Exploration on Teaching Reform of Applied Statistics in Economics and Management Based on Ability Improvement

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Abstract: Solid ability of logical analysis and mathematical statistics has become the essential basic skills of contemporary college students, and the teaching of applied statistics has become the main way to acquire this skill. However, most applied statistics courses still focus on theoretical derivation and interpretation, and its "application" characteristics have not been fully reflected. Taking the students of economics and management as the research object, this paper summarizes the main problems existing in the teaching process of applied statistics, and puts forward some reference solutions from the perspective of improving the application ability based on previous students' learning experience and effect feedback in order to provide beneficial help for the teaching reform of applied statistics in the future.

1. Introduction

Applied statistics, as a basic course for economics and management majors, is dedicated to cultivating students' ability in data collection, collation and analysis, so as to improve students' prediction and cognitive level of uncertain phenomena. The study of this course has important influence and significance on the follow-up study of professional courses and the improvement of practical work ability in the future. However, different from other basic courses, such as college mathematics, management, economics, etc., applied statistics is often potentially contradicted by many students because of its obscure theoretical derivation and complicated statistical formulas [1]. Some scholars' investigations have shown that as many as 80% of college students have experienced some form of statistics anxiety [2]. Taking the college where the author works as an example, some students have gone through three rounds of re-examination before finally getting credits, and some students have been forced to postpone graduation because of failing this course. On the one hand, the emergence of this problem may be caused by subjective reasons such as students' learning attitude and learning ability. On the other hand, it also shows that with the change of economic and social environment, our applied statistics teaching should also make some adjustments in time to conform to the current ability-oriented education system reform trend such as "self-education" and "lifelong learning"

At current stage, the development of economics and management must specialty highlight its

application orientation, which is consistent with the talent demand of China's economic and social development. Especially in recent years, the rise of new concepts such as Internet+, big data and artificial intelligence requires us to train economic and management talents not only as professional talents, but also as compound talents, among which the data analysis ability of economic and management talents has reached an unprecedented height. Thomas J. Sargent, winner of the Nobel Prize in Economics in 2011, once said, "Artificial intelligence is actually statistics, but it uses a gorgeous phrase, which is actually statistics". Therefore, it is necessary to strengthen the training of data analysis ability of economic and management students in the process of compound training of economic and management talents, and the teaching of applied statistics is the most effective and important way for students to acquire this ability. In the future reform of applied statistics teaching, efforts should be made to highlight the application characteristics, take the improvement of students' practical ability as the starting point, and strengthen the cultivation and improvement of students in data collection, variable setting, model construction, software operation and statistical result analysis.

2. Main issues in the teaching of applied statistics in economics and management

The development of modern statistics includes two basic directions: applied statistics and mathematical statistics, which are based on the same basic theories and directions, but the learning difficulty of the former is far lower than that of the latter. Although most schools of economics and management in China offer applied statistics courses, in the specific teaching process, there is an inevitable tendency to apply to mathematics and physics to a certain extent. Through the teaching experience of applied statistics in recent years and students' learning feedback, the author summarizes the following common problems in the current classroom teaching of applied statistics.

2.1 The teaching objectives are not clear, which is quite different from students' needs

Usually, the teaching of applied statistics is to ensure that students can understand the basic concepts and ideas of statistics, master the basic theories and methods of statistics, and explore the inherent laws of data and achieve a correct understanding of the objective world. In the actual teaching process, teachers can basically pass on the concepts, theories and methods of statistics to students, including data types, data acquisition methods, descriptive statistics, inferential statistics and other basic contents. However, there is still a big gap between this and the improvement of students' data processing ability, especially for students majoring in economics and management, it should be the most urgent and important to use statistical software to analyze data and solve practical problems, whether they continue to study in graduate school or participate in work. Taking the author's college as an example, the pre-survey (Table 1) of the course in recent three years shows that nearly 85% of the students want to be able to analyze and solve practical problems independently by studying the applied statistics course, but in the follow-up survey after the course, only less than 20% of the students think that they have acquired this ability. All these indicate that there is a big difference between the current teaching of applied statistics and the actual needs of students, and the guiding ideology of course teaching needs to be changed.

Table 1: Survey Results of Applied Statistics Course(Summary of Grade 17-19).

Aim of the course	Grade 17-19	
	number	percentage
(1)Understand statistical concepts and logic	15	7.46%
(2)Master the basic methods of data collection	117	58.21%
(3)Analyze data with graphs	134	66.67%
(4)Solve problems with metrological analysis software	170	84.58%
Have the following goals been achieved through learning?	Grade 17-19	
	number	percentage
(1)Understand statistical concepts and logic	201	100%
(2)Master the basic methods of data collection	195	97.01%
(3)Analyze data with graphs	157	78.12%
(4)Solve problems with metrological analysis software	39	19.4%

