Professional and applied context of the workshop on probability theory in transport universities

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Abstract.
In the context of the competence-based paradigm of education, the introduction of the concept of professional orientation in the modern mathematical preparation of future specialists creates conditions for learning, in accordance with the professional interests and intentions of students, allows to model the most important components of real professional situations. After all, the presentation of the professional context of classical mathematics contributes to the formation of positive motivations of students regarding their future professional activities and focuses their attention on the interdisciplinary connections of general and special courses. The article is devoted to the general problem of reflecting the contexts of professional activity in the teaching of mathematical disciplines to university students. The important role of the probabilistic component of modern mathematical preparation is emphasized. It is proposed to introduce problems of professional and applied orientation into the workshop of the course "Probability Theory" in transport universities. Examples of formulations of problems of the probabilistic component of mathematical preparation that may arise in real situations of future professional activity of transport specialists are given.
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**Keywords:**
- professional and applied context
- probability theory
- professional orientation
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- probabilistic component of mathematical preparation
- professional activity of specialists
At present, there is practically no field of knowledge in which probabilistic methods are not used to some extent. Therefore, the probabilistic component plays an important role in the mathematical preparation of students of transport universities.

The importance of introducing the concept of professional orientation in the modern mathematical preparation of future specialists in the context of the competence-based education paradigm is known. This implementation creates conditions for learning, in accordance with the professional interests and intentions of students, allows to model the most important components of real professional situations. After all, the presentation of the professional context of classical mathematics and the demonstration of the capabilities of the mathematical apparatus for building models of applied problems and their solution contribute to the formation of positive motivations of students in relation to future professional activities and focus their attention on the interdisciplinary links between general education and special courses [1].

However, the problem of the appropriate content of mathematical disciplines remains largely unresolved. This, in particular, applies to the workshop on the course "Probability Theory". The well-known educational and methodological literature on probability theory, as a rule, considers a traditional set of problems, a significant number of which reproduce standard production situations and do not sufficiently correspond to the nature of professional preparation of future specialists in specific areas. Thus, there is an urgent problem [2] of reflecting the contexts of professional activity in the teaching of the workshop of the course "Probability Theory" for the students of transport universities. First of all, this involves the creation and implementation of a bank of professional and applied tasks with a probabilistic component of mathematical preparation in the educational process.

Here are examples of formulations of professional problems of the course "Probability Theory" for bachelor's degree students in transport specialities. The formulations of the proposed problems are mainly those that may arise in
real situations of future professional activity of specialists.

Let's consider the problems whose content corresponds to the section "Random Events". Problem 1 is solved according to the classical definition of probability using a combinatorial approach.

**Problem 1.** In a certain district, seven road traffic accidents (RTAs) occur independently of each other on seven days of the week. What is the probability that each day of the week there will be one accident?

**Answer:** 0,006.

The concept of conditional probability of an event allows us to calculate the probability of timely delivery of cargo to the consumer in solving Problem 2.

**Problem 2.** The probability that a car operating in a motor transport complex does not violate the conditions of timely delivery of goods to consumers on the first working day of the week is 0.8. The probability that these conditions are not violated during the first two working days of the week is 0.6. Find the probability that a car that did not violate the conditions of timely delivery of cargo during the first day did not violate these conditions during the second day.

**Answer:** 0,75.

The practical significance of Bayes' theorem is well known, as it allows us to reassess the a priori probabilities of hypotheses given the occurrence of a certain event A. In other words, this theorem allows us to find the probabilities of hypotheses after the experiment (the so-called a posterior probabilities), provided that the experiment result was event A. Here is Problem 3 on calculating, using Bayes' theorem, the probability of a passenger moving along a certain path of the street and road network [3].

**Problem 3.** The street and road network (SRN), which is used for urban passenger transport, contains three competitive routes between a pair of transport districts of the city. During a day, on average, passenger traffic on the first route is 1.5 times higher than on the second route, and on the second route it is 1.8 times lower than on the third. The first, second, and third routes are used by 96%, 99%, and 92% of passengers, respectively. A randomly selected
passenger traveled with a transfer. What is the probability that he traveled by the second route?

\[
\frac{5}{107}.
\]

**Answer:** \(\frac{5}{107}\).

The scheme of sequential independent tests by J. Bernoulli forms the basis for solving Problem 4. Similar problem is proposed for independent solution in [4].

**Problem 4.** There are ten trucks at the motor depot. For the normal operation of the depot, there must be at least eight trucks on the line. The probability of failure of each of the trucks to enter the line is 0.1. Find the probability of normal operation of the motor depot in the next day.

**Answer:** 0,9298.

Here are the formulations of professionally-oriented problems, the content of which correspond to the section of the course "Random variables". The formulated applied problems involve the use of properties and numerical characteristics of the laws of distribution of discrete and continuous random variables.

**Problem 5.** On the roads of Ukraine only 70% of car tyres can withstand the warranty period. Find the law of distribution of the number of tyres that can withstand the warranty period out of 5 purchased. Estimate the average number of such tyres and the scatter of possible values.

**Answer:** \(M(X) = 3,5;\) \(D(X) = 1,05\).

**Problem 6.** It is known that in the city of Lviv, 20% of residents prefer to use their own car to get to work. Find the probability that among four randomly selected people

a) there will be no people who prefer to use their own car to get to work;

b) there will be at least one person who prefers to use their own car to get to work;

c) there will be no more than two such people who prefer to use their own car to get to work.

**Answer:** a) 0,4096; b) 0,5904; c) 0,9728.

The following problems, in our opinion, may be useful for future road accident experts (Problem 7), as well as technical audit specialists (Problem 8).

**Problem 7.** During the investigation of the causes of the accident, it was found that it could have occurred as a result of the installing of a detail on the car, the size of which
exceeds the permissible interval (15 mm, 25 mm). It is known that the size of the details that enter the conveyor of the car factory is a normally distributed random variable $X \sim N(a, \sigma)$ with a mathematical expectation $M(X) = 20$ mm, standard deviation $\sigma = 5$ mm. Estimate the probability that the cause of the accident was the installation of a non-standard size detail on the car.

**Answer:** 0.3174.

**Problem 8.** During the inspection of the work of the shop of the plant of hoisting and transporting machines, its management provided the following information: the rejects are 5% of all manufactured products. According to the technical documentation, it is established that the size of the product - parts is a variable $X$, distributed according to the normal law, with a mathematical expectation $M(X) = 10$ mm, standard deviation $\sigma = 0.2$ mm. The value of the maximum permissible deviation of the part size from the nominal one, at which the part is still considered suitable, is 0.3 mm. Evaluate the reliability of the information received from the shop management regarding the quality of the products.

**Answer:** The shop management has reduced the rate of defective products.

The paper highlights the important role of the probabilistic component of mathematical preparation of bachelor's students of transport universities. The importance of introducing the concept of professional orientation in the modern mathematical preparation of future specialists is emphasized, in particular, the relevance of reflecting the contexts of professional activity in the presentation of the workshop of the course "Probability Theory". Examples of formulations of professional problems of the probabilistic component of mathematical preparation of bachelor's students of transport universities are given.

The prospect of further scientific research is the creation of a bank of these problems based on meaningful models of real situations of future professional activity of specialists.

**References:**

[1] Ярхо Т. О. Фундаменталізація математичної підготовки майбутніх фахівців технічного профілю у вищих навчальних закладах: монографія
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