Business, Management and Economics Engineering
ISSN: 2669-2481 / eISSN: 2669-249X
2022 Volume 20 Issue 2
https://doi.org/ 10.5281/zenodo.7221488

DEVELOPMENT OF ECONOMIC STUDENTS THINKING IN TEACHING THEORY OF PROBABILITY AND ELEMENTS OF MATHEMATICAL STATISTICS WITH "PRACTICAL-PROFESSIONAL ORIENTATION"

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Abstract: The training of economists and the development of their professional competence are directly related to the study of economics as well as mathematics, in particular, the study of probabilistic-statistical methods. Because the outcome of many economic processes depends on many random factors and uncertainties. Analytical conclusions are evaluated with a certain degree of probability, which means that the results of a particular test can be considered reliable. Therefore, probability theory and mathematical statistics play an important role in the development of students' economic thinking. The teaching of this science also has its own problems. This article is based on the relevance of teaching probability theory and mathematical statistics based on the concept of "practical-professional orientation", and the mechanisms for implementing this process are presented with enough examples and problems.
Key words: probability, statistics, teaching, economy, education, problem.

Introduction. The training of economists in higher education institutions and the development of their professional competence are directly related to the study of economics as well as mathematics, in particular, the study of probabilistic and statistical methods. Because the outcome of many economic processes depends on many random factors and uncertainties. For example, in production, the relationship between product quality, the consumption of raw materials and labor productivity, daily sales revenue and income are modeled on the basis of probabilistic-statistical analysis and methods. Internal and external variables in each economic process, that is, variations, are studied on the basis of the variational characteristics of these socio-economic phenomena, the laws of their development are determined by probability theory and mathematical statistical methods. The analytical conclusions are evaluated with a certain degree of probability, which means that the results of certain tests can be considered reliable [1], [12].

In the observation of socio-economic phenomena, the mathematical probability of an event is expressed in the form of a statistical law with a stable relative repetition rate. This is the result of the application of probability theory and the law of large numbers of mathematical statistics for socio-economic events under certain conditions. In probability theory, a mathematical model of an economic process is designed, while in mathematical statistics, we construct a mathematical model of economic processes based on the influence of some random factor and analyze its aspects of interest. In this sense, mathematical statistics aims to construct a theoretical probabilistic model of the economic process being studied using its inference methods.

Probability theory and the content of mathematical statistics, which are aimed at training future economists, and the issues of training are not without some problems. In particular, the impact of the principle of "practical-professional orientation of teaching" on the development of professional competence has been little studied. The content of education and the availability of existing teaching aids are not adequate. Probabilistic-statistical models and practical-professional issues are not systematically reflected in the content of mathematics education. Students who have mastered the pure mathematical content face difficulties in analyzing economic processes and solving and modeling professional-practical problems.

Theoretical and methodological bases of teaching and studying probability theory and mathematical statistics in the Republic of Uzbekistan, the issues of improving teaching methods have been studied by I.M. Gaysinskaya, H. Ochilova, J. Qudratov, D.V. Manevich, U.X. Khonkulov [7], [11], [12], [16], [17].

H. Ochilova's research is aimed at developing probabilistic-statistical thinking of students in grades 4-8. The researcher argued that students' probabilistic-statistical thinking depends on their ability to predict and evaluate.

The research of I.M. Gaysinskaya, D.V. Manevich, J. Kudratov is aimed at the selection of probabilistic and statistical materials at school, the organization of optional classes.

U.X. Khonkulov's research promotes the idea of teaching the elements of the stochastic direction of mathematics on the basis of an approach based on interdisciplinary connections and the internal integration of the subject. The content of a special course "Elements of combinatorics, probability theory and mathematical statistics" for academic lyceums "Exact sciences" and "Natural sciences" was developed and put into practice. A set of methods based on internal integration in solving problems related to probability theory and mathematical statistics is proposed.

N.V. Panina, A.G. Elenkin, E. Alexandrova, I.N. Konovalova, S.O. Dolgopolova, R.Sh. Khusnutdinov, Y. Abdullaev, N.M. Soatov and others have conducted a number of studies [9], [18], [19].

N.V. Panina's work examines the practical orientation of probability theory and mathematics statistics as a means of developing the economic thinking of students majoring in economics. The scientific and pedagogical basis of teaching has been improved.

S.O. Dolgopolova's research identifies the theoretical requirements and practical basis for designing a system for the formation of statistical thinking of students majoring in economics.

N.M. Soatov, Y. Abdullaev, Sh.K. Formanov, A. Abdushukurov studied the issues of quantitative analytical aspects of socio-economic phenomena and the description of their close connection with the qualitative side by means of mathematical statistical methods. Recommended as a textbook for students of higher education institutions that train economists, "Theory of Statistics" allows you to study the thinking and ideology of the nation, linking them to the textbook topics.

Main body. Mathematics education begins with specific practical experiences, exercises, and moves to abstract concepts. Professional experience is formed in practice. In this sense, the “practical-professional orientation of teaching” is of particular importance in the study of probability theory and mathematical statistics.

In pedagogical research, the term "practical orientation of teaching" is defined as "the formation of knowledge, skills and competencies in the use of mathematical apparatus in solving specific practical problems through the implementation of appropriate content and methodological connections of mathematical education" [3], [9], [12].

In most scientific sources, the terms "practical orientation of teaching" and "professional orientation of teaching" are used in parallel, and they are the same concepts that complement each other. Authors such as G.V. Dorofeev, L.V. Kuznetsova, V.V. Firsov say that "the professional orientation of teaching is the content, form and methods of teaching mathematics in a particular professional activity; and the practical orientation of teaching is the production of practical exercises, the solution of professional problems."

The analysis and generalization of different views led us to the following definition:

Practical-professional orientation of teaching - the type of educational activity, the content, form and means of education, including practical training for the formation of professional competence. As a result, a well-developed personality of a specialist ready to dynamically solve professional problems is formed [5], [6].

Probability theory and mathematical statistics in the professional training of future economists can be seen to be directly and indirectly related to the "practical-professional orientation of teaching" to practical-professional issues.

