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MODERN METHODS OF SCIENTIFIC RESEARCH IN THE SYSTEM OF TRAINING SCIENTIFIC STAFF OF THE KHERSON STATE MARITIME ACADEMY

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Research work is one of the most difficult types of independent work of applicants for the second level of higher education (master's students), the implementation of which requires special knowledge and skills. For master's cadets, preparing and writing a master's thesis is the first experience of research activity. In the Kherson State Maritime Academy, for master's cadets specializing in «Navigation and Management of Sea Vessels», the course «Modern Methods of Scientific Research and Data Processing» (MMSRDP) is provided, which, according to the curriculum and educational and professional program, is included in the cycle of professional training. The program of the academic discipline «Modern Methods of Scientific Research and Data Processing» is drawn up in accordance with the Code of Training, Certification and Watchkeeping for Seafarers STCW-78, IMO-MODEL COURSE 7.01, 7.03. and according to EPP. The direction of our research is to improve the teaching of the course «Modern Methods of Scientific Research and Data Processing» in the Kherson State Maritime Academy to achieve more significant standards of professional competence of applicants for the second level of higher education (master's students) in the specialization «Navigation and Management of Marine Vessels» of KhSMA. This article examines two of the most important components of the MMSRDP course. The first is the «starting» knowledge of the methodology and methods of scientific research, namely, the most significant classical paradigms that determine the essence of the concepts of methodology and methods of scientific research, concepts and issues of modern methods of empirical and theoretical research. The second, no less important component of the MMSRDP course is the study by master's students of specific methods and techniques of data processing and analysis. Our further research is aimed at a more detailed consideration of the second component of the MMSRDP course - the study by master's students of specific methods and techniques of data processing and analysis in the field of technical sciences, in particular, in the field of navigation, which are most necessary for master's students of the navigation specialty, as well as the development of a set of individual tasks for master's students aimed at the application of specific methods and techniques of data collection and analysis.

***Key words**: scientific research, data processing, navigation, seamanship, competence.*

Statement of the problem

Research work is one of the most difficult types of independent work of applicants for the second level of higher education (master's students), the implementation of which requires special knowledge and skills. For master's students, preparing and writing a master's thesis is the first experience in scientific research activities. Therefore, it is important to give them initial, «starting» knowledge about the methodology and methods of scientific research. It is necessary to explain that any scientific research begins with the formulation of clear goals of scientific research and asking questions that must be answered as a result of scientific research. This is the first, but basic step that determines the direction of all further work. The goals set before the start of scientific research determine the direction of the research and the choice of methods for collecting and analyzing experimental data. Only a clear understanding by a master's student of the research goals will enable him to determine what data is needed and in what volume, as well as how they should be organized for subsequent analysis. Understanding the goals of research by master's students is important for the successful completion of the research and obtaining meaningful final results.

The questions that a researcher (master's student) asks himself before starting work should be aimed at solving a specific problem or filling gaps in existing knowledge. A master's student should formulate questions in such a way that the answers to them are substantiated by the collected data and measurable. This requires master's students to be able to identify specific subtopics from general voluminous topics that can be effectively research.

It is with the analysis and explanation of these most important concepts that the master's students of the specialization «Navigation and management of sea vessels» begin their study of the course «Modern methods of scientific research and data processing» (MMSRDP) at the Kherson State Maritime Academy (KhSMA).

All of the above allows us to draw a conclusion about the relevance of our research aimed at improving the teaching of the course «Modern Methods of Scientific Research and Data Processing» at the Kherson State Maritime Academy.

Analysis of the latest achievements on the identified problem

The study included an analysis of scientific and methodological literature on mathematics, data analysis and processing, mathematical statistics, planning and processing of experimental results in engineering and science, both domestic and foreign authors [1-32]. Classical concepts and issues of modern methodology and methods of scientific research, modern methods of empirical and theoretical research, modern methods of data collection and analysis, specific methods and techniques of data collection and analysis were analyzed. Based on this analysis, the main concepts and issues were identified that we consider

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basic when teaching the course MMSRDP and that cadets-masters of the navigation specialty need to know. A methodological approach to teaching the course «Modern Methods of Scientific Research and Data Processing» at the Kherson State Maritime Academy was determined. Ways for further improvement of teaching this course were outlined.

