

Silabus
Selective Component SC

Special Sections of Higher Mathematics

Name of the discipline:	Special Sections of Higher Mathematics
Higher education level:	second (educational and professional)
Moodle course page:	https://dl2022.khadi.kharkov.ua/course/view.php?id=3259
Scope of the sample component	4 credits (120 hours)
Final control form	Credit
Consultations:	on schedule
Department name:	Department of higher mathematics
Language of instruction:	English
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Summary of the educational component: the purpose of studying the discipline is professional and mathematical training of applicants in the system of multi-stage mathematical training of bachelors, masters and postgraduates, necessary for mastering the theoretical and practical foundations of applying methods and models for analyzing statistical patterns based on observations in technical processes and making statistical decisions.

Subject of the discipline: methods and algorithms for recording, describing and analyzing statistical experimental data of modern technical processes as the basis for reasonable statistical conclusions.

The main objectives of the discipline are:

- study of general information about the selective method, methods of point and interval estimation of unknown parameters of the general population under study;
- formation of practical abilities for applying point and interval assessment in technical tasks;
- formation of the concept of statistical verification of parametric and nonparametric hypotheses;
- application of the general scheme for testing parametric hypotheses to solving professional and applied problems;
- application of the method of testing zero nonparametric hypotheses according to the criterion of consistency of K. Pearson to solving professional and applied problems;
- study of the concept of applying correlation and regression analysis methods in Technical Research;
- formation of abilities to solve professional and applied problems in statistical research of relationships between phenomena.

Prerequisites for studying the educational component: mandatory discipline "Higher Mathematics", selective discipline "Probability Theory", selective discipline "Mathematical Methods in Engineering and Technologies". Компетентності, яких набуває здобувач:

General competencies:

- ability to learn and master modern knowledge
- ability to search, process, and analyze information from various sources
- ability to be critical and self-critical
- ability to adapt and act in a new situation

Special (professional) competencies:

ability to create, improve and apply quantitative mathematical, scientific and technical methods and computer software tools, apply a systematic approach to solving engineering problems of Industrial Mechanical Engineering, in particular, in conditions of technical uncertainty.

Learning outcomes according to the educational program:

knowledge and understanding of the fundamentals of technological, fundamental and engineering sciences underlying the industrial engineering of the relevant industry,
analyze engineering objects, processes, and methods.

Thematic plan

№	Topic name (LC, PR, SR)	Number of hours	
		Ochne	Zaochne
1	LC Review of the main aspects of probability theory. Random events. Random variables.	2	2
	PR Is a classical definition of the probability of a random event. Full probability formula, Bayes formula. Ber-nulli scheme. Numerical characteristics of discrete and continuous random variables. Solving problems.	2	2
	SP Basic Laws of distribution of random variables (Binomial, Poisson, geometric, uniform, exponential, normal). Multidimensional random variables. Limit theorems of probability theory. . Solving professional and applied problems.	11	11
2	LC Problems of Mathematical Statistics. General information about the selective method. Discrete and interval statistical distributions of the sample . Empirical distribution function and its properties. Numerical characteristics of the statistical distribution of the sample	2	2
	PR Is a graphical representation of statistical distributions of the sample. Polygon and histogram. Numerical characteristics of the statistical distribution: sample mean; sample and corrected sample variance, mean square deviation. Solving problems.	2	2
	SP Variational series and their characteristics. Empirical distribution function. Numerical characteristics of the statistical distribution. Solving professional and applied problems.	11	11
3	LC Point estimates of unknown distribution parameters. Statistical estimates and general requirements for them. Estimates of the general mean and general variance. Methods for finding point estimates: the method of moments, the method of maximum (greatest) likelihood	2	2
	PR Finding point estimates by methods of moments and maximum likelihood. Solving problems	2	2
	SR.Solving professional and applied problems using methods for finding point estimates.	11	11
4	LC Basic distribution laws used in Mathematical Statistics. Chi-square, student, and Fischer distributions.	2	2
	PR Distributions of chi-square, student, and Fischer. Solving problems.	2	2
	SR Basic distribution laws used in Mathematical Statistics. Chi-square, student, and Fischer distributions..	11	11
5	LC Interval estimates of unknown distribution parameters. The concept of interval estimation of parameters. General scheme for constructing confidence intervals for normal law parameters. Confidence intervals for the general mean and general variance (normal statistical model) .	2	2
	PR Construction of confidence intervals for the general mean and general variance (normal statistical model) . Solving problems	2	2
	SR Interval estimates of unknown distribution parameters. Confidence intervals for the general mean and general variance (normal statistical model) . Solving professional and applied problems	11	11
6	LC Statistical verification of parametric hypotheses. Basic definitions. General scheme for testing statistical hypotheses. Testing	2	2

