NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE
Department of Economic Cybernetics
Department of Statistics and Economic Analysis

"**CONFIRMED**"
Dean of Agrarian Management Faculty

_____**Anatolii OSTAPCHUK**
"28 "_____April_____2023

"**APPROVED**"
at the meeting of the Department of Economic Cybernetics
Protocol № ____ dated _____ 2023
Chairman of Department
_____**Dmytro ZHERLITSYN**

at the meeting of the Department of Statistics and Economic Analysis
Protocol № ____ dated _____ 2023
Chairman of Department
_____**Inna LAZARYSHYNA**

"**REVIEWED**"
Program Coordinator of the educational program
"Management"

_____**Vitalii LUTSIAK**

PROGRAM OF THE COURSE

PROBABILITY THEORY AND STATISTICS

Specialty 073 "Management "
Educational program "Management "
Faculties: information technologies; economic
Developers:
Lyudmyla Galaieva , Associate Professor of the Department of Economic Cybernetic, PhD in Economics, Associate Professor;
Oksana Makarchuk, Associate Professor of the Department of Statistics and Economic Analysis, PhD in Economics, Associate Professor

Kyiv – 2023

Description of the discipline
Probability Theory and Statistics

<table>
<tr><td colspan="2">Field of knowledge, specialization, educational program, educational degree</td></tr>
<tr><td>Educational degree</td><td>bachelor
(Bachelor's, Master's)</td></tr>
<tr><td>Specialization</td><td>073 "Management"
Code and Name of specialization</td></tr>
<tr><td>Educational program</td><td>Management
Name of program</td></tr>
</table>

Characteristics of the course	
Type	Compulsory
Total number of hours	150
Number of ECTS credits	5
Number of content modules	3
Course project (work) (if applicable)	-
Form of assessment	*Exam*

Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Course (year of study)	1	-
Semester	2	-
Lecture classes	45 hr.	-
Practical, seminar classes	45 hr.	-
Laboratory classes	-.	-
Self-study	60 hr.	-
Individual assignments	-	-
Number of weekly classroom hours for the full-time form of study	6 hr.	-

2. Purpose, objectives, and competencies of the course
"Probability Theory and Statistics": Probability Theory and Mathematical Statistics

The educational activity of each institution of higher education is aimed at training such specialists who could quickly adapt in real conditions and apply in practice the theoretical knowledge obtained during training. In the system of economic education, the place of "Theory of Probability and Statistics" as a discipline is determined by its role in the scientific and practical activities of society. "Probability theory and statistics" refers to a cycle of disciplines that form the profile of a future specialist, equipping him with the basics of theory and practice in the application of mathematical methods for studying the patterns of random phenomena, statistical evaluation and analysis of economic, social and other phenomena and processes.

The purpose of the course is the formation of modern thinking and a system of fundamental theoretical knowledge in the theory of probability and statistics in future specialists, as well as applied practical skills with the use of information technology tools (MS Excel, SPSS, etc.), acquiring the skills of statistical research and analysis of economic phenomena and processes for the adoption effective management decisions.

The task of studying the discipline is the theoretical and practical training of students on the methodology and methods of research and analysis of mass statistical data using the tools of probability theory and statistics.

Acquisition of competencies:

Integrated competency (IC): The ability to solve complex specialized tasks and practical problems characterized by complexity and uncertainty in the conditions in the field of management or in the learning process, which involves the application of theories and methods of social and behavioral sciences

General Competencies (GC):

GC 4. Ability to apply knowledge in practical situations.

GC 8. Skills in using information and communication technologies.

GC 10. Ability to adapt and act in a new situation.

GC 12. The ability to generate new ideas (creativity).

Professional (special) competencies (PC):

PC 1. The ability to define and describe the characteristics of the organization.

PC 2. The ability to analyze the results of the organization's activities, to compare them with the factors of influence of the external and internal environment.

PC 10. The ability to evaluate the performed work, ensure their quality and motivate the personnel of the organization.

PC 12. Ability to analyze and structure organizational problems, form reasonable solutions.

Program Learning Outcomes (PLO):

PLO 4. Demonstrate skills in identifying problems and justifying management decisions.

PLO 6. Demonstrate the skills of searching, collecting and analyzing information, calculating indicators to substantiate management decisions.

3. Program and structure of the course
For Full-time education form of study

Content module 1
Conceptual foundations of probability theory.

Theme 1. Conceptual foundations of probability theory
Stochastic experiment, its role and place in modeling socio-economic and natural processes. The subject of probability theory. Mathematical model of stochastic experiments. Algebra of random events. An axiomatic approach to the construction of probabilities of the stochastic experiment space. Probabilities on a discrete space of elementary events. Sum theorems for incompatible and compatible events. Inclusion and exclusion rule. Classical definition of probability. Basic concepts of combinatorial analysis: basic rule of combinatorics, permutations, placement, combination. Geometric definition of probability. Statistical definition of probability and its properties. Practical application of various approaches to the construction of probability space.

Theme 2. Conditional probability and the concept of independence of events. Formulas of full probability and Bayes
Conditional probability and the product theorem for dependent events. The concept of pairwise independence of random events. Independence as a whole. Full set of events. Full probability formula and Bayes formula. Examples of use in the sequential decision-making procedure (Bayesian approach).

Theme 3. Repetition of experiments and distribution of probabilities
Repeated independent tests. Bernoulli scheme. Distribution of the number of successes in a series of independent stochastic experiments. Binomial distribution. The most likely number of successes and its probability. Approximate methods of calculating binomial probabilities and their accuracy. The local Moivre-Laplace theorem. Moivre-Laplace integral theorem. Bernoulli's theorem for estimating true probability through statistical frequency. "Rare" events. Poisson's theorem. Creative function.