Purpose and task statement

Objective of the study: to determine the methodological approach to the formation of basic concepts of methodology and methods of scientific research in the course «Modern methods of scientific research and data processing» at the Kherson State Maritime Academy.

Objectives of the study:

- To analyze the place of the discipline SMNIOD in the system of training masters in the specialization «Navigation and Management of Marine Vessels» at KhSMA.
- To analyze classical concepts and issues of modern methodology and methods of scientific research and highlight the main ones that master's students in the specialization «Navigation and Management of Marine Vessels» at KhSMA need to know.
- To analyze classical concepts and issues of modern methods of empirical and theoretical research and highlight the main ones that master's students in the specialization «Navigation and Management of Sea Vessels» at KhSMA need to know.

Summary of the main material

Structure of the study

The first part of the study examines the place of the discipline «Modern Methods of Scientific Research and Data Processing» (MMSRDP) in the system of training masters in the specialization «Navigation and Management of Sea Vessels» at the Kherson State Maritime Academy, the goals, objectives and content of the discipline.

The second part of the study is devoted to the consideration of the first of the two most important components of the MMSRDP course – «starting» knowledge about the methodology and methods of scientific research: are being considered the most significant classical paradigms are considered, defining the essence of the concepts of methodology and methods of scientific research, which must be known by master's students of the navigation specialty, and the concepts and issues of modern methods of empirical and theoretical research are also considered.

The third part of the study is devoted to the consideration of the second of the two most important components of the MMSRDP course – specific methods and techniques for processing and analyzing data.

1. MMSRDP in the system of training master's of navigation at KhSMA.

The discipline «Modern Methods of Scientific Research and Data Processing» according to the curriculum and educational and professional program is included in the cycle of professional training.

The program of the academic discipline «Modern methods of scientific research and data processing» is compiled in accordance with the Code of training, certification and watchkeeping for seafarers STCW-78, IMO-MODEL COURSE 7.01, 7.03. [33-35] and in accordance with the Educational professional program (EPP) KhSMA.

The knowledge, skills and abilities obtained as a result of studying the discipline allow you to competently and professionally write the final master's thesis and continue your studies in graduate school.

The discipline «Modern Methods of Scientific Research and Data Processing» is closely related to the following disciplines and their modules:

1. *Mathematics*. Trigonometry, elementary algebra, elementary geometry (plane geometry, stereometry), numerical methods, computational mathematics.

2. *Mathematical statistics and theoretical foundations of navigation.* Methods and techniques for processing statistical information, principles of testing statistical hypotheses. Their application to substantiate navigation methods for determining the vessel's position and assessing its accuracy.

3. *Physics*. Physical phenomena that form the basis of the operating principle of navigational instruments and ship mechanisms. Basic mathematical relationships that describe the principles of their operation.

4. *Navigation and information systems.* Electronic navigation methods for determining the vessel's position, the vessel's location using: coastal landmarks, navigation aids, dead reckoning taking into account winds, tides, currents and calculated speed. Evaluation of the accuracy of the vessel's dead reckoned and observed position.

5. *Computer science*. Universal computer systems for information processing, in particular Excel, as a means of solving problems of mathematical statistics and data processing in navigation.

The study of the academic discipline «Modern Methods of Scientific Research and Data Processing» is aimed at formation the following competencies:

The purpose of studying the discipline is to prepare masters of the specialization «Navigation and management of sea vessels» to write a master's dissertation, scientific papers and, subsequently, to carry out scientific work in the field of navigation.

Objectives of the discipline:

— to familiarize master's students in the specialization «Navigation and Management of Sea Vessels» with modern methodology and methods of scientific research; with modern methods of experimental research; with modern methods of data processing and analysis;

— to form the skills of master's students specializing in «Navigation and Management of Sea Vessels» in using modern methods of experimental research and modern methods of data processing and analysis.

