

Improving the Qualities of Teaching Probability Theory and Statistics

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Abstract: Probability Theory and Statistics is one of the important and fundamental courses for all science and engineering students. In this paper, we consider how to enhance Probability Theory and Statistics teaching. Furthermore, these strategies are expected to promote teaching effect by stimulating student's interest in learning.

Keywords: Probability Theory and Statistics; Teaching strategies; Student-centered

BACKGROUND

Probability Theory and Statistics is a branch of mathematics, which has been widely used in industry, agriculture, military science and technology. In most of the universities in China, Probability Theory and Statistics is a compulsory course for all science and engineering students, economics and management. The main contents include: basic concepts of probability, random variables and probability distribution, digital characteristics, the law of large numbers and the central limit theorem, statistics and probability distribution, parameter estimation and hypothesis test, regression analysis, variance analysis, Mark off chain etc.

In our university, Probability Theory and Statistics course is usually taught in the traditional way. The teachers give lectures when they teach their classes because they believe that this is a good way to transmit knowledge. In a traditional classroom, the teacher will begin class by reviewing, then he will teach the new lesson, finally, he will give a take-home assignment. Some lectures begin by answering questions from homework or from the classroom. The student watches, listens, takes notes and then copies what the teacher does in their assignments. At the end of each semester, all the students are expected to attend closed-book examinations, which account for 70% of the final mark respectively, the other 30% coming from records of exercises (include homework). The total mark is 100, if a student's final mark is less than 60, he fails the Probability Theory and Statistics course. This teaching approach is called "teacher-centered", which is a typical traditional passive class. Teacher is the main actor on the stage and all the students are passive audience.

Like most of the universities in China, our university has increased enrolments by at least 30%-40% over the past few years. Simultaneously, the quality of students generally becomes worse. These bring some problems in higher education and teaching process. Many students have no interest in learning Probability Theory and Statistics course and thus cannot master it because they think it is abstract and useless. Each semester more than 20%-40% of students fail this course. Taking the appropriate measures and improving the quality of teaching for the status of the students learning Probability Theory and Statistics, it has become an urgent need to solve the problem in the teaching process.

IMPROVEMENT STRATEGIES

Student-centered teaching and Cooperative learning

Student-centered teaching focuses on the student, in particular, on the cognitive development of the student. The teacher's goal is to help students grasp the development of knowledge as a process rather than a product. The focus of classroom activities and assignments is on the student-centered process of inquiry itself, not on the products of inquiry. Students create their own conceptual or cognitive models. Content, teaching style, and methods are adapted to aid the cognitive and intellectual growth of students. Student-centered teaching combines an understanding of the way that humans process information with other factors that affect learning such as attitudes, values, beliefs, and motivation [1]. Student-centered teaching methods present good ways for students to learn, and it has the following advantages:

- can enhance curiosity and the natural desire to learn;
- can help students achieve the results they appreciate and consider worthwhile, and which builds their self-esteem and confidence;

- can uncover the excitement in intellectual and emotional discovery, which leads students to become lifelong learners; and
- can improve the teachers' attitudes.

There are many kinds of student-centered approaches, such as cooperative learning, concept mapping, case study, etc. Learning should be cooperative in nature rather than competitive because people do not learn things best at the expense of others. Collaborative learning [2] has been widely employed in many disciplines as an effective instructional strategy. Its use implies a change from teacher-centered learning to a focus on learner-centered learning. It presents learning as an active social process of communication with others. The methods we can take include:

- The teacher gives a lecture and raises a question. Students think about the question individually at first. Then, individuals pair up and exchange thoughts. After that, the pairs share their responses with other pairs, other teams, or the entire class.
- Discussion in class is one of the most common strategies promoting active learning. We encourage students to discuss, debate and ultimately to teach one another.
- We assign students to study a topic in the textbook within a group. Then, ask representatives from some groups to give presentations on their findings. During the presentation, the students in the same group can add comments and other groups can raise questions.
- The group members explain concepts to one another and make sure that everyone in the group is ready for a quiz or other assessment that they will take without teammate help. Students' quiz scores are then summed to form a group score and the best group earns a reward.

