NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Geoinformatics and Aerospace Research of the Earth

PROGRAM OF THE COURSE

MATHEMATICAL STATISTICS FOR GEODATES

Kyiv – 2024

Descreption of the course MATHEMATICAL STATISTICS FOR GEODATES

Industry knowledge training direction, specialty, education level	
Educational qualification	Bachelor
Specialty	193 Geodesy and Land management
Educational program	Geodesy and Land management
Description of the course	
Type	Sample
Total number of hours	120
Number of credits ECTS	4
Number of content modules	2
Course project (work)	-
Form of Control	Final test
Descriptions of the course for full-time and distance learning	
	Full-time
Year of training	2
Semester	3
Lectures	15
Practical, seminars	-
Laboratory studies	30
Independent work	75
Individual tasks	-
Number of weekly hours for full-time study: classroom	3

1. Task and purpose of the discipline

Objective:

The discipline " Mathematical statistics for geodates " ensures that students master the fundamentals of using mathematical and statistical methods and applied processing of geodata and indicators regarding the state of land relations based on the use of modern computer technologies.

The aim of the discipline

The task of studying the discipline is the formation of a specialist in theoretical knowledge and practical skills of geostatistics, mathematical and statistical apparatus of geospatial data processing methods and their properties. In particular, the tasks use spectral properties of spatial objects, derived products (vegetation indices, leaf surface area) with corresponding cartographic projections, which require constant transformations and their further practical use on the basis of geoinformation technologies in the GIS analysis of data and indicators regarding the state of land relations and land cadastral data.

The discipline provides the formation of a number of competencies:

- *general competencies*:

• ZK01. Ability to learn and master modern knowledge;

• ZK02. Ability to apply knowledge in practical situations;

• ZK07. Ability to work autonomously;

• ZK12. The ability to exercise one's rights and responsibilities as a member of society; awareness of the value of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine;

• ZK13. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of history, the patterns of development of the subject area, its place in the general system of knowledge about nature and society, as well as in the development of society, technology and technologies, to use various types and forms of motor activities for recreation and leading a healthy lifestyle.

- *special competencies*:

• SK01. The ability to apply fundamental knowledge to analyze phenomena of natural and man-made origin when performing professional tasks in the field of geodesy and land management;

• SK02. Ability to apply theories, principles, methods of physical and mathematical, natural, socio-economic, engineering sciences when performing tasks of geodesy and land management;

• SK03. Ability to apply regulatory and legal acts, regulatory and technical documents, reference materials in professional activity;

• SK04. Ability to choose and use effective methods, technologies and equipment for carrying out professional activities in the field of geodesy and land management;

• SK05. The ability to use modern information, technical and technological support to solve complex issues of geodesy and land management;

• SK06. The ability to perform remote, ground, field and camera research, engineering calculations for the processing of research results, form research results, prepare reports when solving geodesy and land management tasks;

• SK07. The ability to collect, update, process, critically evaluate, interpret, store, publish and use geospatial data and metadata about objects of natural and man-made origin.

Program results:

• PH2. Organize and manage the professional development of individuals and groups;

• PH3. Convey information, ideas, problems, solutions, own experience and arguments to specialists and non-specialists;

• PH4. Know and apply in professional activity regulatory and legal acts, regulatory and technical documents, reference materials in the field of geodesy and land management and related fields;

• PH5. Apply conceptual knowledge of natural and socio-economic sciences when performing tasks of geodesy and land management;

• PH9. Collect, evaluate, interpret and use geospatial data, metadata about objects of natural and man-made origin, apply statistical methods of their analysis to solve specialized problems in the field of geodesy and land management.

2. Program and structure of the discipline
MATHEMATICAL STATISTICS FOR GEODATES

full-time study form:

Titles content modules and themes	Hours						
	weeks	total	including				
			l	p	lab	ind	i.w.
1	2	3	4	5	6	7	8
Content module 1. Fundamentals of the probability theory and basics statistical indexes							
Topic 1. The main provisions of probability theory and mathematical statistics	1-2	6	2		4		10
Topic 2. Elementary analysis of geodata and indicators on the state of land relations	3-4	6	2		4		10
Topic 3. Basic statistical models. Basic statistics of data and indicators on the state of land relations	4-5	6	2		4		10
Total by Content module		48	6		12		30
Content module 2. Fundamentals of land management geodata statistical analysis							
Topic 4. Methods of statistical evaluation of averages	6-7	14	2		2		10
Topic 5. Statistical models of geodata and indicators on the state of land relations based on samples	8-9	16	2		4		10
Topic 6. Fundamentals of statistical analysis of sample geodata	10-13	16	2		4		10
Topic 7. Multidimensional models of geodata	14-15	26	3		8		15
Total by Content module		72	9		18		45
Total		**120**	**15**		**30**		**45**