	hypotheses about the mathematical expectation and variance of a normal random variable		
	PR Statistical testing of parametric hypotheses. Testing hypotheses about the mathematical expectation and variance of a normal random variable. Solving problems. .	2	2
	SR Statistical testing of parametric hypotheses. The principle of practical confidence in the impossibility of unlikely events. Statistical criterion for testing the null hypothesis. Testing hypotheses about the mathematical expectation and variance of a normal random variable. Solving professional and applied problems.	11	11
7	LC Statistical testing of nonparametric hypotheses. Pearson consistency criterion. Testing the hypothesis of the normal distribution law of the general population.	2	2
	PR Algorithm for applying the Pearson criterion. Testing the hypothesis of the normal distribution law of the general population. Solving problems.	2	2
	SR Statistical testing of nonparametric hypotheses. Method for testing null nonparametric hypotheses using consistency criteria. Pearson consistency criterion. Testing the hypothesis of the normal distribution law of the general population. Solving professional and applied problems .	11	11
8	LC Elements of correlation and regression analysis. Linear pair regression. Correlation coefficient and its properties. The main task of correlation analysis. Significance checks and interval estimates of communication parameters. Basic provisions of regression analysis. Paired regression model.	2	2
	PR Drawing up sample equations of a straight regression line based on the correlation table data. Checking the significance of the correlation coefficient and finding a confidence interval for its estimation. Solving problems. Checking the significance of the regression equation. Solving problems. . .	2	2
	SR Functional, statistical, and correlation dependencies. Significance check and interval evaluation of communication parameters. Solving professional and applied problems.	11	11
Together	LC	16	16
	PR	16	16
	SR	88	88

Training methods:

- * lectures, practical exercises, explanations, etc.;
- * standard calculation works;
- * standardized tests;
- * tasks for in-depth creative training;
- * test papers;
- * presentations of completed tasks and research;
- * student presentations and presentations at scientific events;
- * final comprehensive tests.

Evaluation system and requirements

1 Current academic performance:

1.1 the current success of applicants for performing educational types of work in training sessions and for performing tasks of independent work is evaluated using a four-point Assessment Scale, followed by recalculation to a 100-point scale. When evaluating current academic performance, all types of work provided for in the curriculum are taken into account.

1.2 lectures are evaluated by determining the quality of performance of specified tasks.

1.3 practical exercises are evaluated by the quality of performing a control or individual task, performing and completing practical work.

1.4 assessment of the current academic performance of higher education applicants is carried out at each practical lesson (laboratory or seminar) on a four-point scale ("5", "4", "C", "2") and are entered in the academic performance log.

- "excellent": the applicant has perfectly mastered the theoretical material, demonstrates deep knowledge of the relevant topic or academic discipline, the main provisions;
- "good": the applicant has mastered the theoretical material well, has the main aspects from the original sources and the recommended literature of the RI, presents it in an argumentative manner; has practical skills, expresses his thoughts on certain problems, but admits certain inaccuracies and errors in the logic of presenting the theoretical content or when analyzing the practical one;
- "satisfactory": the applicant has mainly mastered the theoretical knowledge of the educational topic or discipline, is guided in the primary sources and recommended literature of the RI, but does not answer convincingly, confuses concepts, does not answer additional questions uncertainly, does not have stable knowledge; answering questions of a practical nature, shows inaccuracy in knowledge, does not know how to evaluate facts and phenomena, connect them with the future profession;
- "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, almost does not navigate in primary sources and recommended literature, there is no scientific thinking, practical skills are not formed.

2 Final assessment:

An applicant for Higher Education receives a credit in the last lesson in the discipline based on the results of the current assessment. The average score for current activities is converted to points on a 100-point scale.

Higher education applicants who have an average current grade in the discipline below "3" (60 points) can improve their current score in the last lesson by passing tests in the discipline.