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Table 1

Competence requirements for the skills of specialists in accordance with the EPP and STCW with amendments

Competence	Program learning outcomes
OK02. The ability to acquire specialized conceptual knowledge at the level of the latest achievements, which is the basis for original thinking, particularly in the context of research work. OK03. Ability to critically understand problems when conducting research at the intersection of subject areas. OK04. Ability to implement innovative and research activities, communication with representatives of other professional groups of different levels of the international context (with experts from other fields of knowledge/types of economic activity)	PR02. Specialized conceptual knowledge at the cutting-edge level that serves as the basis for original thinking and innovative activity, including in the context of research work. PR03. Ability to critically understand problems when conducting research and/or in professional activities and at the intersection of subject areas. PR07. Ability to use information and communication technologies to search, process and analyze information. PR09. Ability to prepare and present scientific and technical reports, reviews, publications (scientific articles and theses) based on the results of completed research using modern editing and printing tools in accordance with established requirements.

Source: EPP of discipline (2024) and STCW with amendments [33]

The goals and objectives of the course «Modern Methods of Scientific Research and Data Processing» for masters of the specialization «Navigation and Management of Marine Vessels» determined the content of the discipline.

2. «Starting» knowledge about the methodology and methods of scientific research.

Based on the importance of master's students mastering the basic concepts of methodology and methods of scientific research, methods of empirical and theoretical research for the effective conduct of scientific research work, after conducting an analysis of classical concepts and questions in these areas of knowledge, we identified the main ones for presentation in the MMSRDP course [1-32].

1. Methodology of scientific research.

The most common philosophical interpretation of the term «methodology» is that methodology is considered as a philosophical doctrine about the methods of cognition of the ways in which a person transforms reality.

Methodology has two main functions:

— obtaining new knowledge and presenting this knowledge through concepts, criteria, laws, theories, hypotheses;

— organizing the application of new knowledge in practical activities.

The task of methodology is to clarify, transform and construct patterns of human activity that are integrated into everyday human experience.

Methodological research is divided into general, particular and specific:

1. *General methodology of science* studies the problems of substantiation of scientific knowledge regardless of which of the specific scientific disciplines it was obtained in. Its main tasks are:

— study of universal operations of scientific knowledge (explanation and understanding) and methods of substantiating scientific knowledge;

— analysis of criteria for the acceptability of systems of scientific theories;

— study of systems of categories used as the basis of scientific thinking;

— problems of the unity of scientific knowledge.

2. *The private methodology of science* studies the methodological problems of individual sciences or their narrow groups.

A characteristic feature of any private methodology is that, while it is important for some individual science or narrow group of sciences, it is of almost no interest to other disciplines.

For example, the methodology of navigational sciences, the methodology of ecology, the methodology of physics, etc. Each of them uses the operation of explanation, but these explanations use the concept of purpose, which loses its meaning when applied to objects of another subject area.

3. *The specific methodology of science*, sometimes called methodics, studies the methodological aspects associated with individual operations within specific scientific disciplines.

The sphere of this methodology, which varies from science to science, includes, for example, the methodics for conducting an experiment in navigation, the methodics for conducting an experiment in studying the degree of environmental pollution, the methodics for conducting a physical experiment, etc.

Intradisciplinary methods of theoretical and empirical research, including the methodology of specific studies, are, for the most part, highly specialized practices.

The methodology of science undergoes natural changes over time, associated with the orientation toward the real practice of scientific and cognitive activity and overcoming inertia in the selection of models and schemes of scientific knowledge.

At present, the most important task of methodology is the awareness and corresponding constructive reorientation to the problems of natural science, technical and humanitarian scientific knowledge, the transition from the purely objective consideration of scientific subject matter,

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characteristic of the classical approach, to such consideration that takes into account the «human» and/or «natural» factors.

2. Methods of scientific research.

It is necessary to distinguish between the concepts of «methodology» and «method». Method is a way of organizing practical and theoretical development of reality, conditioned by the patterns of development of the object. The final result of scientific research depends on whether the young researcher has realized the research method or not, and has managed to select the necessary methods.

Scientific research is a creative process, there are no predetermined methods of cognition, however, the content of the methods is not formed arbitrarily by the researcher.

The method of scientific research is determined through the practical interaction of the subject of the research (research scientist) with the object of the research. For the effective use of the method, the subject is necessary objective knowledge about the object of the research. Such knowledge is accumulated in scientific theories, so their use fills the method with ideas, principles and approaches.