2.2 Emphasis is placed on theoretical derivation, and the teaching content is not rich enough

The current teaching content of applied statistics mainly includes three parts: data collection and chart display, descriptive statistical analysis and inferential statistical analysis. Specific knowledge points include data types, data sources, data preprocessing, probability and probability distribution, three sampling distributions, parameter estimation, hypothesis testing, independence testing and variance analysis. These contents basically constitute the basic contents of applied statistics, especially in the follow-up teaching process of parameter estimation and hypothesis testing. Because the contents of this part are abstract, teachers usually spend a lot of time to deduce and practice specific statistical indicators and measurement formulas. In addition, the inherent disadvantages of economics and management students in basic courses such as mathematics and probability theory lead teachers to spend a lot of time on theoretical derivation, but students still know little about it, but they don't know why, which further aggravates students' anxiety. In fact, from the analysis of the follow-up application degree, this part of the content basically does not need students to calculate independently. With the help of modern metrological analysis software such as Excel, SPSS, STATA and SAS, these analysis results can be easily realized. Therefore, the author thinks that these contents should focus on the interpretation of logic and results, rather than the deduction of theory and formula. Moreover, from the perspective of scientific research and practical application, the following more important contents such as index selection, model construction, unitary and multiple regression analysis, time series analysis, etc. are not reflected in this course, and the teaching content is incomplete, and the more critical part for improving practical application ability is missing.

2.3 The teaching mode is backward and lacks practical operation

Due to the lack of hardware conditions in most of the economics and management colleges, the teaching of applied statistics has to adopt the traditional classroom teaching method. Mostly, teachers are happily explaining in the classroom, while at the same time, the students are drowsy in the classroom. The effect of teaching is extremely low. In essence, applied statistics should be a practical course, yet traditional teaching methods can only guarantee students' understanding of basic knowledge and theory, but cannot improve students' ability to analyze and solve problems independently. Especially for the teaching of parameter estimation, hypothesis testing, independence testing and analysis of variance, the author believes that allowing students to discuss independently or operate statistical software is a key step to help them understand the content. However, due to some

subjective and objective conditions, at present, most applied statistics classrooms are still difficult to meet this requirement. For the same situation, take hypothesis testing problems as an example, it is used in subsequent scientific research. After students fully understand the basic principles and calculation procedures of hypothesis testing, if they use manual calculations to determine whether to accept or reject the null hypothesis, it may take about 10-15 minutes, but if the operation is performed through the measurement analysis software, it will only take 1-2 seconds after the original data input is completed, and it is almost difficult to encounter in the follow-up scientific research. Especially after further expansion of regression analysis, model construction, etc., traditional teaching models and methods are bound to make major adjustments.

2.4 Departure of teaching, and insufficient learning initiative of students

A major defect of the traditional teaching method is that the way of teaching is departed from the students' autonomous learning. Once the teacher has completed the teaching of the course, there is almost no restriction and communication on the students except for the homework that may be assigned. Take the author's college as an example (Table 2). Of the 201 economic and management students (Grade 17-19) who have completed the applied statistics course, only 17 students clearly stated that they have a certain degree of communication and exchange with the instructor. And as many as 91.54% of the students said that apart from classroom teaching, they did not have any exchanges and communication with the instructor. More prominently, when the course assessment was over, only 9 students said they could recall and tell the main content of statistics accurately, while most of the students put aside the course after the course assessment. All this shows that there are major problems in the current teaching of applied statistics. The purpose for students to study is only to deal with the final exam and obtain corresponding credits, rather than treating statistics as a tool for follow-up research or solving practical problems. The motivation of students to learn independently is insufficient. Therefore, in the follow-up course reform process, how to organically combine the teaching of teachers with the learning of students and stimulate students' interest in active learning is an important content of the teaching reform of this course.

Table 2: Research on the learning effect of applied statistics course.

Issues in the study effect survey questionnaire	Grade 17-19	
	Yes	No
(1)Whether satisfied with the final score or not?	142(70.65%)	59(29.35%)
(2)Do you communicate with teachers after class?	17(8.46%)	184(91.54%)
(3)Whether taking the initiative to prepare and review after class or not?	113(56.22%)	88(43.78%)
(4)After the exam, do you still have a clear memory of the course content?	9(4.48%)	192(95.52%)

3. Exploration of instructional reform under the goal of ability improvement

3.1 Innovate instructional objectives and highlight application features

The current definition of the instructional objective of applied statistics pays more attention to the theoretical perspective and places emphasis on the interpretation of theoretical basis and the calculation of indicators of quantitative statistics, whereas this objective is actually more in line with the instructional requirements of mathematical statistics course. As for the instructional objective of applied statistics, from the essence of applied statistics, combined with the discipline characteristic of the majors of economics and management, the author believes that it can be tried to be defined as: understand basic theories and basic methods of statistics, proficiently grasp and use software of

quantitative statistical analysis for data processing and result interpretation, and enhance the ability of analyzing and solving practical problems. The main reasons include: First, different from mathematical statistics, applied statistics don't have high requirements for the part of mathematical derivation. Instead it focuses more on solving practical problems by statistical tools to achieve a deeper understanding of the objective world. Second, considering with the majors of economics and management, there are basically two employment destinations for students, either to continue their study to engage in scientific research work, or to directly enter the society to conduct practical work. Both of the two work require students to be proficient in using common statistical analysis software, such as Excel, SPSS, STATA, etc. However, our instructional objectives of applied statistics are actually seriously insufficient to reflect these. After a semester of courses, students may not have practiced the above software, which directly leads to the separation of teaching tasks and practical needs.

