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THE MAIN DIFFICULTIES IN LEARNING PROBABILITY THEORY

Mammadova Jabarud Muzaffar
Senior lecturer
Hasanova Matanat Aliqulu
lecturer
Aliyeva Turkan Alasgar
lecturer
Ganja State University
Ganja, Azerbaijan

Abstract: *Elementary probability theory is a field of mathematics that studies random events and patterns associated with their occurrence. The basic concepts of probability theory, such as a random event, probability, combinations and statistics, lay the foundation for more complex mathematical concepts applied in various fields of science and life. The study of probability is an important part of the school curriculum, as it forms students' ability to analyze situations of uncertainty and make informed decisions based on the analysis of probabilistic data. However, probability theory causes certain difficulties for students. Research shows that abstract concepts of probability theory and the lack of practical application at an early age often lead to students not understanding the essence of the probabilistic approach and making mistakes in the perception of the probability of events. These difficulties are relevant not only for schoolchildren, but also for novice students, which makes this topic important for studying and searching for effective teaching methods. The purpose of this article is to explore the main difficulties encountered by students in the study of elementary probability theory, and to propose methods that can help overcome these difficulties. The article also discusses techniques that facilitate the perception of complex concepts and improve students' understanding of the topic.*

Keywords: *probability theory, common mistakes, practice, visuality.*

Introduction.

The study of elementary probability theory is associated with a number of difficulties caused by both the abstractness of the material and the difficulties of perception among students.

The main problems that arise in explaining probability include the following aspects:

1. Misunderstanding of the basic rule of addition and multiplication of probabilities.
2. Difficulties with the perception of independent and dependent events.
3. Errors in determining the probability of complex events. Let's look at these difficulties with specific examples.

One of the first difficulties is understanding the rule of adding probabilities for incompatible events. In general, it is difficult for students to distinguish between situations in which probabilities need to be added and those where they are multiplied.

Example: Let's say we have a bag with 3 red and 2 blue balls in it[5,78]. We randomly pull out one ball. What is the probability that it will be red or blue?

Decision: Since the events "pull out the red ball" and "pull out the blue ball" are incompatible, their probabilities add up:

Probability of pulling out a red ball: P(red)=3/5.

Probability of pulling out a blue ball: P(blue)=2/5 So, the probability that the ball will be red or blue:P(red or blue)=P(red)+P(blue)=3/5+2/5=1

Here, students often get confused about when to add probabilities and when to multiply, which requires additional explanations and practical examples.

Another common problem is understanding independent events and applying the probability multiplication rule. Suppose we flip a coin and roll a six-sided die. What is the probability that the "eagle" and the number 6 on the die will fall out? Decision: These events are independent (the result of the coin toss does not affect the result of the dice roll), so their probabilities are multiplied:

Probability of getting an eagle: P(eagle)=1/2

The probability of getting a 6 on the die: P(6)=1/6

The probability that both events will occur: P (heads and 6) =P(heads)×P (6) = 1/2×1/6=1/12

It can be difficult for students to realize that events can be independent, and that the multiplication of probabilities here is associated with the simultaneous fulfillment of conditions.

This is especially important for understanding more complex probabilistic problems. These examples show how abstract concepts of probability theory, such as the rules of addition and multiplication, create difficulties for students. To overcome such difficulties, it is recommended to use visual diagrams, simulations and practical tasks, which makes it possible to simplify perception and deepen understanding of the topic[1,56-60].

The results of the study.

To facilitate the understanding of probability theory, especially its basic principles, it is important to apply methods that allow students to intuitively grasp probabilistic concepts and avoid common mistakes. In this section, we will look at various approaches that help overcome the difficulties associated with explaining probabilities using practical tools, visualization, and examples from everyday life.

Visual representation and visualization: In order for students to better understand probabilistic events, it is useful to use visual methods such as graphs, diagrams and tables. They allow you to visualize events and their probabilities, making abstract concepts more understandable. Example: Probability Trees: Probability trees are a great way to demonstrate sequential events, such as flipping a coin multiple times or a combination of two independent events (for example, a coin flip and a die roll). Building a tree helps students visually see how probabilities branch out at each stage, and it is easier to understand the principle of independence of events[4,87].

Illustration: Let's say we flip a coin twice. The probability tree will show all possible outcomes: - First level: heads or tails. - Second level (for each result of the first toss): heads or tails again. Each final branch of the tree will represent a probabilistic path, and students will be able to visually see the probability of specific combinations, for example, the loss of two "eagles" in a row.

Game approaches and interactive simulations: Using a game-based approach helps to turn the study of probability into an active and exciting process. Board games, card games, and digital simulations provide the opportunity to simulate the real behavior of probabilistic events. Example: Using dice: One way to teach students the concept of probability is to play with dice. For example, you can ask students to calculate the probability of a certain number falling on a die. Then make several throws and compare the results with the calculated probability. This clearly demonstrates to students the difference between theoretical probability and the results of real experiments.

Online simulations: Online simulations such as coin toss simulators or random number generators can be used to demonstrate the probability of "at least one event". With the help of simulation, students can repeat the experiment many times and see how the probability of "at least one eagle" tends to the calculated one with an increase in the number of throws.

Using everyday examples. Using real-life examples helps students see how probability theory applies to everyday situations. Such examples make learning more practical and allow you to see the connection between theory and reality. Example: Weather forecast: The teacher can ask students to analyze the weather forecast, where the probability of rain is expressed as a percentage. Students can discuss what a 70% chance of rain means in practice, and how it affects everyday decisions (for example, whether to bring an umbrella or not). This allows us to understand the principle of probability in situations of uncertainty, which is often overlooked in abstract problems. Example: Lotteries and contests: You can ask students to calculate the probability of winning a lottery or a competition with a limited number of participants. These tasks help to understand how probability is related to chance and why the probability of winning the lottery is usually very small.

Using the inverse probability method. The method of inverse probabilities (finding the probability of the opposite event) helps to simplify complex probability problems, especially when it comes to the probability of "at least one" or "none" events. Example: The probability of "at least one" When explaining the probability of at least one "heads" falling out in several tosses, it is convenient to first consider the probability of the opposite event — the loss of "tails" in all throws [3,64]. Then you can apply the rule: P(at least one eagle)=1−P(all tails). This method helps to reduce calculations and visually explain how the probability of "at least one" works through simple subtraction.

Conclusion:

The application of the described approaches significantly improves the learning process of elementary probability theory, making it more accessible and understandable for students. The problem of perceiving abstract concepts such as probability is often related to the fact that traditional teaching methods do not always allow students to intuitively understand complex concepts. The introduction of visual aids, interactive simulations, game elements and real-life examples helps to overcome these barriers, developing students' theoretical knowledge and practical understanding of probabilistic analysis. Using visualizations such as probability trees and interactive tools allows students to "see" probabilities in action, which is especially important for tasks involving multiple events. In addition, examples from everyday life, such as weather forecasts or probabilities related to games, contribute to awareness of the importance of the probabilistic approach and its application in real situations. This approach not only increases interest in the subject, but also strengthens the links between theory and practice. The application of the inverse probability method simplifies the solution of more complex problems, such as the probability of "at least one event", avoiding cumbersome calculations. This is useful for students who have difficulties with high probability calculations, and helps to focus on the logic of the problem, which contributes to better learning of the material. Thus, the integrated use of these approaches not only facilitates the teaching of probability theory, but also lays a solid foundation for further study of more complex mathematical concepts.

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