Thus, the method becomes the element of scientific research around which theory, practice, subject and object are united.

The modern system of scientific methods is diverse. All methods, depending on whether they can be applied in a narrow or broader scientific field, are divided into three main groups: general philosophical, general scientific and specifically scientific methods. But despite belonging to one or another group, in the process of research, the methods interact, complement each other, and are aimed at obtaining new knowledge.

The most frequently used general scientific methods in the practice of scientific research are *analysis*, *synthesis*, *induction*, *deduction*, *analogy* and *modeling*.

Analysis is a research method that breaks down the subject of the study into its component parts. Each of these parts is studied separately. This method makes it possible to cover a large number of facts at the same time, identifying possible connections.

Synthesis is a research method that is opposite to analysis; it is the integration of the results of the analysis into a whole, creating a common system. It establishes connections between the parts and makes it possible to understand the object of the study as a whole.

The methods of analysis and synthesis are interconnected. In scientific research, they are usually used simultaneously (sometimes analysis is called descending analysis, and synthesis is called ascending analysis).

Deduction is a research method in which particulars are derived from general provisions («from the general to the particular»). It allows one to draw conclusions about a certain element of a set based on knowledge of the general properties of the entire set.

Induction is a research method in which general principles and patterns are derived from particular facts and phenomena («from the particular to the general»).

The induction method is especially effective in experimental studies with the collection of empirical facts. The researcher establishes phenomena that are recurring in nature and can, by generalizing empirical data, make an assumption about the cause of the phenomena under study. Thus, the researcher makes an inductive conclusion (puts forward a hypothesis), and deduction theoretically proves this conclusion, turning the hypothesis into reliable knowledge.

Analogy is a research method in which knowledge about some objects or phenomena is transferred to other objects or phenomena based on their similarity in essential properties and qualities.

Modeling is a research method in which the object or phenomenon being studied is replaced by its model. The model should reflect the essential characteristics of the real object of study. The characteristics of the original are determined or clarified by the model.

Modeling is actively used in both theoretical and empirical research.

Modeling is considered to be a fairly effective means of predicting the influence of external factors on the phenomenon being studied and making specific decisions.

In our opinion, special attention should be paid to the methods of empirical and theoretical research.

3. Specific methods and techniques for processing and analyzing data.

Scientific research can be conducted at the empirical or theoretical level using the appropriate methods. They rely on the general and, especially, on the private and specific methodology of science.

Each of these levels has its own specific type of research: empirical and theoretical research. Empirical and theoretical research are aimed at studying the same phenomenon, but the results of the research will be different. At the theoretical level, a scientific explanation of the facts obtained at the empirical level occurs. These levels are inseparable from each other, their unity allows achieving objectivity in scientific research.

Empirical scientific research is necessarily based on certain theoretical positions. Their results are systematized and presented from the position of certain theoretical statements.

Theoretical research is based on structural elements: scientific idea, hypothesis, theory, facts, categories, axioms, etc. A clear and distinct understanding of these structural elements enables the researcher to conduct a more precise argumentation or proof of certain theoretical positions.

Theory is a holistic representation of scientific knowledge about the patterns and essential connections of reality.

Categories are the most general and fundamental concepts that reflect the essential connections of reality.

Scientific idea is an intuitive explanation of a phenomenon without intermediate argumentation and awareness of the entire set of connections between the objects of research or its constituent elements.

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Hypothesis is a prediction of the cause that causes the consequence.

Facts are a set of knowledge about an object or phenomenon, the reliability of which has been proven.

Axioms are provisions accepted without proof.

Postulates are statements accepted within the framework of any scientific theory as truth that does not require proof (axioms within this theory).

Principles are the basic initial provisions of any theory, science or worldview.

Concept is an opinion in which objects of a certain class (type) are generalized and isolated according to certain common features.

Proposition is an opinion formulated in the form of a scientific statement.

Judgment is an opinion expressed in the form of a narrative sentence, about which it can be said whether it is true or false.

Laws are stable relationships between recurring phenomena in nature and society.

