Federal State Autonomous Educational Institution of Higher Education
Peoples' Friendship University of Russia named after Patrice Lumumba

Academy of Engineering
(name of the main educational unit (MEU) that developed the educational program of higher education)

WORKING PROGRAM OF THE DISCIPLINE

INFERENTIAL STATISTICS
(name of discipline/module)

Recommended for the field of study/specialty:

27.04.04 CONTROL IN TECHNICAL SYSTEMS
(code and name of the field of study/specialty)

The discipline is mastered within the framework of the implementation of the main professional educational program of higher education (EP HE):

Artificial Intelligence, Machine Learning, and Space Science
(name (profile/specialization) of the educational institution of higher education)

2026

1. THE GOAL OF MASTERING THE DISCIPLINE

The course "Inferential Statistics" is part of the master's program "Artificial Intelligence, Machine Learning, and Space Sciences" in the 27.04.04 "Control in Technical Systems" program and is studied in the second semester of the first year. The course is offered by the department of the partner university. It consists of five sections and ten topics and focuses on the formalization of problems through logical calculus and tools for developing statistical criteria based on logical frameworks.

The purpose of mastering the discipline is to develop skills in synthesizing logical methods and statistical analysis, develop the ability to construct formal models for testing hypotheses, and prepare for the application of logical and statistical tools in Data Science.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Inductive Statistics" aimed at developing the following competencies (parts of competencies) in students:

Table 2.1. List of competencies developed in students while mastering the discipline (results of mastering the discipline)

Cipher	Competence	Indicators of Competency Achievement (within this discipline)
GPC-4	Capable of assessing the effectiveness of the results of development of control systems using mathematical methods	GPC-4.1 Knows the basic mathematical methods used to evaluate the effectiveness of the results of control systems; GPC-4.2 Able to apply mathematical methods to evaluate the effectiveness of the results of management systems; GPC-4.3 Proficient in methods for assessing the effectiveness of management systems;
GPC-6	Capable of collecting and analyzing scientific and technical information, generalizing domestic and foreign experience in the field of automation and control equipment	GPC-6.1 Knows the basic methods of collecting and analyzing scientific and technical information; GPC-6.2 Able to analyze and generalize domestic and foreign experience in the field of automation and control equipment; GPC-6.3 Has knowledge of methods for collecting and analyzing scientific and technical information, and can also generalize domestic and foreign experience in the professional field;

3. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL EDUCATIONAL INSTITUTION

Discipline "Inductive Statistics" refers to the mandatory part of block 1 “Disciplines (modules)” of the educational program of higher education.

As part of the higher education program, students also master other disciplines and/or practices that contribute to the achievement of the planned results of mastering the discipline "Inductive Statistics".

Table 3.1. List of components of the educational program of higher education that contribute to the achievement of the planned results of mastering the discipline

Cipher	Name of competence	Previous courses/modules, practical training*	Subsequent disciplines/modules, practices*
GPC-6	Capable of collecting and analyzing scientific and technical information, generalizing domestic and for-	Relational Database Management System; Python for Data Science;	Undergraduate practice / Pregraduation practice; Research Work; Technology Threats and Cy-

Cipher	Name of competence	Previous courses/modules, practical training*	Subsequent disciplines/modules, practices*
	eign experience in the field of automation and control equipment		bersecurity Systems;
GPC-4	Capable of assessing the effectiveness of the results of development of control systems using mathematical methods		Undergraduate practice / Pre-graduation practice;

* - filled in accordance with the competency matrix and the SUP EP HE

** - elective courses/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF EDUCATIONAL WORK

The total workload of the discipline "Inductive Statistics" is 3 credit units.

Table 4.1. Types of educational work by periods of mastering the educational program of higher education for full-time education.

