.4362	0.5811	0.4002	**0.7010**	*0.3642*	1

As can be seen from the above table, MathAnaly I, AdvaAlge I, AdvaAlge II and SpaceA have the largest linear correlation with AdvaAlge I, which indicates that the grades in the first semester are highly correlated. Three courses, MathAnalyI, MathAnalyIII and AdvaAlge II, have the least linear correlation with SpaceA, which shows the relative independence of analytic geometric thinking mode.

We further use canonical correlation analysis to analyze the canonical correlation between mathematical analysis, advanced algebra and spatial analytic geometry. Fig. 4(a) shows the canonical correlation between mathematical analysis courses and advanced algebra courses, Fig. 4(b) shows the canonical correlation between mathematical analysis courses and analytic geometry courses, and Fig. 4(c) shows the canonical correlation between advanced algebra courses and analytic geometry courses. It can be seen that the correlation between mathematical analysis courses and advanced algebra courses is the most typical. The spatial thinking involved in spatial analysis courses is quite different from that of other courses, so the correlation is not obvious. Seen from Fig. 4, we can see that there is a loose linear correlation between these courses. Thus learning attitude is an important factor to effect students' scores.

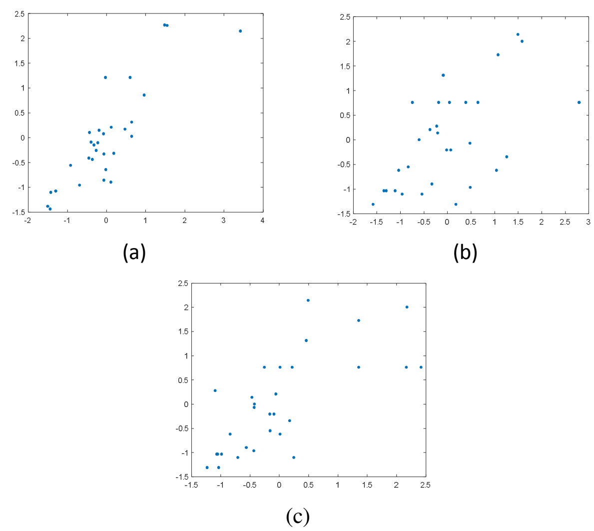

Fig. 4 Canonical correlation analysis of three kinds of courses

IV. CONLUSION

Professional basic courses are the key component of the mathematics course system, which plays an Irreplaceable role in cultivating the scientific quality of students. By analyzing the result final examination as the research tools, we find the reliability of different courses, mathematics analysis is the most difficult course to master. We also find students' learning initiative plays an important role in their academic performance. According to the results obtained above, we should make reasonable teaching reform on the content and form of teaching in Professional basic courses, especially in mathematics analysis.

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