RESEARCH ON THE INTEGRATION OF MATHEMATICAL MODELING THOUGHTS INTO THE CLASS TEACHING OF PROBABILITY THEORY

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ABSTRACT

The connotation of mathematical modeling thought is expounded, and the main content of the integration of mathematical modeling thought into probability theory classroom teaching is studied. Through examples, it focuses on how to integrate mathematical modeling thoughts into the concept, examples and exercises, and proof of properties and theorems in the "Probability Theory" classroom teaching. Therefore, the integration of mathematical modeling thoughts into classroom teaching is effectively implemented.

KEYWORDS: Mathematical modeling thought, Classroom teaching, Mathematical model, Probability theory.

1. INTRODUCTION

Mathematics is a science, a tool and language for describing the universe, and the foundation of various sciences. From elementary school to high school, we continue to learn various concepts and learn how to solve application problems. If any concept is expressed in mathematical symbols, such as the expression of function "y = f(x)", we call it a "mathematical model". To solve any application problem, we need to analyze the meaning of the problem, explore the mathematical relationship, and express it with appropriate symbols, that is, establish a mathematical model, and then use the knowledge we have learned to give the answer through the solution, and then return to the actual test. The whole process is called mathematical modeling. Mathematical modeling itself includes the ideas and processes of proposing hypotheses, expressing variables, and establishing models. It also contains many mathematical ideas and methods, such as special to general ideas, finite to infinite ideas, induction, analogy, and backward analysis, heuristics, etc. All the thoughts including the ideas and processes are called mathematical modeling thinking. In this regard, Academician Li Daqian and others have emphasized the integration of mathematical modeling thoughts into the main mathematical courses as early as 2006 [1-2]. "Probability Theory" is the basic mathematics courses for engineering majors, and the compulsory professional basic courses for science students. It is also the important contents of the postgraduate entrance examination. Some important basic knowledge has been studied in the middle school. At present, many elementary and middle school teachers have realized the importance of integrating mathematical modeling thoughts into teaching, and related teaching and research papers have sprung up in an endless stream. However, university teachers have not paid enough attention to the guidance and teaching of mathematical modeling ideas due to the lack of class hours and heavy

tasks. Many teachers do not understand the meaning and methods of cultivating mathematical modeling ideas. The modeling literacy of students cannot be improved in the classroom. Therefore, the study of mathematical modeling thoughts integrated into the classroom teaching of "Probability Theory" in the university has important practical significance and far-reaching historical significance. It can improve students' ability to analyze and solve practical problems, comprehensively use mathematical knowledge, and further cultivate innovative talents in the new era.

II. The Definition of Integrating Mathematical Modeling Thoughts into Classroom Teaching

A mathematical model is a mathematical structure that makes necessary simplifications and assumptions for a certain aspect or characteristic of an objective thing according to its inherent laws, and uses mathematical symbols and language to describe an ideal problem. Mathematical modeling refers to the whole process of establishing a mathematical model. In other words, we should approximate the process of the actual problem in mathematical language firstly. Then, it is needed to analyze and simplify the objective things, make reasonable assumptions. Further, we use appropriate mathematical tools to express the problem, establish a model, and solve the model results with the help of computing software. And we verify its correctness finally. Mathematical modeling thoughts are the ideas used in the process of mathematical modeling to solve practical problems. Incorporating mathematical modeling thoughts into teaching, also known as mathematical modeling ideas teaching, is to integrate innovative thinking and modeling ideas in mathematical modeling into the learning of basic concepts, the proof of properties and theorems, the answers of examples and exercises in classroom teaching. It is not just to introduce related mathematical modeling cases outside the textbook into the classroom. Large-scale application problems encountered in universities are often more complicated. After the model is established and the results are solved, if the model test does not meet the actual problem, the model assumptions must be re-adjusted and the above process repeated until the test meets the reality. Therefore, the establishment of a mathematical model is actually a process of discovery and innovation using divergent thinking, such as association, analogy, and imagination. It is worthy of our in-depth research and exploration to integrate mathematical modeling and mathematical thinking into classroom teaching.

III. The Main Contents of Mathematical Modeling Thoughts in the Classroom Teaching of Probability Theory

From the perspective of teaching content, each mathematics course is mostly a relatively complete system composed of definitions, properties and theorems, examples and exercises. Many experts and scholars believe that mathematics teaching is to "teaching concepts, teaching principles, and teaching problem solving" [3]. And these "three teachings" all imply rich mathematical modeling ideas, and all are mathematical modeling processes. Incorporating mathematical modeling thoughts into the classroom teaching of probability theory is an innovative process for teachers to fully demonstrate and guide the mathematical modeling ideas in the classroom teaching based on the concepts, properties and theorems, examples and exercises in the textbook. Specifically, there are three aspects as follows.

1. Incorporate mathematical modeling thought into concepts teaching

For the new definitions and new ideas in the "Probability Theory" textbook, teaching of mathematical modeling thoughts is to lead the students to figure out the problem firstly. Then guess, ask the question, analyze the meaning of the problem, by using association and imagination, etc. In order to guide students to converge in divergent thinking, contrast, analogy, etc. The thinking is closely integrated, and the existing models and knowledge points are used to achieve the purpose of innovation or modeling. In this process, the aim is to guide students to learn to ask questions, associate, guess, think actively, and avoid stereotypes. Many concepts in "Probability Theory", for example, conditional probabilities are all derived from reality. When describing these concepts, you can appropriately select vivid examples to attract students' attention, make full use of mathematical symbols and mathematical language description, and establish conceptual models using innovative thinking methods to enable students fully feel the transformation of actual problems into mathematics, fully feel the process of establishing new concepts, that is, feel the process of mathematical modeling and mathematical innovation fully.