Theme 4. Discrete and continuous random variables
Definition of random variables and their classification. The law of distribution of a discrete random variable. Numerical characteristics of the distribution: mathematical expectation, variance, mean square deviation, initial and central moments. Numerical characteristics of the arithmetic mean, a set of random variables. Properties of numerical characteristics. Basic laws of discrete distributions and their numerical characteristics: degenerate, hypergeometric distribution, negative binomial distribution, Bernoulli distribution and its transformations, Poisson distribution, geometric distribution. Examples of application of standard distributions in typical problems in practice.

Definition of continuous random variables. The probability distribution function of a random variable and its properties. Absolutely continuous random variables. Density distribution and its properties. Density distribution of functions from absolutely continuous random variables. Convolution theorem. Numerical characteristics of absolutely continuous random variables and their properties.

Theme 5. Laws of probability distribution of random variables. The law of large numbers
The uniform law of probability distribution and its numerical characteristics. Exponential (exponential) law of distribution. The property of no after-effect.

Transformation of sequences of independent random variables. Gamma distribution. The normal law of probability distribution and its standard representation. Student's and Fisher's (Chi-square) distributions, their relation to the standard normal distribution.

Theme 6. Systems of independent random variables (independent study)

Theme 7. Basic elements of mathematical statistics
Basic concepts of mathematical statistics: sample observations and sample estimates. Methods of parametric and non-parametric estimation of parameters. Methods of testing statistical hypotheses.

Content module 2
Stages of statistical observation and methods of analysis of patterns of distribution

Theme 8. Methodological principles of statistics
General concept of statistics. A brief historical reference to the development of statistics. The subject of studying statistics.

Basic concepts of statistical science. Statistical population. Statistical aggregates in the sphere of social life and their characteristics. Statistical regularity. Statistical indicators.

Content, value and form of statistical indicators. System of statistical indicators.

Theoretical basis of statistics. Statistics and other sciences. Statistics and mathematics. Statistics and accounting.

The method of statistics. Philosophy is the methodological basis of statistics. Features of the statistical method. Statistics as a multidisciplinary science. Stages of statistical research, their unity and relationship.

Organization of statistical service. Tasks of statistics of Ukraine. Law of Ukraine "On State Statistics".

Theme 9. Statistical observation
Concept of statistical observation. Plan of statistical observation. The task of observation. Object and unit of observation. Monitoring program. Statistical tools of observation. Organization of statistical observation. Place, time and terms of observation. Preparatory works. Unified State Register of Enterprises and Organizations of Ukraine.

Organizational forms of observation: reporting, specially organized observations and registers.

Types of statistical observation on the degree of coverage of units and the time of data registration. Types of discontinuous observation.

Methods of statistical observation.

Errors of statistical observation and methods of their detection. Acceptance and control of statistical observation materials.

Theme 10. Compilation and grouping of statistical data. Statistical tables
Summary task, its content. Organization of the assembly. Types of erection. Simple and complex summation. Centralized and decentralized compilation.

Statistical grouping is the basis of scientific processing of mass data. The essence of the grouping method. Tasks and types of groupings. Types of grouping signs. Sequence of grouping. Selection of groups and intervals.

Secondary grouping.

Statistical tables. Constituent elements of the table. Types of tables. Table design rules.

Theme 11. Summarizing statistical indicators

Types of statistical summarizing indicators. Conditions of scientific application of absolute and relative indicators.

Absolute indicators, their types. Units of measurement of absolute indicators. Types of relative indicators, their forms and units of measurement.

Concept of average value. Terms of application of average values. Types of medium.

Methods of calculating different types of averages. Majority rule.

Arithmetic average, methods of its calculation. Simple and weighted arithmetic mean. Justification of the weight for the weighted arithmetic mean. Mathematical properties of the arithmetic mean. Calculation of the arithmetic mean by the method of moments.

Combining averages with the method of statistical groupings in economic analysis.

General and group averages.

Theme 12. Analysis of distribution series

The concept of statistical distribution series. Types of distribution series, their constituent elements.

Graphical representation of distribution series.

Structural averages as characteristics of the distribution center.

Fashion. Ways of calculating fashion in discrete and interval distribution series.

Multimodal distributions.

Median. Methods of calculating the median in discrete and interval distribution series. Bimodal distribution series.

The ratio between the arithmetic mean, mode, and median in a distribution series. Quartiles, deciles, percentiles.

Indicators of variation. Range of variation. Average linear deviation. Mean square deviation (variance). Mean square deviation. Coefficient of variation. Ways of calculating variation indicators for grouped and ungrouped data.

Mathematical properties of dispersion. Calculation of dispersion by the method of moments. The rule of adding variances and its application.

Characteristics of the distribution form, the method of their calculation. The concept of normal distribution.

Theme 13. Analysis of concentration, differentiation and distribution similarity

Concentration. Methodology for assessing the degree of concentration. Concentration coefficient. Coefficient of localization, its characteristics.

Coefficient of similarity of structures, method of its calculation.

Indicators of the intensity of structural shifts. Linear coefficient of structural shifts. Quadratic coefficient of structural shifts.

Theme 14. Selective method in management

General and selective population. The task of selective observation. The concept of statistical estimates. Basic requirements for statistical populations.

Organization of selective observation. A combination of continuous and selective observation. Application of the sampling method in socio-economic statistics.

Methods of selection that ensure the representativeness of the sample. Random selection. Mechanical selection. Typical selection. Serial selection. Combination of different selection methods.

Sampling errors. Mean sampling error. Marginal sampling error. Point and interval estimation of general population parameters. Methodology of statistical assessment of arithmetic mean and percentage. Determination of sampling errors for different sampling methods.

Determination of the required sample size.