Assessment of applicants' Knowledge by testing is carried out on a scale of:

- "Excellent": the theoretical content of the course is fully mastered, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided for in the training program are completed, the quality of their implementation is estimated by the number of points close to the maximum. (at least 90% of correct answers);
- "Very good": the theoretical content of the course is fully mastered, without gaps, the necessary practical skills of working with the mastered material are mostly formed, all the training tasks provided for in the training program are completed, the quality of most of them is estimated by the number of points close to the maximum. (82% to 89% of correct answers);
- "Good": the theoretical content of the course is fully mastered, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the training tasks provided for in the training program are completed, the quality of None of them is evaluated with a minimum number of points, some types of tasks are completed with errors (from 74% to 81% of correct answers);
- "Satisfactory": the theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills of working with the mastered material are mostly formed, most of the training tasks provided for in the training program are completed, some of the completed tasks may contain errors (from 67% to 73% of correct answers);
- "Satisfactory enough": the theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills of working with the mastered material are mostly formed, most of the training tasks provided for in the training program are completed, some of the completed tasks may contain errors (from 60% to 66% of correct answers);
- "Unsatisfactory": the theoretical content of the course is partially mastered, the necessary practical skills of work are not formed, most of the provided training programs for training tasks are not completed, or the quality of their performance is estimated by a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of performing educational tasks(with the possibility of re-passing)(less than 60% of correct answers);
- "Unacceptable" - the theoretical content of the course is not mastered, necessary practical work skills are not formed, all completed training tasks contain gross errors, and additional independent work on the course material will not lead to any significant improvement in the quality of training tasks.(with a mandatory repeat course).

Table-correspondence of final rating ratings in points to national scale and ECTS scale ratings

Rating	Rating on the national scale (exam, credit)	Rating on the ECTS scale	
		Grade	Criteria
90-100	Excellent	A	"Excellent" - the theoretical content of the course is fully mastered, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided for in the training program are completed, the quality of their implementation is estimated by the number of points close to the maximum.
82 – 89	Good	B	"Good" - the theoretical content of the course is fully mastered, without gaps, the necessary practical skills of working with the mastered material are mostly formed, all the training tasks provided for in the training program are completed, the quality of most of them is estimated by the number of points close to the maximum.
75 – 81		C	"Good" - the theoretical content of the course is fully mastered, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the training tasks provided for in the training program are completed, the quality of performance of any of them is not evaluated with a minimum number of points, some types of tasks are performed with errors
67 – 74	Satisfactory	D	"Satisfactory" - the theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills of working with the mastered material are mostly formed, most of the training tasks provided for in the training program are completed, some of the completed tasks may contain errors.
60 – 66		E	"Enough" - the theoretical content of the course is partially mastered, some practical work skills are not formed, many of the training tasks provided for in the training program are not completed, or the quality of performance of some of them is estimated by a number of points close to the minimum.
35 – 59	Unsatisfactory	FX	"Unsatisfactory" - the theoretical content of the course is partially mastered, the necessary practical skills of work are not formed, most of the provided training programs for educational tasks are not completed, or the quality of their performance is estimated by a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of performing educational tasks(with the possibility of re-passing)
1 – 34		F	"Unacceptable" -the theoretical content of the course is not mastered, the necessary practical skills are not formed, all completed training tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of training tasks.(with a mandatory repeat course)

Course policy:

- the course involves working in a team, the environment in the classroom is friendly, creative, open to constructive criticism;
- mastering the discipline involves mandatory attendance at lectures and practical classes, as well as independent work;
- independent work involves the study of individual topics of the academic discipline, which are submitted in accordance with the program for independent study, or were considered briefly;
- all tasks provided for in the program must be completed on time;
- when studying the course, applicants for higher education must adhere to the rules of academic integrity set out in the following documents: "Rules of academic integrity of participants in the educational process of KHNADU (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf), "Moral and ethical code of participants in the educational process of KHNADU (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf).
- cheating during test papers and tests is prohibited (including using mobile devices). Mobile devices can only be used during online testing.

Recommended literature:

1. Герич М.С. Математична статистика / М.С. Герич, О. О. Синявська. – Ужгород : ДВНЗ “УжНУ”, 2021. – 146 с.
2. Каніовська І. Ю. Математична статистика: збірник задач / І. Ю. Каніовська, О. В. Стусь – Київ: КПІ імені Ігоря Сикорського, 2019. – 124 с.
3. Лебедєв Є.О.. Математична статистика. Навч. посібник / Є. О. Лебедєв, Г. В. Левінська, І. В. Розора, М. М. Шарапов. . – Київ: ВПЦ “Київський університет”, 2016. – 159 с.
4. Медведєв М. Г. Теорія ймовірностей та математическая статистика. Підручник / М. Г. Медведєв, І. О. Пащенко – Київ: Видавництво “Ліра -К”, 2008. – 536 с.
5. Назаренко Л. А. Планування і обробка результатів експерименту. Конспект лекцій. / Л. А. Назаренко. – Харків: ХНУМГ ім. О. М. Бекетова, 2018. – 163 с.

Additional sources:

1. distance learning course: : <https://dl2022.khadi-kh.com/course/view.php?id=3259>

Developer (s)

syllabus of the academic discipline



Tetiana YARKHO

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