NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE
Department of Geoinformatics and Aerospace Research of the Earth

APPROVED
Faculty of Land Management
May 15, 2025

CURRICULUM OF ACADEMIC DISCIPLINE

« MATHEMATICAL STATISTICS FOR GEODATA »

Area of knowledge 19. Architecture and Construction
Specialty 193. Geodesy and land management
Academic programme "Geodesy and Land Management"
Faculty Land Management
Developed by: Assistant Professor, Candidate of Economic Sciences Bohdanna ZAYACHKIVSKA
(position, academic degree, academic title)

Kyiv – 2025

Description of the academic discipline

The task of studying the discipline is to form in the specialist theoretical knowledge and practical skills of geostatistics, mathematical and statistical apparatus of methods of processing geospatial data 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 GIS analysis of data and indicators regarding the state of land relations and land cadastral data.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	*Bachelor*	
Specialty	*193 Geodesy and land management*	
Academic programme	*Geodesy and land management*	
Characteristics of the discipline		
Type	Main	
Total number of hours	90 hours.	
Number of ECTS credits	3	
Number of modules	2	
Course project (work) (if any)	None	
Form of assessment	Test	
Indicators of the discipline for full-time and part-time forms of university study		
	Full-time	**Part-time**
Year of study	2	2
Term	3	3- 4
Lectures	3 p.m.	4 hours.
Practical classes and seminars	-	-
Laboratory classes	30 hours.	-
Self-study	45 hours.	-
Number of hours per week for full-time students	3 hours.	

1. Aim, competences and expected learning outcomes of the discipline

The main aim of the discipline "Mathematical Statistics for Geodata" is to ensure that students master the fundamentals of using mathematical and statistical methods and applied processing of geodata and indicators of the state of land relations based on the use of modern computer technologies.

Competencies acquired:

- **integral competences** :

IC. Ability to solve complex specialized tasks geodesy and land management

- **general competences:**

GC01. Ability to learn and master modern knowledge; ZK02. Ability apply knowledge in practical situations; ZK07. Ability to work autonomously;

GC12. Ability to exercise one's rights and responsibilities as a member of society; awareness of the value of civil (free democratic) society and the need for its sustainable development, the rule of law, and the rights and freedoms of man and citizen in Ukraine;

GC13. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of history and the patterns of development of subject matter the area, its place in the general system of knowledge about nature and society, as well as in the development of society, techniques and technologies, use different types and forms motor activities for recreation and leading a healthy lifestyle.

- **special competences:**

SC01. 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;

SC02. Ability to apply theories, principles, and methods of physical and mathematical, natural, socio-economic, and engineering sciences when performing geodesy and land management tasks;

SC03. Ability to apply regulatory legal acts, regulatory and technical documents, reference materials in professional activities;

SC04. Ability to select and use effective methods, technologies and equipment for carrying out professional activities in the field of geodesy and land management;

SC05. Ability to apply modern information, technical and technological support to solve complex issues of geodesy and land management;

SC06. Ability to perform remote, ground, field and office research, engineering calculations for processing research results, formalize research results, prepare reports when solving geodesy and land management tasks;

SC07. Ability to collect, update, process, critically evaluate, interpret, store, publish and use geospatial data and metadata regarding objects of natural and man-made origin.

- ***expected learning outcomes (ELO)*:**

ELO2. Organize and manage professional development persons and groups;

ELO3. Communicate information, ideas, problems, solutions, own experience and arguments to specialists and non-specialists;

ELO4. Know and apply in professional activities regulatory and legal acts, regulatory and technical documents, reference materials in the field of geodesy and land management and related industries;

ELO5. Apply conceptual knowledge of natural and socio-economic sciences when performing tasks in geodesy and land management;

ELO9. Collect, evaluate, interpret and use geospatial data, metadata about objects of natural and man-made origin, apply statistical methods of their analysis for solving specialized problems in the field of geodesy and land management.

2. Program and structure of the academic discipline

– complete term daytime (correspondence) forms obtaining higher education;
– abbreviated term daytime (correspondence) forms acquisition higher education.