CASE STUDY

Probability Theory and Statistics is a science that is very relevant to our real life. It would be worthwhile to find some real cases before the teacher gives a lecture. When students find that what they will learn is useful to the society, they will be active learners. Case studies are capable of being delivered with a range of styles, they can be designed to complement (not replace) other teaching approaches, and focus on re-visiting topics rather than attempting to cover an entire syllabus. In addition, the contexts and delivery styles can be selected in order to be stimulating. For example, the students' grades is a random variable before the exam, probably under the influence of the learning of students, teachers' teaching skills, papers such as ease of random factors. Under normal circumstances, results similar to normal distribution. In the study of normal distribution, let the students do a survey to the college students on mathematical analysis, draw the score histograms, compared with the density function curve of normal distribution, and analyzed the differences between them. If the two has significant differences, then a random factor is not normal. The possible causes may be the students are not diligent enough or the teaching method is improper, or the test is too hard to the students. We can find out the reasons through the analysis, it can be used to guide the teaching management departments to formulate corresponding management regulations, to guide the teaching, better services to students [3].

Use mathematical software

MATLAB is widely used in all areas of applied mathematics, in education and research at universities, and in the industry. So it is a convenient aid in the teaching and learning of Probability Theory and Statistics. Using MATLAB, teachers can demonstrate curves and surfaces quickly and precisely. The graphs can be zoomed in and out, rotated from various angles and viewed from different perspectives.

Example: Set $X \sim N(2, 0.25)$

(1) Find $P\{1 < X < 2.5\}$;

(2) draw the distribution function and distribution density image;

(3) draw the area below the distribution density curve on the interval $[1.5, 1.9]$.

(1) `>> p=normcdf(2.5,2,0.5)- normcdf(1,2,0.5) p =0.8186`

(2) `>> x=0:0.1:4; px=normpdf(x,2,0.5);`

`fx= normcdf(x,2,0.5); plot(x,px,'+b');hold on;`

`plot(x,fx,'*r');legend('Normal Distribution Function', 'Normal Distribution Density');`

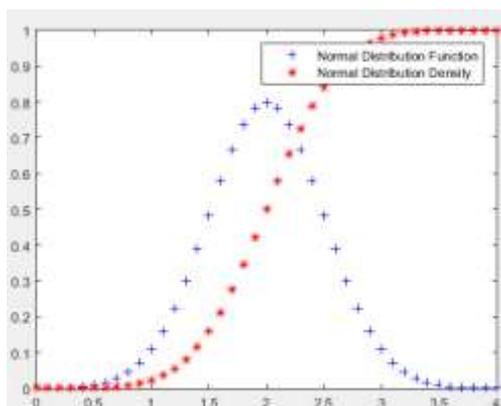


Fig-1:

```
(3) >> specs=[1.5,1.9];
pp=normspec(specs,2,0.5)
```

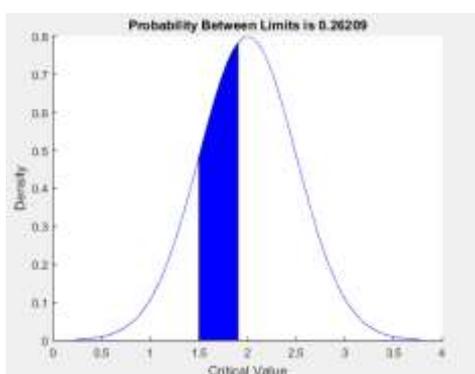


Fig-2:

Adjusting assessment

Assessment is a significant component of teaching and learning. Our principles of assessment should be assessed for the purpose of promoting students' all-round development, individual development and sustainable development. As you know, the traditional assessment is mainly determined by the final closed-book examination at the end of each semester. In the end few weeks for the examination, some students study very hard and they often successfully pass the examination, but forget most of the knowledge as soon as they have finished the test. This assessment does not evaluate students properly.

Table-1: Original and new assessment of numerical compare

Original assessment	New assessment
Homework 20%	Homework 20%
	Classroom assessment 10%
	Semi-term examination 20%
Final examination 80%	Final examination 50%

In classroom assessment, it is necessary to pay attention to that the questioning should be matched with cognitive style one desire to test, and it should also give students enough time to response; meanwhile, information collection should be done in different ways such as testing forms, recording and students' note. On the aspect of math examination, tests of different qualities should be distinguish and it should ensure that both the content and form are diversified and open to water down scores awareness and promote understanding in learning.

CONCLUSION

There are lots of different approaches to teaching, one is not superior to the others in every circumstance. Each of the approaches has its benefits and shortcomings at the same time. Although there exist some possible problems, we believe that those teaching strategies will have positive effects on students' learning.

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