3. Topic of laboratory classes

№	Topic	Hours
Content module 1. Introduction. Basic concepts of computer science		
1	Statistical and variation series of indicators of landowners and land users in MS Excel	2
2	Statistical and Variation Series for landowners and land users in STATISTICA	2
3	Basic statistics of land management indicators	2
4	Laws of the distribution of variables of random variables on an example of land valuation	2
5	Formation of sampling of land-use geodata from general collections	2
6	Criterion of reliability of estimates of cadastral geodata	2
7	Test hypotheses about distribution laws	2
8	Correlation analysis of land management geodata	2
9	Regression analysis of land management geodata	2
10	ANOVA of land management geodata	2
11	MANOVA of land management geodata	2
12	Cluster analysis of land management geodata	2
13	Discriminant analysis of land management geodata	2
14	Factor analysis of land management data and Principal component analysis	2
15	Multidimensional scaling of land management geodata	2

4. Topics of independent work

№	Topic name	Number of hours
1	The basic concept of geostatistics in the field of land relations	15
2	Basic aspects of using the R language for statistical analysis	16
3	Using a decision tree for geodata processing	14
4	ArcGIS software product for statistical analysis of geospatial data	14
5	Mathematical and statistical methods of geospatial data processing	16

5. Means of diagnosing learning outcomes:
- exam;
- module tests;
- essays;
- protection of laboratory work.

6. Teaching methods:
- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory, practical classes);
- visual method (illustration method, demonstration method);
- work with educational and methodical literature (summarizing, summarizing, annotating, reviewing, writing an abstract);
- video method (remote, multimedia, web-oriented, etc.);
- independent work (task performance).

7. Evaluation methods.
-      exam;

- oral or written survey;
- modular testing;
- abstracts, essays;
- defence of laboratory works;
- presentations and speeches at scientific events.

8. **Distribution of points received** by students of higher education. The assessment of the knowledge of a higher education student takes place on a 100-point scale and is translated into national assessments according to the table. 1 of the current "Regulations on examinations and assessments at NUBiP of Ukraine"

Student rating, points	National grade based on exam results
90-100	Excellent
74-89	Good
60-73	Satisfactory
0-59	Unsatisfactory

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): $R_{dis} = R_{aw} + R_{ex}$.

9. **Educational and methodological support**
- electronic educational course of the educational discipline (on the educational portal of NUBiP of Ukraine eLearn - https://elearn.nubip.edu.ua/course/view.php?id=2579);
- abstracts of lectures and their presentations (in electronic form - https://elearn.nubip.edu.ua/course/view.php?id=2579);
- textbooks, training aids, workshops;
- methodical materials on the study of the academic discipline for students of higher education full-time and part-time forms of higher education

10. Recommended sources of information

Basic

1. Hartmann, K., Krois, J., Rudolph, A. (2023): Statistics and Geodata Analysis using R (SOGA-R). Department of Earth Sciences, Freie Universitaet Berlin.
2. Viktor Barkovskyi, Nina Barkovskaya, Oleksiy Lopatin. Probability theory and mathematical statistics. Center for educational literature. 2019. 494 p.
3. Probability, Random Variables, Statistics, and Random Processes: Fundamentals & Applications. Wiles and Sons Inc. 2019. 416 p.
4. Geostatistical Functional Data Analysis (1st ed.). Wiley. Retrieved from https://www.perlego.com/book/3056372/geostatistical-functional-data-analysis-pdf (Original work published 2021)
5. Rogerson, P.A., 2014. Statistical methods for geography: a student's guide. Sage.
6. Schabenberger, O. and Gotway, C.A., 2004. Statistical methods for spatial data analysis. CRC press.
7. Kang-Tsung Chang (2015) Introduction to Geographic Information Systems, Eighth Edition, McGraw Hill.
8. Deterministic and Geostatistical Interpolation Methods sections, Geospatial Analysis: Web site, M. J. de Smith, M. F. Goodchild, P. A. Longley. 2021. URL: http://www.spatialanalysisonline.com/HTML/index.html.

Support

9. Methodological guidelines "Statistical methods in land management". A.O. Koshel, O.I. Novikov. - Kyiv, 2018. - 44 p.
10. Steven S. Skiena. The Data Science Design Manual. Computer Science Department Stony Brook University. 2017. 453 p.
11. Senyo P.S. Probability theory and mathematical statistics. - K.: Center of educational literature, 2004.
12. Adamov, V.E. Economics and statistics: Textbook. Ed. S.D. Ilyenkova. M.: Finances and Statistics, 2019. 287p.
13. The State Statistics Service of Ukraine. URL: www.ukrstat.gov.ua
14. The State Service of Ukraine for Geodesy, Cartography and Cadastre. URL: https://land.gov.ua/
15. Eurostat. URL: https://ec.europa.eu/eurostat

"APPROVED"
Academic Council of the Faculty of Land Management
Protocol No. 9 by May 21, 2024

The head of the academic council _____Taras IEVSIUKOV