Content module 3
Methods of statistical data analysis in management

Theme 15. Statistical methods of measuring relationships
Types of relationships between phenomena. Functional and correlational relationships. Analytical grouping method.

Analysis of variance.

Concept of correlation-regression analysis. The main tasks of correlation analysis. Prerequisites of correlation analysis. Types of correlational dependencies according to the form and direction of communication.

Simple linear correlation analysis. Construction of the regression equation. The method of calculating the parameters of the regression equation. Economic content of regression coefficients. Indicators of assessment of tightness of connection. Correlation index. Linear correlation coefficient. Coefficient of determination.

Simple nonlinear correlation analysis. Methodology for calculating the parameters of the egression equation. Correlation index. Coefficient of determination.

Multiple correlation analysis. The method of calculating the parameters of the regression equation. Economic content of partial regression coefficients. Paired, partial and multiple correlation coefficient. Partial and multiple coefficients of determination.

Non-parametric correlation analysis. Correlation analysis of qualitative features.

Theme 16. Analysis of the intensity of dynamics
Statistical series of dynamics, their constituent elements. Momentary and interval, parallel and interconnected series of dynamics. Rules for building dynamics series.

Indicators of series of dynamics. Average level and methods of its calculation. Absolute growth. Growth rate. Growth rate. The value of one percent increase. Methods of calculating dynamics indicators. Basic method. Chain method. Relationships between indicators of dynamics.

Average levels of a series of dynamics.

Methodology for calculating indicators of the intensity of phenomena characterized by two dynamic series. Coefficient of advance. Absolute acceleration (deceleration) of growth. Coefficient of acceleration (deceleration) of the relative speed of dynamics.

Transformation of dynamics series. Closing the series of dynamics. Reduction of series of dynamics to one basis.

Theme 17. Analysis of development trends and seasonal fluctuations
Methods of identifying development trends. Method of enlarged intervals. The moving average method. Analytical alignment of dynamics series by the method of least squares. Interpolation. Extrapolation.

Analysis of seasonal fluctuations. Seasonality indices. Seasonal wave. Average annual coefficient of seasonality.

Theme 18. Index analysis in the management system
The concept of indices. The value of indices in economic analysis. Types of indices. Individual and general indices. Basic elements of general indexes. Indexed values. Weights and proportionality factors. General aggregate indices. Principles of construction of general aggregate indices. The main tasks solved with the help of indexes.

A system of indices for characterizing the dynamics of a complex phenomenon. Basic and chain indexes.

Average arithmetic and harmonic indices. The principles of their construction.

Mid-level indexes. Indexes of variable composition, permanent composition, structural shifts.

Index method of analysis in the management system. Assessment of the influence of individual factors on the change of complex phenomena based on interrelated indices.

Territorial indexes.

Theme 19. Graphic method in management

The role and significance of statistical graphs. Basic elements of a statistical graph. Graphics field. Geometric signs. Spatial landmarks. Scale landmarks. Explanation of the schedule.

Types of statistical graphs. Diagrams. Cartograms. Card diagrams. Types of diagrams and methods of their construction.

Methods of graphic representation of the dynamics of phenomena, the structure of the relationship.

STRUCTURE OF THE DISCIPLINE THEORY PROBABILITY AND STATISTICS

Names of content modules and topics	Number of hours											
	Full-time form						Part-time form					
	total	including					total	including				
		l	s	lab	ind	ss		l	s	lab	ind	ss
1	2	3	4	5	6	7	8	9	10	11	12	13
Content Module 1. Probability Theory and Mathematical Statistics												
Theme 1. Concepts of Probability Research	10	3	3			4						
Theme 2. Conditional Probability; the Law of Total Probability and Bayes' Theorem	4	1	1			2						
Theme 3. Rules of Probability Distributions	6	2	2			2						
Theme 4. Discrete Random Variables (DRV) and Continuous Random Variables (CRV)	10	3	3			4						
Theme 5. Probability Distributions. . Law of large numbers and central limit theorem	10	3	3			4						
Theme 6. Systems of independent random variables	8	Self study.		Self study.		8						
Theme 7. Elements of Mathematical Statistics	12	3	3			6						
Total hours for the Module 1	**60**	**15**	**15**			**30**						
Content module 2. Stages of statistical observation and methods of analysis of patterns of distribution												
Theme 8. Methodological principles of statistics	**6**	**2**	**2**			**2**						
Theme 9. Statistical observation	**6**	**2**	**2**			**2**						
Theme 10. Compilation and grouping of statistical data. Statistical tables	**6**	**2**	**2**			**2**						

Theme 11. Summarizing statistical indicators	6	2	2			2						
Theme 12. Analysis of distribution series	7	2	2			3						
Theme 13. Analysis of concentration, differentiation and distribution similarity	7	2	2			3						
Theme 14. Selective method in management	7	2	2			3						
Total hours for the Module 2	**45**	**14**	**14**	-	**-**	**17**						
Content module 3. Methods of statistical data analysis in management												
Theme 15. Statistical methods of measuring relationships	17	6	6			5						
Theme 16. Analysis of the intensity of dynamics	10	4	4			2						
Theme 17. Analysis of development trends and seasonal fluctuations	6	2	2			2						
Theme 18. Index analysis in the management system	6	2	2			2						
Theme 19. Graphic method in management	6	2	2			2						
Total hours for the Module 3	**45**	**16**	**16**	-	**-**	**13**						
Total hours	**150**	**45**	**45**	-	-	**60**						