Methods of empirical and theoretical research

Based on the importance of master's students acquiring not only basic knowledge about modern methods of data collection and analysis, but also mastering specific methods and techniques of data collection and analysis used in the field of technical sciences, in particular, in the field of navigation, after analyzing classical methods and techniques in these areas of knowledge, we have identified the main ones for presentation in the MMSRDP course.

In the process of preparing a master's thesis, one of the key stages is data collection and analysis. Data processing (analysis) methods are critically important for any scientific research. Correctly selected methods of data collection and subsequent processing directly affect the research results and increase the likelihood of obtaining accurate and reliable results.

One of the tools for analyzing experimental data and observations conducted by the researcher, as well as the language by which the obtained mathematical results are communicated, is mathematical statistics. The mathematical apparatus is widely used in solving classification problems and searching for new patterns, for setting new scientific hypotheses.

The use of mathematical and statistical techniques for processing and analyzing data in modern scientific research is based on the researcher's knowledge of the basic methods and stages of mathematical and statistical analysis: their sequence, necessity and sufficiency.

It is necessary to show novice researchers that understanding the essence and rules of application of methods is primary, and the choice of formulas and calculations carried out on them is secondary.

Statistical processing of research results is based on the sampling method and its principle: if a certain statement is true for a random sample, then it is also true for the general population from which this sample was obtained.

It is important for master's students to understand that the value of a certain parameter for the entire population (mean value, median, dispersion, etc.) is, in most cases, impossible to obtain (an exception is conducting a study on a group that includes all elements of the population). However, this value of the parameter can be estimated from a sample. The accuracy of such an estimate depends on the measurement method (measurement error) and the size and representativeness of the sample (sampling error).

Of course, a random sample from the general population must be representative. Representativeness of the sample is one of the pressing issues, the successful solution of which determines the reliability of the conclusions obtained during statistical processing of research results.

Representativeness of the sample is the completeness and adequacy of its representation of the properties of the general population.

A sample is **representative** if its probability characteristics coincide with or approach the corresponding characteristics of the general population within the specified permissible error.

The sample will be representative if:

— the probability of inclusion in the sample for each element of the general population is the same;

— the sample size ensures the required accuracy of the characteristics of the general population.

The minimum size n of the repeated sample is determined by the formula:

$$n_{\min} = \frac{t^2 \cdot \sigma^2}{(\Delta x)^2},$$

where Δx – the specified permissible absolute error in determining the arithmetic mean;

σ – sample standard deviation;

t – the confidence coefficient, which depends on the confidence probability with which the results of the sample study must be guaranteed.

The units of measurement of the values σ and Δ must be the same.

To calculate t, the Excel function *T.INV(1-α, n-1)* is used, where α is the significance level, n is the sample size.

When choosing a specific method and technique for processing and analyzing data, they rely, first of all, on the type of data (data classification) and, in accordance with it, as well as the goals and objectives of the study, the analysis criterion is selected.

The first stage of data analysis - classification

The use of mathematical apparatus for processing the results of scientific research, solving classification problems, searching for new patterns, and formulating new scientific hypotheses is possible only for what can be measured.

Measurement is the assignment of numbers to objects or events based on a certain system of rules.

Data classification is the determination of their type according to the corresponding measurement scale (data is measured on a numerical or non-numerical scale).

There are different types of measurement scales, but they are usually interconnected [4-8, 11, 22-32].

The most commonly used gradation is:

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— scale of classification (of names, nominal);
— scale of order;
— scale of intervals;
— scale of relationship.

Sometimes they also talk about discrete and continuous measurement scales, classifying the classification scale and order scale as discrete. Since these scales do not have intermediate values, they are often called non-quantitative, qualitative. Continuous measurement scales include interval scale and ratio scale. They are called quantitative (metric) scales.

Scale of classification (of names, nominal). No comparison operations other than «equal» and «not equal» are possible. Numbering or naming serves only to identify the object. For example, by vessel type: 1 – river vessels, 2 – sea and ocean vessels, 3 – river-sea vessels.

Scale of order. It is possible to compare objects by size – «greater», «less», «equal». Other operations are impossible. Values set by different specialists may not coincide (scale shift). For example, comparison of ships by tonnage: 1 – small ships, 2 – medium ships, 3 – large ships; or the scale of stellar magnitudes – a measure of the brightness of a celestial body from the point of view of an observer on Earth: the brighter the object, the smaller its stellar magnitude.