We believe that the content and structure of practical issues for economists should meet the following didactic and methodological requirements:

- Probability-statistical problem corresponds to the subject of mathematics, the relevance of the current dynamics of production, to include professional information;
- The text of the issue should be as short and clear as possible, aimed at the formation of systematic and consistent practical tasks and on this basis to solve real-life problems;
-compliance with the trend of formation of knowledge, skills and abilities of professional importance, to promote the development of professional competencies of future economists;
- The emergence of technical capabilities in the performance of calculations to obtain digital results, the use of special programs Excel, MathCad, Statistics and similar programs technical calculation tools.

Practical-professional issues should serve not to study a large amount of educational material, but to deepen the understanding of probabilistic-statistical terms and facts, to develop the ability to apply theoretical knowledge in professional activities.

We have divided problems related to probability theory and mathematical statistics for economists into the following three types depending on the method of presentation.

1. Pure mathematical issues. Pure mathematical content that can be solved using mathematical formulas and concepts based on rigid algorithmsi issues.

We can say that the methods of solving such problems are ready and in practice not professional.

Here are some examples [4], [10], [14].

Example. There are 10 red and 6 blue balls in the box. Take 2 balls per plate. Find the probability that both balls are the same color.

Solution: Let the event A be red of both balls and let the event B be blue of both balls. Apparently, events A and B are not co-occurring events. So,

$$P(A+B)=P(A)+P(B)$$

The C_{10}^2 result allows the event A to occur. As a C_6^2 result allows event B to occur. The total number of possible outcomes is C_{16}^2 .

In that case:

$$P(A+B)=\frac{C_{10}^2+C_6^2}{C_{16}^2}=\frac{\frac{10\cdot 9}{2}+\frac{6\cdot 5}{2}}{\frac{16\cdot 15}{2}}=\frac{60}{120}=\frac{1}{2}$$

Example. Two hunters fired one at the wolf. The probability of the first hunter hitting the wolf is 0.7, and that of the second is 0.8. Find the probability that at least one arrow hits the wolf.

Solution: Let the event A shoot the first hunter's wolf, and let the event B shoot the second hunter's wolf. Apparently, events A and B are co-occurring but not related to each other. In that case

$P(A+B)=P(A)+P(B)–P(AB)=P(A)+P(B)-P(A)\cdot P(B)=0{,}7+0{,}8-0{,}7\cdot 0{,}8=0{,}94.$

Example. Probability of each shot hitting the target $p=\frac{2}{3}$. Find the probability that three of the 10 shots fired hit the target.

Solution: In that case, according to Bernoulli's formula: $n=10;\ k=3;\ p=\frac{2}{3};\ q=\frac{1}{3}.$

$$P_{10}(3)=C_{10}^3\left(\frac{2}{3}\right)^3\left(\frac{1}{3}\right)^7$$

Example. The probability of hitting a target when one bullet is fired is 0.8. Find the probability that exactly 75 bullets hit the target when 100 bullets are fired.

Solution: $n=100;\ k=75;\ p=0{,}8;\ q=0{,}2$

In that case,

$$\frac{k-np}{\sqrt{npq}}=\frac{75-100\cdot 0{,}8}{\sqrt{100\cdot 0{,}8\cdot 0{,}2}}=-1{,}25$$

from the table

$$\varphi(-1{,}25)=0{,}1826$$

So,

$$P_{100}(75)=\frac{0{,}1826}{4}=0{,}04565$$

2. Practical and professional issues. Mathematical problems related to professional activity.

The method of solving for practical-professional problems is formed, and the comparison of the values required to solve it requires only a little mental effort. As a result of solving this problem, professional competence is developed to a certain extent through the use of appropriate calculation formulas, that is, automatism is formed.

Here are some examples [10], [13], [15].

Example. In a large advertising firm, 21% of employees earn high salaries. 40% of the company's employees are women. At the same time, 6.4% of workers are high-paid women. Is there any reason to say that there is discrimination in the payment of women's labor in the company?

Solution: From the point of view of probability theory, the question can be asked: "How likely is it that a randomly selected female worker will receive a higher salary?" If we consider A the phenomenon of "randomly selected worker receives a high salary", B - the phenomenon of "randomly selected female worker", then:

$$P_B(A) = \frac{P(AB)}{P(B)} = \frac{0{,}064}{0{,}40} = 0{,}16$$

Since the number 0.16 here is less than the number 0.21, it can be concluded that women are less likely than men to earn higher wages in an advertising firm.

Example. The probability that a consumer will see an advertisement for a particular product on television is 0.04, and the probability of seeing an advertisement for the same product in a special advertising exhibition is 0.06. If these two events are independent, what is the probability that the consumer will see both types of advertising?

Solution: Let event A-consumer have seen an advertisement for a product on television and let event B-consumer have seen an advertisement for a product in a special advertising exhibition. These events are independent. In this case:

$$P(AB) = P(A)P(B) = 0{,}04 \cdot 0{,}06 = 0{,}0024$$

Example. If it is known that 4% of all products are of poor quality and 75% of quality products meet the first grade requirement, find the probability that the product obtained by chance is first grade.

Solution: Let event A- "selected product quality" and let event B- "selected product 1st grade". According to the terms of the case $P(A) = 1 - 0{,}04 = 0{,}96$ and $P_A(B) = 0{,}75$. In this case:

$$P(AB) = P(A)P_A(B) = 0{,}96 \cdot 0{,}75 = 0{,}72$$

Example. 5% of the products of a particular enterprise are of poor quality. Find the probability that two of the 5 products randomly selected are of poor quality.

Solution: Probability of randomly selected product is poor quality $p = 0{,}05$. In that case, according to Bernoulli's formula

$$P_5(2) = C_5^2(0{,}05)^2(0{,}95)^{5-2} = \frac{5!}{2!\,3!}(0{,}05)^2(0{,}95)^3 = 0{,}02$$

Example. 1% of the bulk of the product is of poor quality. What should be the size of a random sample so that the probability of encountering at least one poor quality product is not less than 0.95?

Solution: It is known that $n \geq \frac{\ln(1-P)}{\ln(1-p)}$. Depending on the condition $P = 0{,}95, p = 0{,}01$.

So, $n \geq \frac{\ln 0{,}05}{\ln 0{,}99} \approx 296$. That is, if the sample size is at least 296, the probability of encountering at least one poor quality product during the inspection is not less than 0.95.

Example. The number of visitors to the bank is subject to the Poisson distribution. On average, one customer enters the bank every 3 minutes.

a) Find the probability that one customer will enter the bank in the next minute.

b) Find the probability that at least three people enter the bank within the next minute.

