The use of stochastic approaches in computational modeling of professional tasks in the training of future personnel in the field of physical education and sports

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Abstract

Objective of the study is aimed at developing a methodological justification for solving problems in probability theory using the Python programming language in the process of professional training of students specializing in physical education and sports.

Methods and structure of the study. As an approach to solving probabilistic problems involving independent repeated trials (in particular, Bernoulli and Poisson formulas), the use of specialized Python libraries such as NumPy, SciPy, Matplotlib, Seaborn, Pandas, SymPy and Scikit-learn is proposed. The practical implementation and testing of this approach was carried out within the framework of the academic discipline "Methods of mathematical information processing" by students studying in the direction of 44.03.05 Pedagogical education (profile "Physical culture, Life safety").

Results and conclusions. As a result of the research, a method was developed for solving probabilistic problems related to independent repeated tests (Bernoulli and Poisson formulas) through the use of Python libraries in the context of professional training of specialists in the field of physical education and sports. The integration of the research results into the methodological support of the educational process will expand the available resources for the digital transformation of higher education and contribute to the formation of students' competencies: universal (the ability to solve standard professional tasks based on digital technologies) and professional (the ability to apply mathematical methods in combination with computer tools for creating and analyzing models of varying degrees of abstraction).

Keywords: *professional training of a student in the field of physical culture and sports, solving probabilistic problems, Python programming language, methodological support, competence.*

Introduction. It is known that modern digital tools in the field of PCIs are used to predict the future results of athletes' competitive activities, improve the biomechanics of movement, increase the level of physical fitness and the functional state of those involved in sports and physical activity. Digital technologies are based on methods of probability theory and mathematical statistics (E.A. Burovsky, Y.B. Grishunina [1]; Davidson-Paylon Cameron [2]; S.Ya. Krivolapov [3]; N.I. Popov, E.S. Bolotin [4]).

The universal multimodal system for developing these methods today is the Python environment. The widespread demand for these technologies in the field of data analysis actualizes the problem of training future specialists in probabilistic and statistical methods, which allows them to acquire knowledge and understanding of the basics of digital technologies and transfer them to the field of their professional tasks.

Objective of the study is aimed at developing a methodological justification for solving problems in probability theory using the Python programming language in the process of professional training of students specializing in physical education and sports.

Methods and structure of the study. The method of solving probabilistic problems in the study of independent repeated trials (Bernoulli and Poisson formu-

la) is based on the use of Python programming language libraries: NumPy; SciPy; Matplotlib; Seaborn; Pandas; SymPy; Scikit-learn. The development of the Python language and the expansion of the functionality of its libraries provide opportunities for creating conditions for the effective solution of probabilistic problems using modeling methods (random walk, various types of random variable distributions, sample characteristics, etc.), statistical data analysis (estimation of sample parameters, verification of statistical hypotheses, construction of confidence intervals, etc.), visualization of experimental results, simulation probabilistic models.

The research was carried out as part of the study of the discipline "Methods of mathematical information processing" by students of the training area 44.03.05 Pedagogical education (with two training profiles), orientation (profile) Physical education, Life safety.

Results and conclusions. As part of the study, the RP was updated in accordance with the needs for students to acquire knowledge in the field of probability theory. The structure of the academic course of this discipline includes the following modules:

Module 1: Introduction to probability theory. (Basic concepts of probability theory. Combinatorics. Formulas of combinatorics. Types of probabilities. Events and their properties. Conditional probability and independence of events. Independent repeated tests).

Module 2: Fundamentals of Statistics. (Descriptive statistics. Numerical characteristics of the sample. Testing statistical hypotheses).

Module 3: Python programming for solving probabilistic problems. (Introduction to Python. Basics of Python syntax. Working with NumPy and SciPy libraries for mathematical calculations, Matplotlib and Seaborn for data visualization. Solving probabilistic problems in Python).

Module 4: Application of probabilistic methods in FKiS. (Simulation of sports events. Probabilistic models for analyzing competition results. Data analysis in sports. The use of statistical methods to evaluate the effectiveness of training. Application of probabilistic methods in biology and ecology).

The considered problems in probability theory and mathematical statistics (independent repeated tests (Bernoulli and Poisson formula), implemented in the professional training of students in the field of sports statistics, analyze sports data and involve the use of Python programming language libraries in their solution: NumPy; SciPy; Matplotlib.