2. Incorporate mathematical modeling thought into examples and exercises teaching

Most of the examples and exercises in the textbook are practical problems that have been simplified. These topics have been removed from the rough, and many tedious details have been deleted. Therefore, the mathematical modeling thinking teaching of textbook examples and exercises focuses on analyzing the meaning of the problem, properly expressing the variables in the problem, using the method of association, and using the formula model that has been learned to solve it. That is to understand each sentence of the question correctly, especially clearly the known and the results fully understand the meaning of the question, and use appropriate and concise symbols to express the variables that appear or hide in the question, and use association or analogy methods to call existing models and examples. The spark of inspiration is collided, and the solution and inspection are carried out.

For example, suppose that the probability of a lens made by an Optical Instrument Factory is 0.5 when it is dropped for the first time. If it is not broken for the first time, the probability that it is broken for the second time is 0.7. If it is not broken for the first two times. The probability of falling and breaking for the third time is 0.9. Try to find the probability that the lens is not broken after falling 3 times.

This is a practical application problem. The use of mathematical modeling ideas is to comprehensively analyze the meaning of the problem, give an appropriate mathematical expression or description, associate the learned model and related knowledge to give a perfect answer and verify it. In this regard, we must focus on solving the following three problems:

(1) Analyze the meaning of the question. The so-called "analysis of the meaning of the question" is to analyze the entire question, sentence by sentence. While asking the question, we should understand

the meaning of the question and give a logical explanation, and thoroughly figure out the "known and desired". We should also understand clearly whether the "probability of falling 3 times without breaking" is a conditional probability or a product event probability? By considering the actual background and possible circumstances, the theory infers the probability of what is sought as a "product event", and then solves it by the formula that has been learned.

(2) Appropriate expression. In the above example, the probability of 3 events is known, and the probability of another event is required. The question involves the event "the lens is broken or not broken by the first, second, and third drops." Therefore, it is necessary to appropriately use "capital letters" to represent "events", and then concisely express all known conditions and requirements. According to the principle of " Concise Language and Rich Meaning ", it is to use appropriate symbols to indicate "the ird time break", and use opposite events to indicate "the ird time unbroken". Thus, all known conditional probabilities and the probabilities of "events occurring simultaneously" are expressed.

(3) Associate the learned knowledge, solve the problem and get the result. Students should be guided to associate the multiplication formula they just learned, and substitute the three known probability data to get the result. Therefore, for the sample questions and exercises in the book, teachers should educate and guide students: learn to analyze the meaning of the questions, learn to express, learn to use innovative thinking such as association, collide with sparks of inspiration, and reap the joy of successful solution.

3. Incorporate mathematical modeling thought into the proof teaching of the properties and theorems

The thought of mathematical modeling is actually an extension of innovative ideas. Probability theory is the basis of mathematical statistics, and there are very important "Chebyshev's inequality" and proof questions after class. The integration of mathematical modeling thought teaching into the proof of the property theorem means: (1) Recognize the known conditions and verify the results comprehensively. (2) Make full use of innovative thinking methods, that is, association, contrast and other creative thinking methods. (3) With an idea, find an opportunity, inspiration or breakthrough, and proceed smoothly to prove it. For example, take a continuous random variable as an example to prove Chebyshev's inequality: We should firstly analyze the meaning of the question, know clearly and verify it. Teachers can drive problem analysis by asking questions, allowing students to think about the meaning of the two sides of the inequality, and fully associate the definition of the variance on the right side of the inequality and the meaning of the probability on the left side of the inequality. Then, teachers guide students to compare and intuitively reason about what is known and verify, and finally find an opportunity to "magnify the inequality" and prove the conclusion. This not only enables students to understand and master the application process of divergent thinking, but also enables students to experience the ingenuity and beauty of mathematical proof methods, and improve their logical thinking ability, divergent thinking and convergent thinking ability. Many problems in college

mathematics (such as the proof of the nature of the correlation coefficient, etc.) can guide students to use association, analogy, conjecture and other methods to easily solve a complex problem.

In short, the integration of mathematical modeling thoughts into the teaching of "Probability Theory" does not mean that the content of the mathematical modeling course is simply explained in the probability class, but the teacher uses the innovative thinking methods and modeling ideas to reveal the generation of deductive concepts, the problem solving in examples and exercises, and the proof of property theorems, etc. together with the students in the classroom teaching of probability theory. University teachers use vivid language and examples to guide students in the classroom teaching of "Probability Theory" for learning the conceptual background, theoretical proofs and application examples of mathematical modeling thoughts and methods. By guiding and enlightening students' innovative thinking, breaking through conventional thinking patterns, and feeling the charm and role of mathematical modeling thoughts as soon as possible, which will help to improve student's innovative ability for embarking on the road of scientific research and innovation as soon as possible.

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