Solution: According to the terms of the issue, on average, one customer enters the bank every 3 minutes. Mathematical expectation for Poisson distribution assuming that the parameter is equal to λ, we obtain that $\lambda = \frac{1}{3}$.

a) We find the probability that one customer will enter the bank in the next minute:

$$P\ (X=1) = \frac{\lambda^1}{1!}e^{-\lambda} = \frac{e^{-1/3}}{3} = 0{,}2388$$

b) To find the probability that at least three people will enter the bank in the next minute, we find the inverse event, that is, the probability that at most two people will enter:

$$P(X \le 2) = P(X=0) + P(X=1) + P(X=2) = e^{-\lambda}\left(1 + \frac{\lambda^1}{1!} + \frac{\lambda^2}{2!}\right) = e^{-\frac{1}{3}}\left(1 + \frac{1}{3} + \frac{1}{18}\right)$$
$$= 0{,}9952$$

In this case: $P(X \ge 3) = 1 - P(X \le 2) = 1 - 0{,}9952 = 0{,}0048$;

3. Problematic practical-professional issues. The problem is not stated in mathematical language, but is presented in the form of a problem. In this case, it is necessary to solve the required task, which is carried out through a practical activity, and as a result, a mathematical form of the problem is formed.

A number of questions need to be answered in problematic practical-professional issues. How to collect initial data, what to analyze when processing them, what mathematical formulas to use, etc.? Undoubtedly, such issues are most useful in terms of the formation of professional competence, from which begins to understand and solve the problematic situation.

Here are some examples.

Problem. Have each student form a series of events and determine the content of those event combinations.

Sample issue. Avicenna's Lab Company advertises Laktovita products in 3 different ways: on TV, through advertising banners and on websites. Let's mark the fact that when one of the customers who came to buy the company's product was selected at risk and let event A- the selected customer saw the product advertisement on TV, let event B- the selected customer saw the product advertisement on advertising banner and let event C the selected customer saw the product advertisement on websites. Explain the following events:

a) AB; b) $AB + C$; c) $\bar{A}B$; d) $\overline{BC}$.

Solution:

a) AB - the selected customer saw the product advertisement on TV and advertising banners;

b) $AB + C$ - the selected customer saw the product advertisement on TV and advertising banners or websites;

c) $\bar{A}B$ - the selected customer sawn't the product advertisement on advertising banners but saw it on TV;

d) $\overline{BC}$- the selected customer sawn't the product advertisement on advertising banners and websites.

Problem. Have each student form a series of events and determine the interrelationships of those events.

Sample issue. One of the customers who visited the "Ishonch" chain of stores was selected at risk. Let event A- he came to buy a TV set, B- he came to buy vacuum cleaner, C- he came to buy Artel TV set, D- he came to buy Artel vacuum cleaner, E- he came to buy Artel products. Determine the relationship between these events.

Solution:

All of these events come together in pairs. For example, a customer may have received a Samsung TV and an Artel vacuum cleaner, events A and D may be observed at the same time, or a customer may have received a vacuum cleaner and an Artel washing machine, events B and E may be monitored at the same time.

All of these events may be joint. It is possible that the customer came at the same time to buy an Artel TV, an Artel vacuum cleaner and an Artel washing machine. It is also possible to add that it would be wrong to say that only events A, B, C, D or E are observed for a randomly selected client.

The event C favors the event A. Because the fact that the customer is came to buy Artel TV means that he came to buy a TV.

The event C favors the event E. Because the fact that the customer is came to buy Artel vacuum cleaner means that he came to buy a Artel product.

The event D favors the event B. Because the fact that the customer is came to buy Artel vacuum cleaner means that he came to buy a vacuum cleaner.

The event D favors the event E. Because the fact that the customer is came to buy Artel vacuum cleaner means that he came to buy a Artel product.

Problem. An entrepreneur can bet on one or more businesses. Which choice do you prefer?

Sample issue. The entrepreneur wants to invest his available funds in the business. There are 2 different types of businesses that are recommended. These businesses are not related to each other and the probability that the money invested in both types of business will not pay off is the same 0.1. The entrepreneur is thinking about betting all his money on one business or splitting his money on two businesses. Which event is more likely: does money justify itself when betting on one type of business, or does money justify itself when betting on at least one type of business?

Solution:

A- the event that the money invested in the 1st business justifies itself;

B- the event that the money invested in the 2nd business justifies itself;

C-the phenomenon of money justifying itself in at least one when betting money on both businessesget

In that case it will be $C = AB + \bar{A}B + A\bar{B}$ and $P(C) = P(AB + \bar{A}B + A\bar{B}) = P(AB) + P(\bar{A}B) + P(A\bar{B}) = P(A)P(B) + P(\bar{A})P(B) + P(A)P(\bar{B})$.

As you know, $P(A) = P(B) = 1 - 0{,}1 = 0{,}9$ and $P(\bar{A}) = P(\bar{B}) = 0{,}1$. That is why $P(C) = 0{,}9 \cdot 0{,}9 + 0{,}1 \cdot 0{,}9 + 0{,}9 \cdot 0{,}1 = 0{,}99$. That is, $P(C) > P(A)$.

So, entrepreneurwhen betting money on both businesses, the probability that the money will justify itself in at least one is the samethe money invested in the business is more likely to justify itself. In short, it is better to invest money in both businesses.

Problem. The entrepreneur buys a variety of products from several firms and sells them in his stores. In order to reduce transportation costs, it intends to buy and sell with only one firm and terminate the contract with the rest. Develop a strategy to determine which firm is best suited to maintain relationships with.

Sample issue. The businessman has set up mini-markets in two places. Sausage products are sold in the 1st mini-market from "Tokhtaniyaz ota" company. Sausage products from Sharshara will be sold in the 2nd mini-market. The entrepreneur calculated that transportation costs would be reduced by 1,200,000 soums per month if the products were imported from one company rather than from two companies. In the last month, the daily profit from the sale of sausage products was recorded in table 1:

Table 1

Data	Profit in the 1st mini-market (thousand soums)	Profit in the 2nd mini-market (thousand soums)	Data	Profit in the 1st mini-market (thousand soums)	Profit in the 2nd mini-market (thousand soums)
1	150	120	**16**	185	152
2	152	130	**17**	140	154
3	154	154	**18**	160	150
4	150	150	**19**	170	260
5	160	160	**20**	180	300
6	190	230	**21**	130	20
7	125	80	**22**	180	30
8	148	140	**23**	160	150
9	140	152	**24**	155	250
10	154	154	**25**	150	400
11	155	72	**26**	170	60
12	170	260	**27**	185	20
13	202	230	**28**	130	220
14	130	120	**29**	160	150
15	170	150	**30**	165	152

Based on this information, which firm's products would the entrepreneur prefer to continue trading?