3.2 Expand instructional contents and meet the needs of scientific research

At the present stage, the instructional contents of applied statistics mainly includes data type, data source, data preprocessing, probability and probability distribution, three major sampling distribution, parameter estimation, hypothesis test, independence test and variance analysis, etc. These contents are the underlying theories of statistics and should be very important. However, among them, probability and probability distribution actually have been fully studied in the preorder course of students: probability theory and mathematical statistics. And relatively the type, source, and preprocessing of data are particularly simple, while the slightly difficult parts lay on three sampling distributions, parameter estimation and hypothesis test, whose contents are the basis for subsequent model construction and regression analysis. But in the process of practical application, these parts are often embedded in the processes of data processing and data analysis, rather than being completely reflected in the process of practical application. Therefore, the author believes that, for the contents of these parts, the explanation of logic and methods should be more focused on, and the requirements for the derivation and calculation of specific data can be lowered. Under this guiding ideology, we should further expand the instructional contents and scope of applied statistics, by incorporating more useful contents into the learning scope of this course, such as variable selection, model construction, unary and multiple regression analysis, time series analysis, panel data analysis, etc. By doing this, it can not only attract students' learning interests, but also help students get started quickly in subsequent scientific research or practical work. Once I have carried out an informal pre-school research on newly enrolled postgraduate students, and found that although most students have studied applied statistics before their enrollment, they are unclear to common statistical methods such as model construction, regression analysis, and independence test, etc., and they have not used common statistical analysis software in practice, which is very unfavorable to the development of subsequent scientific research work during the stage of postgraduate.

3.3 Enrich instructional methods and reflect practical applications

The traditional process of applied statistics is classroom teaching–after-class assignments–final examinations, which is in absence of the stages of actual hand operation and independent thinking by students. Therefore, the author believes that reforms can be conducted from the following aspects: Firstly, add the discussion section. In the section of the teaching of basic theories and basic methods, students are required to conduct independent discussions in small groups. Each group should summarizes the essence of the theory or method and raises corresponding questions or doubts, thereby deepening their impression of basic theories and improving the effect of classroom teaching. Secondly, introduce case teaching methods. For instance, in the section of parameter estimation and hypothesis

test, traditional calculation questions are boring and difficult to understand, and it has been difficult to meet students' increasing demand for knowledge. So teachers can independently develop some cases, in which knowledge points to be explained are integrated, to increase the interests and practicality of knowledge points [3]. Especially, when the instructional contents are expanded to regression analysis, model construction, etc., actual cases of listed firms can be used to enrich the instructional contents and effects. Finally, vigorously promote the construction of smart classrooms or computer rooms. It is best to conduct instructional activities of applied statistics in the computer room, so that students can actually be exposed to software operation rather than boring mathematical derivation and calculation, which is very helpful for the improvement of application ability of students. But also, attention should be paid to strengthening the supervision on students to prevent them from using computers for matters unrelated to the teaching activities, thereby reducing the effectiveness of teaching.

3.4 Enhance teacher-student interaction and strengthen independent learning

The reform of instructional contents of this part mainly starts from the teachers. That is, to increase the attraction degree of this course for students, we can try to adopt the "big curriculum group" mode that have been adopted by many schools [4]. In this mode, several teachers are responsible for one same course, and each teacher is only responsible for the part he is superior to, so that teachers can have enough time to prepare for instructional activities and keep the freshness and mystery of the course. Meanwhile, it is also necessary to arouse the learning enthusiasm of students from multiple perspectives. For example, for students of economics and management, whose subsequent professional choices are accounting, finance, human resources, market impact, enterprise management, etc., corresponding cases and models can be designed from different professional backgrounds in specific cases or the processes of practical operation, to increase student recognition of this course. In addition to classroom teaching, teachers should also strengthen the after-class communication with students. Specifically, the mode of "elite class" currently used by a part of schools is to improve the scientific literacy of undergraduate students and strengthen the connection between teachers and students by achieving one-to-one mode between teachers and students. This mode can be tried in colleges where conditions permit. By adopting this, it can not only promote the communication between teachers and students, but also further promote the study of statistical knowledge.

4. Conclusions

The development of industries such as the Internet and big data has put forward new requirements and challenges for the training of professionals in economics and management. Standing at a new historical starting point, the curriculum and teaching of applied statistics should also be reformed to a certain extent to adapt to the trend of development [5]. Traditional applied statistics has not been fully reflected in its application characteristics due to the unclear course objectives, narrow teaching content, and single teaching methods, and the students' ability to solve practical problems by using statistical tools is insufficient. Combining the author's years of statistical teaching experience and students' learning experience, this paper has proposed teaching reform ideas in terms of clarifying teaching objectives, expanding teaching content, enriching teaching capacity, and strengthening teaching training. By doing so to continue to develop applications in the future. The significance of this paper is to provide useful attempts and explorations for the continued reform of applied statistics teaching.

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