It is possible to compare the degree of expression of a classification feature. For example, when describing the results «before» and «after» some influence and the researcher sees trends in repeated measurements, or to assess the differences in experimental data obtained under two different conditions for the same sample.

Scale of interval. This scale allows not only comparison by magnitude, but also determination of «how much more» (i.e., «addition» and «subtraction» operations). Relative data have the properties of interval data. In addition, they have a certain absolute zero point (the value from which other values are counted). For example, temperature scales (Celsius, Kelvin, Fahrenheit, Reaumur).

Scale of relationship. This scale has a natural starting point and all operations are allowed: «comparison», «addition» and «subtraction», «multiplication» and «division», that is, it is possible to clarify the questions «how many times» and «how much more». For example, weight, length, etc.

In the process of development of science and measuring instruments, it is possible to move from one scale of measurements to another, more advanced one, for example, the first thermometers measured temperature in a scale of order («moderate», «warm», «hot», etc.).

The scale of measurement imposes restrictions on the statistical characteristics that can be calculated for a random variable measured in a specific scale, and on the methods of data analysis that can be correctly applied to them (Tables 2, 3).

The second stage of data analysis – the choice of the analysis criterion

In data analysis, the concept of a random variable is widely used as a value that, as a result of a test/experiment, takes on a value that is previously unknown and depends on random causes.

If, as a result of each study, a random variable corresponds to only one number, then it is called one-dimensional or **scalar**. If, as a result of each study, a random variable corresponds to several numbers that characterize different properties of an object, then it is called multidimensional or **vector**.

Table 2

Possible operations and statistical characteristics of measurement scales

Scale name	Scale type	Operations	Statistical characteristics that can be calculated
Classifications	Discrete	=, ≠	Frequencies, modal class
Order	Discrete	=, ≠, >, <	Frequencies, mode, median, rank correlation
Interval	Continuous	=, ≠, >, <, +, -	Frequencies, mode, median, rank correlation, mean, variance
Relationships	Continuous	=, ≠, >, <, +, -, /, *	All available

Table 3

Relationship between measurement scales and applied data analysis methods

Scale of measurement of influencing variables	Scale of measurement of dependent variables	Applied methods of data analysis
Intervals or relations	Intervals or relations	Regression and correlation analysis
Time	Intervals or relations	Time series analysis
Names or order	Intervals or relations	Analysis of variance (If the number of factors is more than two, it is more convenient to use regression analysis)
Mixed	Intervals or relations	Covariance and regression analysis
Names or order	Names or orders	Analysis of rank corrections and contingency tables (For multi-cell contingency tables, regression analysis can be used)
Names or order	Intervals or relations	Discriminant analysis, cluster analysis, taxonomy

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The values of a vector random variable are divided into **independent** (factorial) and **dependent** (resulting). Dependent variables are considered as a result of external influences on the object of study. The external influences themselves are expressed by independent variables.

The simplest task of data analysis is the task when the influence of one independent factor on the variable under study is assessed (single-factor analysis).

To analyze the obtained experimental data, correlation and regression analyses are used, which are often combined into one method of correlation-regression analysis.

Correlation analysis. Useful at the preliminary stage of data processing, allows you to determine the degree of strength of the relationship between two or more random variables (factors).

Regression analysis. Solves the main problem of the experiment, establishes the structure and parameters of the model linking quantitative indicators: the resulting and factor variables.

Before choosing a criterion for data analysis, it is necessary to determine the type of distribution law: whether the distribution law is normal or not. Most often, the Pearson criterion is used to test the hypothesis about the distribution law. An example of using the Pearson criterion is given below.

Depending on the type of data, the type of distribution and additional conditions, the principle (criterion) of statistical data processing is selected: parametric or nonparametric.

The parametric principle includes all methods of analyzing normally distributed quantitative features, that is, measured in continuous scales: intervals, ratios (in metric scales).

The nonparametric principle is used in all other cases – for analyzing quantitative features regardless of their type of distribution and for analyzing qualitative features.