Solution: First of all, let's calculate the daily average profit (sample average) in each mini-market:

$$\bar{x}_T = \frac{150 + 152 + 154 + \cdots + 165}{30} = 159$$

$$\bar{y}_T = \frac{120 + 130 + 154 + \cdots + 152}{30} = 159$$

The average benefit is the same. Now we calculate the standard deviation. For this, we first calculate the sample variances:

$$D_x = \frac{(150 - 159)^2 + (152 - 159)^2 + \cdots + (165 - 159)^2}{30} = 348{,}8$$

$$D_y = \frac{(120 - 159)^2 + (130 - 159)^2 + \cdots + (152 - 159)^2}{30} = 6807{,}1$$

$$\sigma_x = \sqrt{D_x} = 18{,}7$$

$$\sigma_y = \sqrt{D_y} = 82{,}5$$

We can also calculate the coefficient of variation:

$$v_x = \frac{\sigma_x}{\bar{x}_T} \cdot 100\% = 11{,}76\%$$

$$v_y = \frac{\sigma_y}{\bar{y}_T} \cdot 100\% = 51{,}89\%$$

This means that the products of Tokhtaniyaz ota are more stable than the products of Sharshara. Therefore, it is good that Tokhtaniyaz ota continues to sell its products.

Along with these and similar problematic practical-professional issues, it will be useful to cite the economic meanings of popular problems of probability theory and mathematical statistics.

Monty Hall problem

This problem is named in honor of the host of the TV show "Let's Make a Deal" Monty Hall. In this show, participants could win by playing a game. At the end of the game, a conditional selection was made as follows: the participant was given the opportunity to choose one of three doors. One of them had a new car, and the other two had embarrassing prizes (e.g., a pumpkin in one and a baby pacifier in the other). The participant does not know which prize is behind which door and randomly selects one door. The starter can simply show the prize behind the door chosen by the participant. However, Monty Hall behaves as follows: he opens one of the doors (without a prize) that the participant did not choose. Because the beginner knew what prize was behind each door. He then tells the participant that he can choose another unopened door instead of the one he had previously chosen. This is where the difficult question arises: if a participant changes their choice, will the probability of winning a car increase, decrease, or not change?

Can this solution be used in the economy? Yes. In the context of economic uncertainty that analysts often encounter, the following conclusion should be borne in mind when solving a problem: it is not necessary to know exactly the only correct solution. If you know exactly what will not happen, the chances of a successful prediction are always high. For example, when the world is on the brink of a financial crisis, politicians are always trying to predict the right course of action to minimize the effects of the crisis. The role of the Monti Hall paradox in the field of economics can be described as follows: There are three doors for heads of state. One leads to hyperinflation, the other to deflation, and the third to the desired moderate economic growth. But the mountain How do you find the answer? Politicians say some of their actions will lead to more jobs and economic growth. But leading economists, experienced people, including Nobel Prize winners, also make it clear to them that one of these options will not necessarily lead to the desired result. Will politicians change their choices after that? It's okay to change. zgartiradimi? It's okay to change. zgartiradimi? It's okay to change.

St. Petersburg paradox

The game is offered as follows: before the start of each game, the player pays (bets) a unit amount, and then one coin is taken and tossed until it first lands with the side of the coat of arms. If the first time falls 1 unit, the second time falls 2 units, the third time falls 4 units, etc. Each time the amount is doubled, the player is given as a prize. How much of the down payment can this game be considered fair?

Can this solution be used in the economy? Yes. In the second half of the 20th century, alternatives to the application of the St. Petersburg paradox in financial markets were discovered and developed. The mathematician K. Menger was the first to propose the use of the St. Petersburg paradox in the economic field, focusing on finding a descriptive model of behavior in conditions of uncertainty rather than setting a "fair price" for a particular gambling game. The application of this problem in economics is found in ideas such as the principle of marginal utility reduction, expected utility as a criterion for decision-making in conditions of uncertainty, fundamentals of insurance microeconomics, risk management and game theory. Besides, they tried to use the St. Petersburg paradox as proof of some modern approaches to financial modeling. It was proposed to apply as one of the most popular alternatives to modern financial theory as the founder of economophysics.

The first digit problem

Find the probability that the randomly selected natural number entry begins with the digit 3.

This issue will help you determine if the financial statements are fake or not.

We believe that the solution of problematic practical issues can be done in three stages:

Stage 1. At this stage, the condition and conclusion of the given issue are separated, the content and essence are clarified. What needs to be found is determined, and when the condition and conclusion of the issue are separated, a clear practical action is identified. Then the problem is reduced to a mathematical form.

Stage 2. At this stage focuses on planning and the choice of solution. What additional information is needed to apply it, a solution plan is identified, and implemented step-by-step. At this stage, if the information provided is sufficient to solve the problem, the method of solving it will be selected. If there is not enough information, it will be determined what additional information is needed and then a solution plan will be developed. On this basis, they gradually approach the right solution.

Stage 3. At this stage, the problem is solved according to the plan, errors are identified and corrected, and the solution is checked directly. At this stage, students understand the importance of professional issues on the basis of experience, practice, the importance of probabilistic-statistical methods.

Of course, in solving all types of problems, students will need to be able to apply certain properties, theorems and their results, to use different methods.

When solving problems, it is necessary to pay attention to the following:

-know and remember the basic concepts, definitions, properties and formulas of probability theory and mathematical statistics;

- be able to plan their activities in solving problems and determine what mathematical concepts can be used to solve the problem;

-understand the essence of the problem.

The above methodological recommendations should be applied at all stages of the process of solving practical professional problems: understanding the essence of the problem and taking the necessary practical actions, planning, problem solving and investigation.

Conclusion. Explaining the course of probability theory and mathematical statistics for students majoring in economics with the help of problematic practical-professional issues will help them to develop their economic thinking, to solve problems in their work, to plan, forecast future activities in the field of economics. Helps to draw conclusions.