4. Themes of seminar classes
(The curriculum does not provide)

5. Practical class topics

№	Name	Hours
1	Theme 1. Introduction to Probability. Concepts of Probability Research.	3
2	Theme 2. Conditional Probability; the Law of Total Probability and Bayes' Theorem.	1
3	Theme 3. Rules of Probability Distributions.	2
4	Theme 4. Discrete Random Variables (DRV). Continuous Random Variables (CRV).	3
5	Theme 5. Probability Distributions. Law of large numbers and central limit theorem.	3
6	Theme 6. Systems of independent random variables.	-
7	Theme 7. Elements of Mathematical Statistics.	3
8	Theme 8. Methodological principles of statistics.	2
9	Theme 9. Statistical observation.	2
10	Theme 10. Summary and grouping of statistical data. Statistical tables.	2
11	Theme 11. Summarizing statistical indicators.	2
12	Theme 12. Analysis of distribution series.	2
13	Theme 13. Analysis of concentration, differentiation and similarity of distributions.	2
14	Theme 14. Selective method in management.	2
15	Theme 15. Statistical methods of measuring relationships.	6
16	Theme 16. Analysis of the intensity of dynamics.	4
17	Theme 17. Analysis of development trends and seasonal fluctuations.	2
18	Theme 18. Index analysis in the management system.	2
19	Theme 19. Graphic method in management.	2
Total Hours		*45*

6. Themes of laboratory classes
(The curriculum does not provide)

7. Self-study themes

№	Name	Hours
1	Theme 1. Introduction to Probability. Concepts of Probability Research.	4
2	Topic 2. Conditional Probability; the Law of Total Probability and Bayes' Theorem.	2
3	Topic 3. Rules of Probability Distributions.	2
4	Topic 4. Discrete Random Variables (DRV). Continuous Random Variables (CRV).	4
5	Topic 5. Probability Distributions. Law of large numbers and central limit theorem.	4
6	Topic 6. Systems of independent random variables.	8
7	Topic 7. Elements of Mathematical Statistics.	6
8	Theme 8. Methodological principles of statistics.	2
9	Theme 9. Statistical observation.	2

10	Theme 10. Summary and grouping of statistical data. Statistical tables.	2
11	Theme 11. Summarizing statistical indicators.	2
12	Theme 12. Analysis of distribution series.	3
13	Theme 13. Analysis of concentration, differentiation and similarity of distributions.	3
14	Theme 14. Selective method in management.	3
15	Theme 15. Statistical methods of measuring relationships.	5
16	Theme 16. Analysis of the intensity of dynamics.	2
17	Theme 17. Analysis of development trends and seasonal fluctuations.	2
18	Theme 18. Index analysis in the management system.	2
19	Theme 19. Graphic method in management.	2
Total Hours		60

8. Samples of control questions, tests for assessing the level of knowledge acquisition by students.

Control questions

1. How is the frequency of random event A determined and denoted?
2. What are the main properties of probability and frequency?
3. What is the subject of combinatorics?
4. What combinations are called permutations, placement, combination? How are the numbers of these compounds marked and calculated?
5. How are the basic principles of combinatorics formulated?
6. What random events are called independent?
7. How is conditional probability defined and denoted?
8. How are theorems of multiplication of probabilities of dependent and independent random events formulated and with what formulas are they written?
9. What conditions must an event satisfy so that its probability can be found using the full probability formula? What does this formula look like?
10. When is the Bayes formula used and how is it written?
11. What sequence of trials forms a Bernoulli circuit?
12. What formula is called the Bernoulli formula and what does it allow you to calculate?
13. What formulas are used to find the probability of event A less than m
or at least m times in n trials of the Bernoulli scheme?
14. What formula is used to find the probability of occurrence of event A at least once in n trials?
15. How can you determine the most probable value of the number of occurrences of an event And in the Bernoulli scheme?
16. How can you determine the number of trials in a Bernoulli scheme that allows you to state with probability P that event A will occur at least once?
17. What formula is used to calculate the probability of the occurrence of an event in several experiments, if the total number of experiments is large, and the probability of the occurrence of an event in each experiment is the same and very small, such that np<10?
18. In what cases is it appropriate to use limit theorems in the Bernoulli scheme?
19. When is it appropriate to use Poisson's formula?
20. When is it appropriate to use the local or integral Moivre-Laplace formula?
21. How are Laplace's local and integral functions defined and what are their properties?
22. How do you find Pn(m) in the case of consecutive trials with different probabilities?
23. How is Bernoulli's theorem formulated and what is its consequence?
24. What is the relationship between the statement of Bernoulli's theorem and the Laplace integral function? What problems can be solved by this connection?
25. How are random variables determined; concept of discrete and continuous random variable?
26. In what ways can a discrete random variable be specified?
27. Specify the basic laws of the distribution of a discrete random variable and the conditions for their use.
28. What do the main characteristics of a discrete random variable mean (explain)?
29. What formulas are used to calculate the main numerical characteristics of a discrete random variable?
30. How are the distribution function and probability density of continuous random variables determined? What properties do these functions have?
31. What is the relationship between integral and differential probability distribution functions?
32. What formulas can be used to calculate the probability of hitting a random value in the interval (a, b)?
33. What are the main numerical characteristics of a continuous random variable and what characterizes each of them?

34. What formulas are used to calculate the main numerical characteristics of a continuous random variable?

35. Specify the main properties of mathematical expectation and variance.

36. What is the moment of probability and what does it show?

37. What values can the distribution function of a random variable take?

38. What values can the density function of a random variable take?

39. How can the distribution law of a random variable be defined? How is Bernoulli's theorem formulated and what is its consequence?

40. What is the relationship between the statement of Bernoulli's theorem and the Laplace integral function? What problems can be solved by this connection?

41. How are random variables determined; concept of discrete and continuous random variable?

42. In what ways can you set a discrete random variable?

43. Specify the basic laws of the distribution of a discrete random variable and the conditions for their use.

44. What do the main characteristics of a discrete random variable mean (explain)?

45. What formulas are used to calculate the main numerical characteristics of a discrete random variable?

46. How are the distribution function and probability density of continuous random variables determined? What properties do these functions have?