Type of academic work	**TOTAL,**academic hours		**Semester(s)**
			2
Contact work, academic hours	*34*		*34*
Lectures (LC)	17		17
Laboratory work (LW)	17		17
Practical/seminar classes (SC)	0		0
Independent work of students, academic hours	*74*		*74*
Control (exam/test with assessment), academic hours	*0*		*0*
Total complexity of the discipline	**academic hours**	***108***	*108*
	credit	***3***	*3*

5. CONTENT OF THE DISCIPLINE

Table 5.1. Content of the discipline (module) by types of academic work

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
Section 1	Types and kinds of statistical data.	1.1	Types of statistical data. Quantitative (discrete and continuous) variables. Qualitative (nominal and ordinal) variables. Types of statistical data analysis. Primary and secondary analysis. Descriptive statistics. Descriptive statistics indicators. Criteria for testing hypotheses about the distribution law.	Quantitative variables: discrete (integer) and continuous (taking any values within an interval). Qualitative variables: nominal (unordered categories) and ordinal (categories with a natural order). Types of statistical data analysis. Primary analysis (direct processing of raw data) and secondary analysis (reinterpretation of previously collected data). Descriptive statistics as a method of summarizing and presenting data.	LC, LW
		1.2	Types of feature distributions. Parametric and nonparametric principles of statistical processing. Normal and non-normal distribution. Mode. Median. Arithmetic mean. Standard deviation. Standard error of the mean. Distribution width. Confidence interval. Quantiles. Number of objects as a characteristic of qualitative data.	Parametric and nonparametric principles of statistical analysis. Conditions for applying parametric methods (normal distribution). Normal distribution and distributions different from the normal distribution. Key characteristics of distribution: mode (the most frequently occurring value), median (central value), and arithmetic mean. Variability indicators: standard deviation (a measure of the spread of values). Standard error of the mean (a measure of the accuracy of the sample estimate of the mean).	LC, LW
Section 2	Selecting comparison criteria.	2.1	Tasks and applications of inductive statistics. Statistical hypotheses. Statistical significance. Type I error. Type II error.	Applications of inductive statistics: generalizing sample results to the entire population. Statistical hypotheses: null and alternative. The concept of statistical significance. Type I error (rejecting a true null hypothesis) and Type II error (accepting a false null hypothesis).	LC, LW
		2.2	Assumption of feature bias. One-tailed tests. Two-tailed tests. Dependent and independent samples. Statistical criteria. Methodology of inductive statistical analysis. Nonparametric methods.	Assumption of feature shift (unidirectional or bidirectional change). One-tailed tests (testing for a change in a specific direction) and two-tailed tests (testing for any change). Dependent samples (related observations) and independent samples (different groups of subjects). Statistical criteria: parametric and nonparametric. Methodology of inductive statistical processing of research results. Nonparametric methods (not requiring the assumption of a normal distribution).	LC, LW
Section 3	Risk and threshold analysis using a contingency table.	3.1	Contingency table. Rules for filling out a contingency table. $\chi 2$ test. Yates' correction.	Rules for completing a contingency table (cross-tabulation) to analyze the relationship between two qualitative variables. The chi-square ($\chi 2$) test is used to test the independence of variables. Yates' correction for continuity is used for small tables.	LC, LW