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DEVELOPMENT OF ECONOMIC STUDENTS THINKING IN TEACHING THEORY OF PROBABILITY AND ELEMENTS OF MATHEMATICAL STATISTICS WITH “PRACTICAL-PROFESSIONAL ORIENTATION”

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Abstract: The training of economists and the development of their professional competence are directly related to the study of economics as well as mathematics, in particular, the study of probabilistic-statistical methods. Because the outcome of many economic processes depends on many random factors and uncertainties. Analytical conclusions are evaluated with a certain degree of probability, which means that the results of a particular test can be considered reliable. Therefore, probability theory and mathematical statistics play an important role in the development of students' economic thinking. The teaching of this science also has its own problems. This article is based on the relevance of teaching probability theory and mathematical statistics based on the concept of "practical-professional orientation", and the mechanisms for implementing this process are presented with enough examples and problems.

Key words: probability, statistics, teaching, economy, education, problem.

Introduction. The training of economists in higher education institutions and the development of their professional competence are directly related to the study of economics as well as mathematics, in particular, the study of probabilistic and statistical methods. Because the outcome of many economic processes depends on many random factors and uncertainties. For example, in production, the relationship between product quality, the consumption of raw materials and labor productivity, daily sales revenue and income are modeled on the basis of probabilistic-statistical analysis and methods. Internal and external variables in each economic process, that is, variations, are studied on the basis of the variational characteristics of these socio-economic phenomena, the laws of their development are determined by probability theory and mathematical statistical methods. The analytical conclusions are evaluated with a certain degree of probability, which means that the results of certain tests can be considered reliable [1], [12].

In the observation of socio-economic phenomena, the mathematical probability of an event is expressed in the form of a statistical law with a stable relative repetition rate. This is the result of the application of probability theory and the law of large numbers of mathematical statistics for socio-economic events under certain conditions. In probability theory, a mathematical model of an economic process is designed, while in mathematical statistics, we construct a mathematical model of economic processes based on the influence of some random factor and analyze its aspects of interest. In this sense, mathematical statistics aims to construct a theoretical probabilistic model of the economic process being studied using its inference methods.

Probability theory and the content of mathematical statistics, which are aimed at training future economists, and the issues of training are not without some problems. In particular, the impact of the principle of “practical-professional orientation of teaching” on the development of professional competence has been little studied. The content of education and the availability of existing teaching aids are not adequate. Probabilistic-statistical models and practical-professional issues are not systematically reflected in the content of mathematics education. Students who have mastered the pure mathematical content face difficulties in analyzing economic processes and solving and modeling professional-practical problems.

Theoretical and methodological bases of teaching and studying probability theory and mathematical statistics in the Republic of Uzbekistan, the issues of improving teaching methods have been studied by I.M. Gaysinskaya, H. Ochilova, J. Qudratov, D.V. Manevich, U.X. Khonkulov [7], [11], [12], [16], [17].

H. Ochilova's research is aimed at developing probabilistic-statistical thinking of students in grades 4-8. The researcher argued that students' probabilistic-statistical thinking depends on their ability to predict and evaluate.

The research of I.M. Gaysinskaya, D.V. Manevich, J. Kudratov is aimed at the selection of probabilistic and statistical materials at school, the organization of optional classes.

U.X. Khonkulov's research promotes the idea of teaching the elements of the stochastic direction of mathematics on the basis of an approach based on interdisciplinary connections and the internal integration of the subject. The content of a special course "Elements of combinatorics, probability theory and mathematical statistics" for academic lyceums "Exact sciences" and "Natural sciences" was developed and put into practice. A set of methods based on internal integration in solving problems related to probability theory and mathematical statistics is proposed.

N.V. Panina, A.G. Elenkin, E. Alexandrova, I.N. Konovalova, S.O. Dolgopolova, R.Sh. Khusnutdinov, Y. Abdullaev, N.M. Soatov and others have conducted a number of studies [9], [18], [19].

N.V. Panina's work examines the practical orientation of probability theory and mathematics statistics as a means of developing the economic thinking of students majoring in economics. The scientific and pedagogical basis of teaching has been improved.

S.O. Dolgopolova's research identifies the theoretical requirements and practical basis for designing a system for the formation of statistical thinking of students majoring in economics.

N.M. Soatov, Y. Abdullaev, Sh.K. Formanov, A. Abdushukurov studied the issues of quantitative analytical aspects of socio-economic phenomena and the description of their close connection with the qualitative side by means of mathematical statistical methods. Recommended as a textbook for students of higher education institutions that train economists, "Theory of Statistics" allows you to study the thinking and ideology of the nation, linking them to the textbook topics.

Main body. Mathematics education begins with specific practical experiences, exercises, and moves to abstract concepts. Professional experience is formed in practice. In this sense, the “practical-professional orientation of teaching” is of particular importance in the study of probability theory and mathematical statistics.

In pedagogical research, the term "practical orientation of teaching" is defined as "the formation of knowledge, skills and competencies in the use of mathematical apparatus in solving specific practical problems through the implementation of appropriate content and methodological connections of mathematical education" [3], [9], [12].

In most scientific sources, the terms "practical orientation of teaching" and "professional orientation of teaching" are used in parallel, and they are the same concepts that complement each other. Authors such as G.V. Dorofeev, L.V. Kuznetsova, V.V. Firsov say that "the professional orientation of teaching is the content, form and methods of teaching mathematics in a particular professional activity; and the practical orientation of teaching is the production of practical exercises, the solution of professional problems."

The analysis and generalization of different views led us to the following definition:

Practical-professional orientation of teaching - the type of educational activity, the content, form and means of education, including practical training for the formation of professional competence. As a result, a well-developed personality of a specialist ready to dynamically solve professional problems is formed [5], [6].

Probability theory and mathematical statistics in the professional training of future economists can be seen to be directly and indirectly related to the "practical-professional orientation of teaching" to practical-professional issues.

We believe that the content and structure of practical issues for economists should meet the following didactic and methodological requirements:

- Probability-statistical problem corresponds to the subject of mathematics, the relevance of the current dynamics of production, to include professional information;
- The text of the issue should be as short and clear as possible, aimed at the formation of systematic and consistent practical tasks and on this basis to solve real-life problems;
-compliance with the trend of formation of knowledge, skills and abilities of professional importance, to promote the development of professional competencies of future economists;
- The emergence of technical capabilities in the performance of calculations to obtain digital results, the use of special programs Excel, MathCad, Statistics and similar programs technical calculation tools.