47. What is the relationship between integral and differential probability distribution functions?

48. What formulas can be used to calculate the probability of hitting a random variable in the interval (a, b)?

49. What are the main numerical characteristics of a continuous random variable and what characterizes each of them?

50. What formulas are used to calculate the main numerical characteristics of a continuous random variable?

51. Specify the main properties of mathematical expectation and variance.

52. What is the moment of probability and what does it show?

53. What values can the distribution function of a random variable take?

54. What values can the density function of a random variable take?

55. How can the distribution law of a random variable be determined.

56. In what cases is the corrected sample variance used and how is it related to the sample variance?

57. Specify the main problems of mathematical statistics.

58. Specify the numerical characteristics of the sample and the formulas by which they are calculated.

59. What is the subject of mathematical statistics?

60. What is the sample mean square deviation (standard)?

61. What is the clustered distribution of the accumulated sample frequency called?

62. What are ungrouped and grouped sampling frequency distributions?

63. What is called a simple random sample? How is simple random sampling done using random numbers?

64. What is called a statistical, general and sample population, the volume of these populations?

65. How are frequency or frequency histograms determined for grouped sample data? How is a frequency range determined for grouped sample data?

66. How is the empirical distribution function defined and denoted? What are the main properties of this function?

67. How does the width of the interval class of grouped sample data affect the quality of the histogram? What are the recommendations for choosing the number of interval classes?

68. What is the geometric meaning of the median and how is it calculated for grouped sample data?

69. What is the probabilistic meaning of a histogram and frequency polygon for grouped sample data?
70. What properties does the sample mean have?
71. What statistical estimates are called point or interval?
72. How are statistical evaluations of numerical characteristics determined and the conditions of their immutability, effectiveness, and validity?
73. What is the confidence probability or reliability of the estimate?
74. What is the procedure for finding a confidence interval for estimating the mathematical expectation of a normal distribution with known and unknown ?
75. Specify the procedure for testing hypotheses.
76. According to what criterion is the test of the hypothesis about the equality of mathematical expectations of N normally distributed populations carried out?
77. When is the Pearson agreement test (chi-square) used?
78. What is called a statistical criterion, critical area and critical point of hypothesis testing?
79. What are the errors of the first and second kind of statistical hypothesis testing?
80. How to test the hypothesis about the equality of mathematical expectations?
81. How do you find the theoretical frequencies of the normal distribution to test the hypothesis according to Pearson's rule?
82. How is the hypothesis about the equality of variances of two normal populations tested?
83. What is the meaning of the power criterion for hypothesis testing?
84. What hypotheses are called statistical, basic and alternative, simple and complex?
85. What is the subject of studying statistics?
86. What is called a statistical indicator?
87. Explain the concept of statistical regularity. Types of regularities.
88. What is a statistical population, a population unit?
89. What feature is called variable?
90. Name the classification of feature scales.
91. Name the stages of statistical research.
92. What is a statistical observation, what is its essence?
93. Name the types of statistical observation based on the degree of coverage of population units.
94. Name the types of statistical observation of the accounting of facts over time.
95. Ways of monitoring.
96. What is a summary of statistical data? What types of erection do you know?
97. What is statistical grouping?
98. Name the types of groupings, their essence.
99. In what sequence is grouping carried out?
100. What are absolute values?
101. What is a relative value? Describe the types of relative quantities.
102. What is the average value? Name the types of average values, the methods of their calculation.
103. What is the essence of the method of moments?
104. What is a distribution series? Name the types of distribution series.
105. Name the characteristics of the center of the distribution series.
106. What are quartiles and deciles?
107. Name the indicators used to measure variation?
108. What are the different types of dispersion? What is the essence of the rule of adding variance?
109. What indicators are used to characterize the degree of asymmetry and acuity?
110. What is the peculiarity of calculating the localization coefficient? What is similarity ratio?
111. What is selective observation?
112. What are the schemes for selecting units in the sample population?
113. Name the types of selection of units in the sample population?

114. How do you determine the mean and marginal error of the sample for the mean and proportion?

115. What does the sample size depend on?

116. Name the prerequisites for applying correlation-regression analysis.

117. What indicators are used to assess the closeness of the relationship in the correlation-regression model?

118. What are elasticity coefficients, - coefficients?

119. Methodology for calculating the rank correlation coefficient.

120. How to calculate the Fechner coefficient?

121. In what cases are association and contingency coefficients used?

122. What types of dynamic series do you know?

123. What methods do you know of calculating indicators of dynamics series?

124. What is the essence of the method of analytical alignment of dynamics series by the method of least squares?

125. What is interpolation and extrapolation of dynamics series?

126. Statistical index, its types.

127. Rules for constructing aggregate indexes.

128. What is the essence of calculating general indices by averaging individual indices?

129. What is the variable composition index? What are the sub-indices of variable composition indices?

130. Name the types of statistical graphs.

Example of the Test questions

Question 1. Name the type of grouping that is used for studying the availability and direction of connection between signs, from which one is effective, and another - factor that affects the result: (answer-word).
Question 2. Intervals in which minimum and maximum values of a sign are known we call: **Choose one correct answer:**
1. equal   2. closed   3. unequal   4. open
Question 3. Statistical pattern as an important statistical category includes the following conformities: **Choose one or several correct answers:**
1.development of phenomena   2. structural shifts   3. change of phenomena in the past   4. division of elements of the aggregate   5. connection between the phenomena
Question 4. On 20 (n) plots of agricultural lands the average yield is 30 centners / ha ($\overline{y}$). n₁=10, n₂= 5, n₃=5, $\overline{y_1}$ =25, $\overline{y_2}$ =31). Calculate the average yield of third group.
Question 5. Signs that do not have quantitative expression and are recorded as a text record belong to the attribute signs