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
		3.2	The use of a contingency table to calculate values of risk, odds, risk-odds ratio, increase or decrease in absolute and relative risks, index of potential benefit or harm, sensitivity, specificity, positive and negative predictive value, and likelihood ratio.	Calculation based on a contingency table of the following indicators: risk magnitude, odds magnitude, risk ratio, and odds ratio. Indicators of increase or decrease in absolute and relative risks. Index of potential benefit or harm. Indicators of diagnostic test quality: sensitivity (proportion of correctly identified positive cases) and specificity (proportion of correctly identified negative cases).	LC, LW
		3.3	Fisher's exact test.	Using Fisher's exact test to analyze small contingency tables. Conditions for using the test. Differences between Fisher's exact test and the chi-square test.	LC, LW
Section 4	Research of dependencies.	4.1	Statistical methods for finding relationships between variables. Correlation analysis. Pearson's linear correlation coefficient. Spearman's rank correlation coefficient.	Statistical methods for finding relationships (interrelations) between variables. Correlation analysis as a method for assessing the strength and direction of relationships. Pearson's linear correlation coefficient (for normally distributed quantitative variables). Spearman's rank correlation coefficient (for ordinal variables or those with a non-normal distribution).	LC, LW
		4.2	Regression analysis. Binary logistic regression and its capabilities. Probability of a binary event. Assessing the adequacy of a binary logistic regression model. Multinomial logistic regression. Cox regression, or the proportional hazards model. Risk of an event occurring.	Binary logistic regression: the method's capabilities for predicting binary outcomes (yes/no). The probability of a binary event occurring as the model's output variable. Assessing the adequacy of the binary logistic regression model. Multinomial logistic regression (for nominal dependent variables with more than two categories). Cox regression (proportional hazards) for time-to-event analysis.	LC, LW
Section 5	Dimensionality reduction.	5.1	Dimensionality reduction. Factor analysis, the purpose of factor analysis. Principal component extraction procedure. Scatterplot of the studied variables. Kaiser's criterion. Scree criterion. Component matrix. Vector loadings of variables.	Data dimensionality reduction as a method for decreasing the number of variables while preserving the maximum amount of information. Factor analysis: the purpose of the method (identifying hidden latent factors that explain the structure of relationships between the observed variables). The procedure for extracting principal components. A dissection diagram of the studied variables (a graphical representation of factor loadings). The Kaiser criterion (extracting factors with an eigenvalue greater than one). The scree criterion (a graphical method for determining the number of factors). Component matrix (variable loadings on factors). Vector representations in factor space. Interpretation of the extracted factors.	LC, LW

* - to be completed only for FULL-TIME education: LC – lectures; LW – laboratory work; SC – practical/seminar classes.

6. LOGISTIC AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support for the discipline

Audience type	Equipment of the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	A lecture hall equipped with specialized furniture, a whiteboard (screen), and multimedia presentation equipment.	
Computer class	A computer room for conducting classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with personal computers (in the amount of ____ units), a board (screen) and technical means for multimedia presentations.	
For independent work	A classroom for independent student work (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information System.	

* - the classroom for independent work of students MUST be indicated!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. Matthews S. Review of Statistical Learning for Big, Dependent Data. – 2024.

2. Das S. Causal Inference in R: Decipher complex relationships with advanced R techniques for data-driven decision-making. – Packt Publishing Ltd, 2024.

Further reading:

1. Cheung LC Probability Modeling and Statistical Inference in Cancer Screening. – 2024.

2. Sahu PC, Pal SR, Das AK Estimation and inferential statistics. – New Delhi: Springer, 2015. –P. 1-317.

Resources of the information and telecommunications network "Internet":

1. RUDN University Electronic Library System and third-party electronic library systems to which university students have access based on concluded agreements

- RUDN University Electronic Library System – RUDN University Electronic Library System https://mega.rudn.ru/MegaPro/Web
- Electronic Library System "University Library Online" http://www.biblioclub.ru
- EBS Yurayt http://www.biblio-online.ru
- Electronic Library System "Student Consultant" www.studentlibrary.ru
- EBS “Knowledge” https://znanium.ru/

2. Databases and search engines

- Sage https://journals.sagepub.com/
- Springer Nature Link https://link.springer.com/
- Wiley Journal Database https://onlinelibrary.wiley.com/

- Scientometric database Lens.org https://www.lens.org

Educational and methodological materials for independent work of students in mastering a discipline/module:*

1. Lecture course on the subject "Inductive statistics".

* - all teaching and methodological materials for independent work of students are posted in accordance with the current procedure on the discipline page in TUIS!

DEVELOPER:

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