Practical-professional issues should serve not to study a large amount of educational material, but to deepen the understanding of probabilistic-statistical terms and facts, to develop the ability to apply theoretical knowledge in professional activities.

We have divided problems related to probability theory and mathematical statistics for economists into the following three types depending on the method of presentation.

1. Pure mathematical issues. Pure mathematical content that can be solved using mathematical formulas and concepts based on rigid algorithmsi issues.

We can say that the methods of solving such problems are ready and in practice not professional.

Here are some examples [4], [10], [14].

Example. There are 10 red and 6 blue balls in the box. Take 2 balls per plate. Find the probability that both balls are the same color.

Solution: Let the event A be red of both balls and let the event B be blue of both balls. Apparently, events A and B are not co-occurring events. So,

$$P(A+B)=P(A)+P(B)$$

The C_{10}^2 result allows the event A to occur. As a C_6^2 result allows event B to occur. The total number of possible outcomes is C_{16}^2 .

In that case:

$$P(A+B)=\frac{C_{10}^2+C_6^2}{C_{16}^2}=\frac{\frac{10\cdot 9}{2}+\frac{6\cdot 5}{2}}{\frac{16\cdot 15}{2}}=\frac{60}{120}=\frac{1}{2}$$

Example. Two hunters fired one at the wolf. The probability of the first hunter hitting the wolf is 0.7, and that of the second is 0.8. Find the probability that at least one arrow hits the wolf.

Solution: Let the event A shoot the first hunter's wolf, and let the event B shoot the second hunter's wolf. Apparently, events A and B are co-occurring but not related to each other. In that case

$P(A+B) = P(A) + P(B) - P(AB) = P(A) + P(B) - P(A) \cdot P(B) = 0{,}7 + 0{,}8 - 0{,}7 \cdot 0{,}8 = 0{,}94.$

Example. Probability of each shot hitting the target $p = \frac{2}{3}$. Find the probability that three of the 10 shots fired hit the target.

Solution: In that case, according to Bernoulli's formula: $n = 10;\ k = 3;\ p = \frac{2}{3};\ q = \frac{1}{3}$.

$$P_{10}(3) = C_{10}^{3}\left(\frac{2}{3}\right)^{3}\left(\frac{1}{3}\right)^{7}$$

Example. The probability of hitting a target when one bullet is fired is 0.8. Find the probability that exactly 75 bullets hit the target when 100 bullets are fired.

Solution: $n = 100;\ k = 75;\ p = 0{,}8;\ q = 0{,}2$

In that case,

$$\frac{k - np}{\sqrt{npq}} = \frac{75 - 100 \cdot 0{,}8}{\sqrt{100 \cdot 0{,}8 \cdot 0{,}2}} = -1{,}25$$

from the table

$$\varphi(-1{,}25) = 0{,}1826$$

So,

$$P_{100}(75) = \frac{0{,}1826}{4} = 0{,}04565$$

2. Practical and professional issues. Mathematical problems related to professional activity.

The method of solving for practical-professional problems is formed, and the comparison of the values required to solve it requires only a little mental effort. As a result of solving this problem, professional competence is developed to a certain extent through the use of appropriate calculation formulas, that is, automatism is formed.

Here are some examples [10], [13], [15].

Example. In a large advertising firm, 21% of employees earn high salaries. 40% of the company's employees are women. At the same time, 6.4% of workers are high-paid women. Is there any reason to say that there is discrimination in the payment of women's labor in the company?

Solution: From the point of view of probability theory, the question can be asked: "How likely is it that a randomly selected female worker will receive a higher salary?" If we consider A the phenomenon of "randomly selected worker receives a high salary", B - the phenomenon of "randomly selected female worker", then:

$$P_B(A) = \frac{P(AB)}{P(B)} = \frac{0{,}064}{0{,}40} = 0{,}16$$

Since the number 0.16 here is less than the number 0.21, it can be concluded that women are less likely than men to earn higher wages in an advertising firm.

Example. The probability that a consumer will see an advertisement for a particular product on television is 0.04, and the probability of seeing an advertisement for the same product in a special advertising exhibition is 0.06. If these two events are independent, what is the probability that the consumer will see both types of advertising?

Solution: Let event A-consumer have seen an advertisement for a product on television and let event B-consumer have seen an advertisement for a product in a special advertising exhibition. These events are independent. In this case:

$$P(AB) = P(A)P(B) = 0{,}04 \cdot 0{,}06 = 0{,}0024$$

Example. If it is known that 4% of all products are of poor quality and 75% of quality products meet the first grade requirement, find the probability that the product obtained by chance is first grade.

Solution: Let event A- "selected product quality" and let event B- "selected product 1st grade". According to the terms of the case $P(A) = 1 - 0{,}04 = 0{,}96$ and $P_A(B) = 0{,}75$. In this case:

$$P(AB) = P(A)P_A(B) = 0{,}96 \cdot 0{,}75 = 0{,}72$$

Example. 5% of the products of a particular enterprise are of poor quality. Find the probability that two of the 5 products randomly selected are of poor quality.

Solution: Probability of randomly selected product is poor quality $p = 0{,}05$. In that case, according to Bernoulli's formula

$$P_5(2) = C_5^2(0{,}05)^2(0{,}95)^{5-2} = \frac{5!}{2!\,3!}(0{,}05)^2(0{,}95)^3 = 0{,}02$$

Example. 1% of the bulk of the product is of poor quality. What should be the size of a random sample so that the probability of encountering at least one poor quality product is not less than 0.95?

Solution: It is known that $n \geq \frac{\ln(1-P)}{\ln(1-p)}$. Depending on the condition $P = 0{,}95, p = 0{,}01$.

So, $n \geq \frac{\ln 0{,}05}{\ln 0{,}99} \approx 296$. That is, if the sample size is at least 296, the probability of encountering at least one poor quality product during the inspection is not less than 0.95.

Example. The number of visitors to the bank is subject to the Poisson distribution. On average, one customer enters the bank every 3 minutes.

a) Find the probability that one customer will enter the bank in the next minute.

b) Find the probability that at least three people enter the bank within the next minute.