Answer	1.Correct
	2. Incorrect

Question 6. To statistical rows of distribution we refer: **Choose one or several correct answers:**
1. ranged   2. variational   3. structural   4. attributive
Question 7. Choose the correct sequence during the construction of interval row of distribution:
1. determine the number of groups of studied aggregate   2. calculate the value of the interval   3. allocate variants in ranged row   4. determine the interval boundaries
Question 8. What is the sum of deviations of individual values of the sign from the arithmetic middling?
Question 9. According to the plan for the current year revenue from product sales was 255 thousands of UAH., actually - 258 thousands. Determine the relative index of executing planned task.
Question 10. Which of the following dispersion correlations do not match the rule of adding variances: **Choose one correct answer:**
1. $\sigma^2_{заг.} = \sigma^2_{мгр.} + \sigma^2_{внг.}$ 2. $\sigma^2_{мгр.} = \sigma^2_{заг.} - \sigma^2_{внг.}$ 3. $\sigma^2_{внг.} = \sigma^2_{заг.} - \sigma^2_{мгр.}$ 4. $\sigma^2_{внг.} = \sigma^2_{мгр.} + \sigma^2_{заг.}$
Question 11. Choose a formula for calculation limited sampling error   **Choose one or several correct answers:**
1. $\Delta_{\bar{x}} = t \cdot m_x$ 2. $\Delta_{\bar{x}} = t \cdot \sqrt{\dfrac{\sigma^2}{n}}$ 3. $\Delta_{\bar{x}} = \sqrt{\dfrac{\sigma^2}{n}}$
Question 12. If all frequencies of the row of distribution increase or decrease in the constant number of times k, the arithmetic middling will increase or decrease in k times

Answer	1.Correct

	2.Incorrect

Question 13. Net profit during the first year increased on 10%, during the second - on 5%, third - 15%. On what percentage did the profit increase over three years?

Question 14. Choose the correct sequence of growth of different types of middling calculated for one and the same variation row (majorization):

1. geometric
2. quadratic
3. harmonic
4. arithmetic

Question 15. Determine compliance with calculation of individual indexes and their concrete species:

A. $i_q = \dfrac{q_1}{q_0}$	1. price index 2. index of physical size of goods 3. index of the commodity circulation
B. $i_p = \dfrac{p_1}{p_0}$	
C. $i_{qp} = \dfrac{p_1 q_1}{p_0 q_0}$	

Question 16. System of measures that turn to increase crop yield in agriculture is called (answer – in a word)

Question 17. Square of average error is directly proportional to the dispersion of the sign in the general aggregate and is inversely proportional to size of sampling

1. Yes
2. No

Question 18. Write linear form of regression:

Question 19. What is region of acceptability?
Choose one correct answer:

1. number of acceptability position of sample point in sample space that lead to acceptance of null hypothesis
2. sample space of sample variable
3. critical region
4. statistical criterion

Question 20. Match names of average values with the methods of their calculation:

A. $\bar{x} = \dfrac{\sum\limits_1^n x}{n}$	1. quadratic middling 2. arithmetic middling 3. harmonic middling 4. geometric middling
B. $\bar{x} = \sqrt{\dfrac{\sum x^2}{n}}$	
C. $\bar{x} = \dfrac{n}{\sum\limits_j^m \dfrac{1}{x}}$	
D. $\bar{x} = \sqrt[n]{x_1 x_2 x_3 .. x_n}$	

Question 21. Index of the commodity circulation increased on 10%, price index decrease on 10%. Find index of yielding:

Question 22. Errors which appears from imperfect research tools or methods are called
Choose one correct answer:

1. system
2. random
3. intentional

Question 23. What is region of acceptability?
Choose one correct answer:

1.   number of acceptability position of sample point in sample space that lead to acceptance of null hypothesis
    2.   sample space of sample variable
    3.   critical region
    4.   statistical criterion

Question 24. Which areas are not include to spring productive area:
(**Choose one or several correct answers**)
1. reseeding 2. line spacing sowing on cultivated crops 3. sowing of closed soil 4. permanent grasses 5. green sowing
Question 25. What means statistical hypothesis? Choose one or several correct answers:
1.   scientifical assumption, that demands control, confirmation 2.   scientifical assumption about size of statistical characteristic 3.   scientifical assumption that needs to be controlled
Question 26. When use average indexes:
Choose one or several correct answers
1.   when do not complete information about same indexes that are analyzed 2.   when unknown data about price change per unit of product for the base period of time 3.   when necessary doing an analysis of social-economic phenomenon for long period of time
Question 27. Sample, which quite accurately reflects the general aggregate is called:
Choose one correct answer:
1.   unified 2.   representative 3.   identical

Question 28. Process of development, movement of social-economic phenomenon's in time is called dynamic

Answer	1. Right
	2. Wrong

Question 29. Value of varying sign which is in the middle of ranged distribution row
Choose one correct answer:
1. dispersion 2. mode 3. median 4. arithmetic

Question 30. Determine correspondence of interconnection between phenomenons:

A. particular significance of factor respons only one concrete significance of result	1.correlation relationship 2.function relationship
B. particular significance of factor respons multiple significance of result	

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE			
Educational level "Bachelor" Faculty of Agrarian Management Specialty, educational program 073 Management	**Department of Economy Cybernetics & Department of Statistics and Economic Analysis** 2022-2023 educational year	**Exam variant №** From the discipline "Probability Theory and Statistics"	**Approved** Head of the Department of Economy Cybernetics _____(D.M. Zherlitsyn) (signature) Head of the Department of Statistics and Economic Analysis _____(I.D.Lazaryshyna) (signature) _____2023

Questions (Tasks)

1. Conditional Probability. Independence of Events. (**10b**)

2. (5 b)

Calculate expected value (M(x)) if the probability distribution of marks at the exam for some students is defined with the table:

X_i	2	3	4	5
P_i	0,1	0,5	0,3	0,1

3. (5 b) .