For normally distributed features, parametric and nonparametric methods give similar results.

Example of using the Pearson criterion. Check whether the distribution of the general population is normal. Perform the check at a significance level of 0.05 for the empirical distribution of the sample:

Table 4

Sample data

X_i	5	7	9	11	13	15	17	19	21
n_i	15	26	25	30	26	21	24	20	13

Solution. To check whether the general population is normally distributed or not, we use the Pearson criterion.

The empirical distribution of the sample of the general population is given as a sequence of equally spaced variants and their corresponding frequencies, therefore we apply the algorithm:

1. Formulate hypotheses.

Null hypothesis: H0: the general population is normally distributed.

Alternative hypothesis: H1: the general population is not normal.

2. Calculate the sample size n = 200, the sample mean $\overline{x}_{sel}$ =12,63 and the sample standard deviation σ_{sel} =4,695.

3. Calculate the theoretical frequencies n_i' (n=200 - sample size; $h = x_{i+1} - x_i$ =2 - table step):

Table 5

Calculation of theoretical frequencies

x_i	$u_i = \frac{x_i - \overline{x}_{sel}}{\sigma_{sel}}$	$\varphi(u) = \frac{1}{\sqrt{2\pi}} \cdot e^{-\frac{u^2}{2}}$	$n_i' = \frac{n \cdot h}{\sigma_{sel}} \cdot \varphi(u_i)$
5	-1,62513	0,106515	9,1
7	-1,19915	0,194385	16,6
9	-0,77316	0,295872	25,2
11	-0,34718	0,37561	32,0
13	0,078807	0,397705	33,9
15	0,504792	0,351219	29,9
17	0,930777	0,258693	22,0
19	1,356763	0,158922	13,5
21	1,782748	0,081428	6,9

4. Find the observed value of the Pearson criterion $\chi^2_{obs} = \sum \frac{(n_i - n_i')^2}{n_i'}$ (make a calculation table):

Table 6

Calculation table

n_i	$n_i - n_i'$	$(n_i - n_i')^2$	$\frac{(n_i - n_i')^2}{n_i'}$
15	5,9	35,10824	3,86877
26	9,4	89,09492	5,379806
25	-0,2	0,043013	0,001706
30	-2,0	4,0033	0,1251
26	-7,9	62,14661	1,834136
21	-8,9	79,61611	2,660718
24	2,0	3,841978	0,174319
20	6,5	41,73556	3,082459
13	6,1	36,75459	5,298001
		χ^2_{obs} =	**22,4**

5. Determine the number of degrees of freedom: k = 9-3 = 6.

6. The significance level for the condition α = 0.05.

7. Find the critical value of the Pearson criterion $\chi^2_{cr}(\alpha; k)$ – the right-hand critical region for the significance level and the number of degrees of freedom according to the χ^2 distribution table (Appendix 5): $\chi^2_{cr}(\alpha; k)$ =**12,6**.

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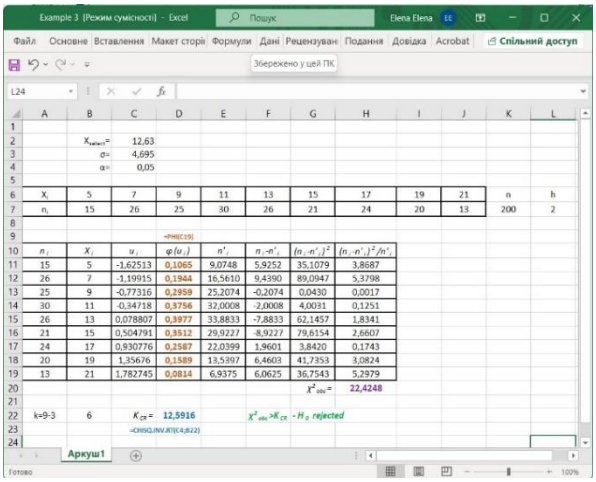
8. Compare the observed and critical values of the Pearson criterion: $\chi^2_{obs}(\alpha;k) > \chi^2_{cr}(\alpha;k)$, which means we reject the null hypothesis. Consequently, the distribution of the general population is not normal.