Solution: According to the terms of the issue, on average, one customer enters the bank every 3 minutes. Mathematical expectation for Poisson distribution assuming that the parameter is equal to λ, we obtain that $\lambda = \frac{1}{3}$.

a) We find the probability that one customer will enter the bank in the next minute:

$$P\,(X = 1) = \frac{\lambda^1}{1!}e^{-\lambda} = \frac{e^{-1/3}}{3} = 0{,}2388$$

b) To find the probability that at least three people will enter the bank in the next minute, we find the inverse event, that is, the probability that at most two people will enter:

$$P(X \leq 2) = P(X = 0) + P(X = 1) + P(X = 2) = e^{-\lambda}\left(1 + \frac{\lambda^1}{1!} + \frac{\lambda^2}{2!}\right) = e^{-\frac{1}{3}}\left(1 + \frac{1}{3} + \frac{1}{18}\right)$$
$$= 0{,}9952$$

In this case: $P(X \geq 3) = 1 - P(X \leq 2) = 1 - 0{,}9952 = 0{,}0048$;

3. Problematic practical-professional issues. The problem is not stated in mathematical language, but is presented in the form of a problem. In this case, it is necessary to solve the required task, which is carried out through a practical activity, and as a result, a mathematical form of the problem is formed.

A number of questions need to be answered in problematic practical-professional issues. How to collect initial data, what to analyze when processing them, what mathematical formulas to use, etc.? Undoubtedly, such issues are most useful in terms of the formation of professional competence, from which begins to understand and solve the problematic situation.

Here are some examples.

Problem. Have each student form a series of events and determine the content of those event combinations.

Sample issue. Avicenna's Lab Company advertises Laktovita products in 3 different ways: on TV, through advertising banners and on websites. Let's mark the fact that when one of the customers who came to buy the company's product was selected at risk and let event A- the selected customer saw the product advertisement on TV, let event B- the selected customer saw the product advertisement on advertising banner and let event C the selected customer saw the product advertisement on websites. Explain the following events:

a) AB; b) $AB + C$; c) $\bar{A}B$; d) $\overline{BC}$.

Solution:

a) AB - the selected customer saw the product advertisement on TV and advertising banners;

b) $AB + C$ - the selected customer saw the product advertisement on TV and advertising banners or websites;

c) $\bar{A}B$ - the selected customer sawn't the product advertisement on advertising banners but saw it on TV;

d) $\overline{BC}$- the selected customer sawn't the product advertisement on advertising banners and websites.

Problem. Have each student form a series of events and determine the interrelationships of those events.

Sample issue. One of the customers who visited the "Ishonch" chain of stores was selected at risk. Let event A- he came to buy a TV set, B- he came to buy vacuum cleaner, C- he came to buy Artel TV set, D- he came to buy Artel vacuum cleaner, E- he came to buy Artel products. Determine the relationship between these events.

Solution:

All of these events come together in pairs. For example, a customer may have received a Samsung TV and an Artel vacuum cleaner, events A and D may be observed at the same time, or a customer may have received a vacuum cleaner and an Artel washing machine, events B and E may be monitored at the same time.

All of these events may be joint. It is possible that the customer came at the same time to buy an Artel TV, an Artel vacuum cleaner and an Artel washing machine. It is also possible to add that it would be wrong to say that only events A, B, C, D or E are observed for a randomly selected client.

The event C favors the event A. Because the fact that the customer is came to buy Artel TV means that he came to buy a TV.

The event C favors the event E. Because the fact that the customer is came to buy Artel vacuum cleaner means that he came to buy a Artel product.

The event D favors the event B. Because the fact that the customer is came to buy Artel vacuum cleaner means that he came to buy a vacuum cleaner.

The event D favors the event E. Because the fact that the customer is came to buy Artel vacuum cleaner means that he came to buy a Artel product.

Problem. An entrepreneur can bet on one or more businesses. Which choice do you prefer?

Sample issue. The entrepreneur wants to invest his available funds in the business. There are 2 different types of businesses that are recommended. These businesses are not related to each other and the probability that the money invested in both types of business will not pay off is the same 0.1. The entrepreneur is thinking about betting all his money on one business or splitting his money on two businesses. Which event is more likely: does money justify itself when betting on one type of business, or does money justify itself when betting on at least one type of business?

Solution:

A- the event that the money invested in the 1st business justifies itself;

B- the event that the money invested in the 2nd business justifies itself;

C-the phenomenon of money justifying itself in at least one when betting money on both businessesget

In that case it will be $C = AB + \bar{A}B + A\bar{B}$ and $P(C) = P(AB + \bar{A}B + A\bar{B}) = P(AB) + P(\bar{A}B) + P(A\bar{B}) = P(A)P(B) + P(\bar{A})P(B) + P(A)P(\bar{B})$.

As you know, $P(A) = P(B) = 1 - 0{,}1 = 0{,}9$ and $P(\bar{A}) = P(\bar{B}) = 0{,}1$. That is why $P(C) = 0{,}9 \cdot 0{,}9 + 0{,}1 \cdot 0{,}9 + 0{,}9 \cdot 0{,}1 = 0{,}99$. That is, $P(C) > P(A)$.

So, entrepreneurwhen betting money on both businesses, the probability that the money will justify itself in at least one is the samethe money invested in the business is more likely to justify itself. In short, it is better to invest money in both businesses.

Problem. The entrepreneur buys a variety of products from several firms and sells them in his stores. In order to reduce transportation costs, it intends to buy and sell with only one firm and terminate the contract with the rest. Develop a strategy to determine which firm is best suited to maintain relationships with.

Sample issue. The businessman has set up mini-markets in two places. Sausage products are sold in the 1st mini-market from "Tokhtaniyaz ota" company. Sausage products from Sharshara will be sold in the 2nd mini-market. The entrepreneur calculated that transportation costs would be reduced by 1,200,000 soums per month if the products were imported from one company rather than from two companies. In the last month, the daily profit from the sale of sausage products was recorded in table 1:

Table 1

Data	Profit in the 1st mini-market (thousand soums)	Profit in the 2nd mini-market (thousand soums)	Data	Profit in the 1st mini-market (thousand soums)	Profit in the 2nd mini-market (thousand soums)
1	150	120	**16**	185	152
2	152	130	**17**	140	154
3	154	154	**18**	160	150
4	150	150	**19**	170	260
5	160	160	**20**	180	300
6	190	230	**21**	130	20
7	125	80	**22**	180	30
8	148	140	**23**	160	150
9	140	152	**24**	155	250
10	154	154	**25**	150	400
11	155	72	**26**	170	60
12	170	260	**27**	185	20
13	202	230	**28**	130	220
14	130	120	**29**	160	150
15	170	150	**30**	165	152

Based on this information, which firm's products would the entrepreneur prefer to continue trading?