Unemployment.	*Employed*	*Unemployed*
Male	1000	40
Female	800	160

Assign a probability that each of the following is true.

a. An unemployed person is female.
b. An unemployed person is male.
c. A male is unemployed.
d. A female is employed.

Test (max 10 b)

1. The function $F^*(x)$ has all the properties of distribution function $F(x)$.

1	True
2	False

2. What does the name graph of relative frequency from values of options?

1	Polygon
2	Ogive
3	Polygon distribution
4	Cumulate

3. To place under the function.

1. Sample mean - $\overline{X}_в$. For non grouped data sample mean is count using the formula:	a) $\overline{X}_в = \dfrac{\sum\limits_{i=1}^{k} x_i n_i}{n}$
2. Sample variance - S^2 . For non grouped data random variance is calculated by the formula:	b) $D_в = \dfrac{\sum\limits_{i=1}^{n}(x_i - \overline{X}_в)^2 n_i}{n}$
3. Sample mean - $\overline{X}_в$. For the grouped data:	c) $\overline{X}_в = \dfrac{\sum\limits_{i=1}^{n} x_i}{n}$
4. Sample variance - S^2 . For the grouped data:	d) $S^2 = \dfrac{n}{n-1} D_в$,

4. Random variable is

1.	The quantitative characteristic of researches.
2.	Size which is a result of researches can be that or another numerical value.
3.	Root quadratic from a variance

5. What is designation of expected value?

(In the form of answers to give in a word)

6. What formula is used for expected value of random variable:

1.	$$M(X) = m_x = x_1 \cdot p_1 + x_2 \cdot p_2 + \cdots + x_n \cdot p_n = \sum_{i=1}^{n} x_i \cdot p_i$$
2.	$$D(X) = M\left[(X - m_x)^2\right] = \sum_{i=1}^{n} (x_i - m_x)^2 \cdot p_i$$
3.	$D(X) = M(X^2) - (M(X))^2$
4.	$\sigma(X) = \sigma_x = \sqrt{D(X)}$

7. Qualitative - Categorical or Nominal: Examples are-

| 1.	Temperatures, Salaries
2.	Color, Gender, Nationality
3.	Number of points scored on a 100 point exam, Scales of Measurement
4.	Temperatures, Salaries, Nationality

8. A _____ is a subset of the measurements selected from the population.

1	sample
2	census
3	simple random sample
4	random sample

9. Random Variables includes:

1.	Discrete random variable
2.	Continuous random variable
3.	Discrete and continuous random variable

10. What is this?
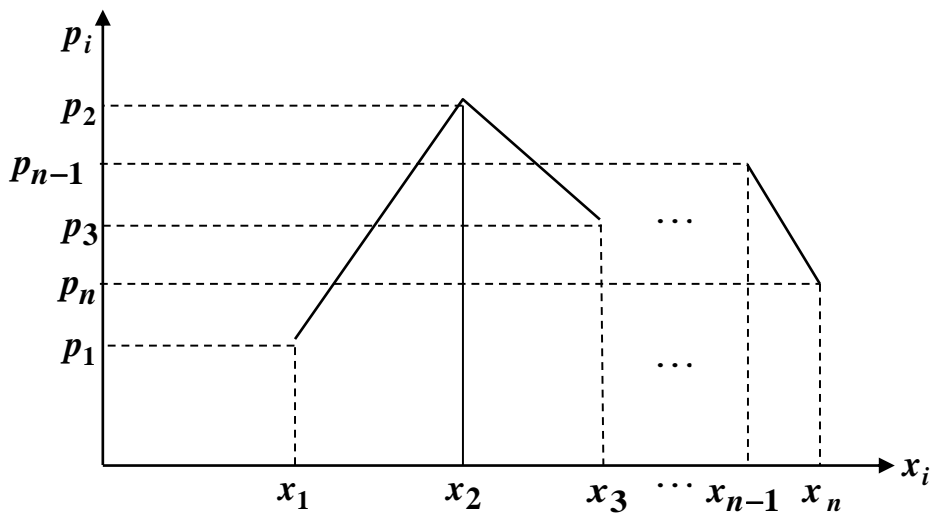
1. Polyhedron of distribution
2. A number of distribution

9. Teaching methods

Teaching methods are ways of joint activities and communication between teachers and graduates, providing positive motivation to learn, mastering the system of professional knowledge, skills and abilities, forming a scientific worldview, development of cognitive forces, culture of mental work of future professionals.

The following teaching methods are used during the educational process:

Depending on the source of knowledge: verbal (explanation, conversation, discussion, dialogue); visual (demonstration, illustration); practical (problem solving, business games).

By the nature of cognitive activity: explanatory-visual problem statement; partial search and research methods.

By place in educational activities:

- methods of organization and implementation of educational activities that combine verbal, visual and practical methods; reproductive and problem-searching; methods of educational work under the guidance of a teacher and methods of independent work of higher education students;

- methods of control and self-control over educational activities: methods of oral, written control; individual and frontal, thematic and systematic control.