Solution in Excel:



Conclusions

During the conducted research, a methodological approach to improving the teaching of the course «Modern Methods of Scientific Research and Data Processing» at the Kherson State Maritime Academy was determined. Namely, during the study, classical concepts and issues of modern methodology and methods of scientific research, modern methods of empirical and theoretical research, modern methods of data collection and analysis, specific methods and techniques of data collection and analysis were analyzed. As a result of the analysis, the main concepts and issues were identified, which we consider basic when teaching the course MMSRDP and which must be known by master's cadets of the navigation specialty.

The tasks set before the beginning of the study were completed, the goal of the study was achieved.

Studying the discipline «Modern Methods of Scientific Research and Data Processing» provides applicants for the second level of higher education (Masters) with basic knowledge of the methodology, methods and organization of scientific activity to ensure their professional socialization as researchers.

In addition, studying the discipline «Modern Methods of Scientific Research and Data Processing» by Masters students provides them with the opportunity to correctly select the methods of collecting and analyzing data for the relevant application area.

Correct application of the studied methods and techniques of collecting and analyzing data allows Masters students to:

— prove the correctness and validity of the methodological techniques and methods used;

— strictly justify experimental plans;

— generalize experimental data.

The content of the MMSRDP course is a powerful tool for master's students, contributing to the development of their objective thinking. We see prospects for further study of the stated problem, firstly, in a more detailed study of the specifics of studying by master's students of those specific methods and techniques of data processing and analysis that are used in the field of technical sciences, in particular, in the field of navigation, and are most necessary for master's students in the navigation specialty. Secondly, in the need to develop a set of individual tasks for master's students aimed at applying specific methods and techniques of data collection and analysis.

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СУЧАСНІ МЕТОДИ НАУКОВИХ ДОСЛІДЖЕНЬ У СИСТЕМІ ПІДГОТОВКИ НАУКОВИХ КАДРІВ ХЕРСОНСЬКОЇ ДЕРЖАВНОЇ МОРСЬКОЇ АКАДЕМІЇ

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Науково-дослідна робота – один із найскладніших видів самостійної роботи здобувачів другого рівня вищої освіти (курсантів-магістрів), здійснення якої потребує спеціальних знань та умінь. Для курсантів-магістрів підготовка та написання магістерської роботи – перший досвід науково-дослідної діяльності. У Херсонській державній морській академії для курсантів-магістрів спеціалізації «Навігація та управління морськими судами» передбачено вивчення курсу «Сучасні методи наукових досліджень та обробки даних» (СМНДОД), який за навчальним планом та освітньо-професійною програмою входить до циклу професійної підготовки. Програма навчальної дисципліни «Сучасні методи наукових досліджень та обробки даних» складена відповідно до Кодексу підготовки та дипломування моряків та несення вахти ПДМНВ-78, IMO-MODEL COURSE 7.01, 7.03. та згідно з ОПП. Напрямом наших досліджень є вдосконалення викладання курсу «Сучасні методи наукових досліджень та обробки даних» у Херсонській державній морській академії для досягнення більш значущих стандартів професійної компетентності здобувачів другого рівня вищої освіти (курсантів-магістрів) спеціалізації «Навігація та управління морськими судами» ХДМА. У цій статті розглядаються дві найважливіші складові курсу СМНДОД. Перша – це «стартові» знання про методологію та методи наукового дослідження, а саме, найбільш значущі класичні парадигми, що визначають суть понять методологія та методи наукового дослідження, поняття та питання сучасних методів емпіричного та теоретичного досліджень. Друга, не менш важлива складова курсу СМНДОД – це вивчення курсантами-магістрами конкретних методів та прийомів обробки та аналізу даних. Подальші наші дослідження спрямовані на більш детальний розгляд другої складової курсу СМНДОД – на вивчення курсантами-магістрами конкретних методів і прийомів обробки та аналізу даних у галузі технічних наук, зокрема, у сфері судноводіння, які найбільш необхідні курсантам-магістрам судноводійської спеціальності, а також розробці набору індивідуальних завдань на конкретних методів збору та аналізу даних.
Ключові слова: *наукові дослідження, обробка даних, навігація, судноводіння, компетентність.*

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