Solution: First of all, let's calculate the daily average profit (sample average) in each mini-market:

$$\bar{x}_T = \frac{150 + 152 + 154 + \cdots + 165}{30} = 159$$

$$\bar{y}_T = \frac{120 + 130 + 154 + \cdots + 152}{30} = 159$$

The average benefit is the same. Now we calculate the standard deviation. For this, we first calculate the sample variances:

$$D_x = \frac{(150-159)^2 + (152-159)^2 + \cdots + (165-159)^2}{30} = 348{,}8$$

$$D_y = \frac{(120-159)^2 + (130-159)^2 + \cdots + (152-159)^2}{30} = 6807{,}1$$

$$\sigma_x = \sqrt{D_x} = 18{,}7$$

$$\sigma_y = \sqrt{D_y} = 82{,}5$$

We can also calculate the coefficient of variation:

$$v_x = \frac{\sigma_x}{\bar{x}_T} \cdot 100\% = 11{,}76\%$$

$$v_y = \frac{\sigma_y}{\bar{y}_T} \cdot 100\% = 51{,}89\%$$

This means that the products of Tokhtaniyaz ota are more stable than the products of Sharshara. Therefore, it is good that Tokhtaniyaz ota continues to sell its products.

Along with these and similar problematic practical-professional issues, it will be useful to cite the economic meanings of popular problems of probability theory and mathematical statistics.

Monty Hall problem

This problem is named in honor of the host of the TV show "Let's Make a Deal" Monty Hall. In this show, participants could win by playing a game. At the end of the game, a conditional selection was made as follows: the participant was given the opportunity to choose one of three doors. One of them had a new car, and the other two had embarrassing prizes (e.g., a pumpkin in one and a baby pacifier in the other). The participant does not know which prize is behind which door and randomly selects one door. The starter can simply show the prize behind the door chosen by the participant. However, Monty Hall behaves as follows: he opens one of the doors (without a prize) that the participant did not choose. Because the beginner knew what prize was behind each door. He then tells the participant that he can choose another unopened door instead of the one he had previously chosen. This is where the difficult question arises: if a participant changes their choice, will the probability of winning a car increase, decrease, or not change?

Can this solution be used in the economy? Yes. In the context of economic uncertainty that analysts often encounter, the following conclusion should be borne in mind when solving a problem: it is not necessary to know exactly the only correct solution. If you know exactly what will not happen, the chances of a successful prediction are always high. For example, when the world is on the brink of a financial crisis, politicians are always trying to predict the right course of action to minimize the effects of the crisis. The role of the Monti Hall paradox in the field of economics can be described as follows: There are three doors for heads of state. One leads to hyperinflation, the other to deflation, and the third to the desired moderate economic growth. But the mountain How do you find the answer? Politicians say some of their actions will lead to more jobs and economic growth. But leading economists, experienced people, including Nobel Prize winners, also make it clear to them that one of these options will not necessarily lead to the desired result. Will politicians change their choices after that? It's okay to change. zgartiradimi? It's okay to change. zgartiradimi? It's okay to change.

St. Petersburg paradox

The game is offered as follows: before the start of each game, the player pays (bets) a unit amount, and then one coin is taken and tossed until it first lands with the side of the coat of arms. If the first time falls 1 unit, the second time falls 2 units, the third time falls 4 units, etc. Each time the amount is doubled, the player is given as a prize. How much of the down payment can this game be considered fair?

Can this solution be used in the economy? Yes. In the second half of the 20th century, alternatives to the application of the St. Petersburg paradox in financial markets were discovered and developed. The mathematician K. Menger was the first to propose the use of the St. Petersburg paradox in the economic field, focusing on finding a descriptive model of behavior in conditions of uncertainty rather than setting a "fair price" for a particular gambling game. The application of this problem in economics is found in ideas such as the principle of marginal utility reduction, expected utility as a criterion for decision-making in conditions of uncertainty, fundamentals of insurance microeconomics, risk management and game theory. Besides, they tried to use the St. Petersburg paradox as proof of some modern approaches to financial modeling. It was proposed to apply as one of the most popular alternatives to modern financial theory as the founder of economophysics.

The first digit problem

Find the probability that the randomly selected natural number entry begins with the digit 3.

This issue will help you determine if the financial statements are fake or not.

We believe that the solution of problematic practical issues can be done in three stages:

Stage 1. At this stage, the condition and conclusion of the given issue are separated, the content and essence are clarified. What needs to be found is determined, and when the condition and conclusion of the issue are separated, a clear practical action is identified. Then the problem is reduced to a mathematical form.

Stage 2. At this stage focuses on planning and the choice of solution. What additional information is needed to apply it, a solution plan is identified, and implemented step-by-step. At this stage, if the information provided is sufficient to solve the problem, the method of solving it will be selected. If there is not enough information, it will be determined what additional information is needed and then a solution plan will be developed. On this basis, they gradually approach the right solution.

Stage 3. At this stage, the problem is solved according to the plan, errors are identified and corrected, and the solution is checked directly. At this stage, students understand the importance of professional issues on the basis of experience, practice, the importance of probabilistic-statistical methods.

Of course, in solving all types of problems, students will need to be able to apply certain properties, theorems and their results, to use different methods.

When solving problems, it is necessary to pay attention to the following:

-know and remember the basic concepts, definitions, properties and formulas of probability theory and mathematical statistics;

- be able to plan their activities in solving problems and determine what mathematical concepts can be used to solve the problem;

-understand the essence of the problem.

The above methodological recommendations should be applied at all stages of the process of solving practical professional problems: understanding the essence of the problem and taking the necessary practical actions, planning, problem solving and investigation.

Conclusion. Explaining the course of probability theory and mathematical statistics for students majoring in economics with the help of problematic practical-professional issues will help them to develop their economic thinking, to solve problems in their work, to plan, forecast future activities in the field of economics. Helps to draw conclusions.

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