In the process of teaching the discipline to intensify the educational and cognitive activities of higher education seekers provides for the use of the following educational technologies:

- work in small groups allows to structure practical seminars on the form and content, creates opportunities for participation of each student in higher education in the work on the topic of the lesson, provides the formation of personal qualities and experience of social communication;

- seminars-discussions involve the exchange of views and views of participants on this topic, as well as develop thinking, help to form views and beliefs, the ability to formulate opinions and express them, learn to evaluate other people's suggestions, critically approach their own views;

- brainstorming - a method of solving urgent problems, the essence of which is to express as many ideas in a limited period of time, discuss and select them;

- case method - a method of analysis of specific situations, which allows to bring the learning process closer to the real practical activities of specialists and involves consideration of industrial, managerial and other situations, complex conflicts, problematic situations, incidents in the study of educational material;

- presentations - speeches to the audience, used to present certain achievements, results of the group, a report on the implementation of individual tasks, briefings, demonstrations.

10. Forms of assessment

Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated 26.04.2023, protocol №10) the types of control of higher education are current control, intermediate and final certification.

Ongoing control is carried out during practical, laboratory and seminar classes and aims to check the level of readiness of higher education students to perform specific work.

Intermediate control is conducted after studying the program material and should determine the level of knowledge of higher education students in the program material obtained during all types of classes and independent work.

Forms and methods of intermediate control, mastering the program material are developed by the lecturer of the discipline and approved by the relevant department in the form of testing, written tests, colloquium, etc., which can be assessed numerically.

Mastering the program material by a higher education student is considered successful if his / her rating is not less than 60 points on a 100-point scale.

Semester control is conducted in the form of a semester exam or semester test in a particular discipline.

The semester exam is a form of final attestation of mastering the theoretical and practical material on the academic discipline for the semester.

Semester test is a form of final control, which consists in assessing the mastering of higher education theoretical and practical material (performed by student certain types of work in practical, seminar or laboratory classes and during independent work) in the discipline for the semester.

Differentiated test is a form of control that allows to assess the implementation and mastery of higher education program of practical training, preparation and defense of course work (project).

Applicants for higher education are required to take exams and tests in accordance with the requirements of the working curriculum within the timeframe provided by the schedule of the educational process. The content of exams and tests is determined by the working curricula of disciplines.

The content of exams and tests is determined by the working curricula of disciplines.

11. Distribution of grades received by students.

 Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated 26.04.2023, protocol №10)

Student rating, points	National grade based on exam results	
	Exams	Credits
90-100	Excellent	Passed
74-89	Good	
60-73	Satisfactory	
0-59	Unsatisfactory	Not passed

In order to determine the rating of a student (listener) in the discipline R_{dis} (up to 100 points), the rating from the exam R_{ex}(up to 30 points) is added to the rating of a student's academic work R_{aw} (up to 70 points): $R_{dis} = R_{aw} + R_{ex}$.

12. Educational and methodological support

1.ЕНК на навчальному порталі НУБІП України «Probability Theory and Statistics». Режим доступу: https://elearn.nubip.edu.ua/course/view.php?id=1827
2.Галаєва Л.В., Коваль Т.В., Шульга Н.Г. Методичні вказівки до виконання практичних робіт з дисципліни «Теорія ймовірностей та математична статистика» Ч 1. «Теорія ймовірностей». Київ: НУБіП України, 2022. 328с.
3.Скрипник А.В., Галаєва Л.В., Коваль Т.В., Шульга Н.Г. «Теорія ймовірностей ймовірнісні процеси та математична статистика». Київ: ТОВ»Аграр Медіа Груп», 2017. 265 с. http://elibrary.nubip.edu.ua/16947/
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5. Makarchuk O. Statistics. Methodical recommendations for lectures and practical classes on Statistics for preparation students of Bachelor degree for specialties 073 «Management», 075 «Marketing», 2023, 4,2 д.а.

12. Recommended sources of information

Main
Tutorials

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2. Basic Statics. Electronic source: https://www.adb.org/publications/basic-statistics-2017

3. Cox Dennis, Cox Michael. The Mathematics of Banking and Finance. The Atrium, Southern Gate, Chichester , John Wiley & Sons Ltd, 2016. 332 p.

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9. Kennedy Peter. A guide to econometrics. Massachusetts: The MIT Press, 2015. 468p.

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14. Ruric E. Wheeler, W.D.Peeples, Jr. Modern Mathematics. Brooks: Cole Publishing Company, 2016. 707p.

15. Simon Carl P., Blume Lawrence. Mathematics for economists. New York, London: W.W.Norton & Company, 2017. 930p.

16. Studies in mathematics education. The teaching of statistics / R.Morris. Unesco, 2015. 258p.

17. Галаєва Л.В., Коваль Т.В., Шульга Н.Г. Практикум «Теорія ймовірностей» / Навч. пос. - Київ: ВЦ "Компринт", 2023. – 464с.

18. Горкавий В.К. Статистика: Навч. посібник.К.: Алерта, 2020. 644 с.

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22. Мармоза А.Т. Практикум з теорії статистики і сільськогосподарської статистики: Навч.посіб. Центр навчальної літератури, 2019. 664 с.

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24. Опря А.Т., Дорогань-Писаренко Л.О., Єгорова О.В., Кононенко Ж.А. Статистика (модульний варіант з програмованою формою контролю знань). Навчальний посібник. Підручник. К.: Центр навчальної літератури, 2019. 536 с

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Recommended sources of information (Electronic Resources)

1. Кабінет Міністрів України. URL: http://www.kmu.gov.ua/control/

2. Державний Комітет статистики України. URL: http://ukrstat.gov.ua/

3. Продовольча та сільськогосподарська організація ООН (ФАО). URL: http://www.fao.org/

4. Світовий банк. URL: http://www.worldbank.org/

5. Євростат. URL: http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home

6. Положення про екзамени та заліки у Національному університеті біоресурсів і природокористування України, затверджене Вченою радою НУБіП України від 26.04.2023 р. протокол № 10. URL: https://nubip.edu.ua/sites/default/files/u284/polozh_ekzameni_zaliki_z_dopovnennyam_2023_na _sayt.pdf