To calculate the probabilities of random events using the Bernoulli formula, you need to import the libraries: Numpy and Comb from Scipy.special. We use them to calculate the binomial coefficient. The probability function allows you to calculate the desired probabilities. Here are some examples of professionally oriented tasks.

Example 1. The probability of bankruptcy of the Greencity fitness club in three years is 0.2. Find the probability that more than two out of eight similar fitness clubs will remain in three years. We set the input parameters: n is the total number of fitness clubs, k is the number of clubs that have not gone bankrupt, p is the probability of bankruptcy, and q is the probability of preservation.

To calculate the probability that more than two clubs will remain, we subtract the sum of the probabilities for k=0,1,2 (the number of remaining fitness clubs) from 1, and then output the resulting probability (Fig. 1).

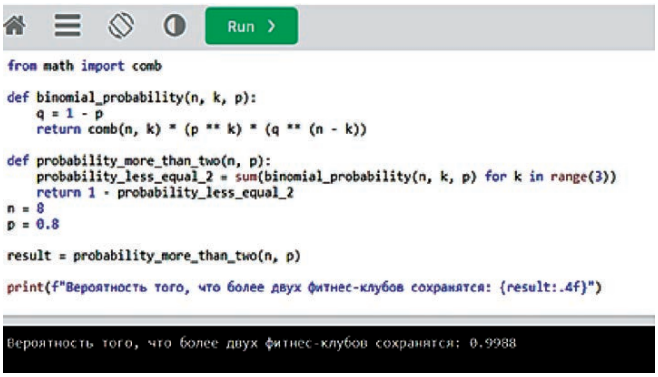

Fig. 1. Probabilities of maintaining more than two fitness clubs

To calculate the probabilities using the Poisson formula, we import the Math library for mathematical operations and Poisson from Scipy.stats to work with the Poisson distribution.

Example 2. 400 participants are registered for the sports event. The probability that each participant will contact the organizers of the event within an hour (for example, to get information or clarify details) is 0.01. Find the probability that: a) within an hour, at least three participants will contact the organizers; b) within an hour, five participants will seek help from the organizers; c) within an hour, no more than four participants will need the organizers of the event. The Poisson formula will be applied in this solution, as the number of requests from participants is a rare event.

We enter the parameters: n is the total number of participants, p is the probability of contacting, and – is the average number of requests to the organizers. To calculate the probabilities in each case, we will use the "poisson" function (Fig. 2).

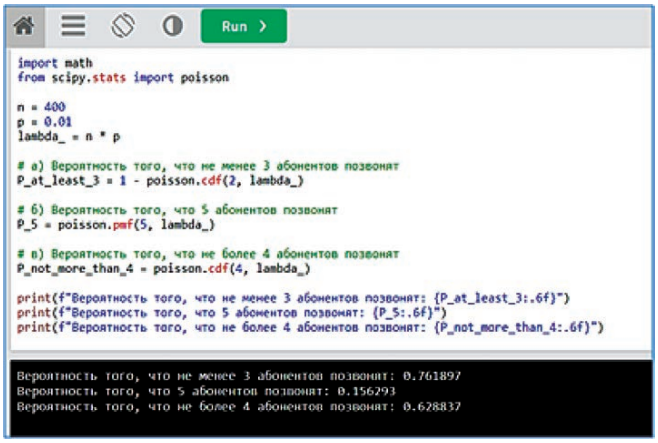

Fig. 2. The desired probabilities according to the Poisson formula

The proposed method of solving probabilistic problems in the study of independent repeated tests (Bernoulli and Poisson formula) based on Python programming language libraries confirms a significant degree of abstraction without emphasis on the technical side of execution, which develops the learner's ability to create algorithms and models of new quality.

Conclusions. The result of the study was a method for solving probabilistic problems in the study of independent repeated tests (Bernoulli and Poisson formulas) using Python programming language libraries in the professional training of students in the field of PCIs. The inclusion of this research in the methodological support of the student's professional training in the field of physical culture and sports will contribute to the expansion of the resource base in the implementation of the digital transformation of higher education.

The proposed method of solving probabilistic problems in the study of independent repeated tests (Bernoulli and Poisson formula) using Python programming language libraries: NumPy; SciPy; Matplotlib; Seaborn; Pandas; SymPy; Scikit-learn contributes to the formation of competencies in students at the FKiS: universal (to solve standard tasks of professional activity based on the use of digital technologies); professional (to use mathematical tools in integration with computer environments to create and study models of various levels of abstraction).

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