Modules and topics	Number hours												
	full-time							part-time					
	weeks	total	including					total	including				
			l	p	lab	ind	s.st.		l	p	lab	ind	s.st.
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Content-based module 1. ***Foundations theories probabilities and basic statistical indicators***													
Topic 1. Basic Probability theory and mathematical statistics	1	6	2		4				1				
Topic 2. Elementary geodata analysis and indicators regarding the state of land relations	3	6	2		4				1				
Topic 3. Basic statistical models. Basic statistics data and indicators regarding the condition land relations	5	6	2		4								
Together by meaningful module		18	6		12			2	2				
Content-based module 2. ***Foundations statistical analysis land surveyors geodata***													
Topic 4. Methods statistical estimation of average values	7	14	2		2		10		1				
Topic 5. Statistical models geodata and indicators regarding the condition land relations based on samples	9	16	2		4		10						
Topic 6. Fundamentals of statistics analysis selective geodata	11	16	2		4		10						
Topic 7. Multidimensional geodata models	13	26	3		8		15		1				
Together by meaningful module		72	9		18		45	2	2				
Total hours		90	15		30		45	4	2				

3. Topics of lectures

No.	Topic	Hours
1	Topic 1. Basic Probability theory and mathematical statistics	2
2	Topic 2. Elementary geodata analysis and indicators regarding the state of land relations	2
3	Topic 3. Basic statistical models. Basic statistics data and indicators regarding the condition land relations	2

4	Topic 4. Methods statistical estimation of average values	2
5	Topic 5. Statistical geodata models and indicators regarding the condition land relations based on samples	2
6	Topic 6. Fundamentals of statistics sample analysis geodata	2
7	Topic 7. Multidimensional geodata models	2

4. **Topic of laboratory (practical, seminars) classes**

No.	Topic	Hours
1	Statistical and variational series of area indicators landowners and land users in MS Excel	2
2	Statistical and variational series of area indicators landowners and land users in STATISTICS	2
3	Basic statistics main indicators for geospatial data	2
4	Laws distribution variables random quantities on example assessments lands	2
5	Formation samples geodata and indicators of state land relations from general aggregates	2
6	Criteria reliability grades cadastral geodata	2
7	Audit hypothesis about laws of distribution	2
8	Correlational analysis geodata and indicators of state land relations	2
9	Regressive geodata analysis and indicators of state land relations	2
10	Single-factor dispersive analysis geodata and indicators of state land relations	2
11	Multifactorial dispersive analysis geodata and indicators of state land relations	2
12	Cluster analysis of geodata and status indicators land relations	2
13	Discriminatory analysis geodata and indicators of state land relations	2
14	Factorial analysis cadastral geodata and method main component	2
15	Multidimensional scaling geodata and indicators of state land relations	2

5. **Topics of self-study**

No.	Topic	Hours
1	Basic concept geostatistics in field land relations	9
2	Basic aspects using R languages for carrying out statistical analysis	10
3	Using trees solutions for processing geodata	8
4	Program product ArcGIS for goals statistical analysis geospatial data	8
5	Mathematical and statistical methods processing geospatial data	10

6. Methods assessing expected learning outcomes:

– test;
– modular tests;

– protection laboratory work.

7. Teaching methods:

– verbal method (lecture, discussion, interview etc);
– practical method (laboratory, practical occupation);
– visual method (method illustrations, demonstration method);
– work with educational and methodological literature (note-taking, thesis, annotating, reviewing, writing an abstract);
– video method (remote, multimedia, web-based etc);
– independent work (implementation tasks).

8. Results assessment The knowledge of a higher education applicant is assessed on a 100-point scale and is converted into a national assessment in accordance with the current "Regulations on Examinations and Tests at the NUBiP of Ukraine"

8.1. Distribution of points by types of educational activities

Topic	Learning outcomes	Evaluation
First semester		
Module 1. INFORMATION TECHNOLOGIES IN GEODESY AND LAND MANAGEMENT		
Laboratory work 1. Statistical and variation series of area indicators landowners and land users in MS Excel. Statistical and variation series of area indicators landowners and land users in STATISTICS Individual work 1. Basics concept geostatistics in field land relations	ELO2, 3, 4, 5, 9. Including acquiring knowledge about the theoretical and methodological basis of the discipline, the basics theories probabilities , to form understanding the term "statistics". Understand difference of theory probabilities from reality and from the rules actions with probable events and probabilities their implementation.	
Laboratory work 2. Basic statistics main indicators for geospatial Data. Laws distribution variables random quantities on example assessments lands Individual work 2. Basics aspects using R languages for carrying out statistical analysis	ELO4, 5, 9. Including understand basics of elementary statistics analysis , be able to carry out elementary statistical analysis using geodata as an example and indicators of land conditions relations regarding number of owners and land users plots and their area. Acquire skills perform works with tables, graphs and charts.	
Laboratory work 3. Formation samples geodata and indicators of state land relations from general aggregates. Criteria reliability grades cadastral geodata	ELO2, 3, 4, 5, 9. Including r understand the concept of statistical models and their types. Be able to develop basic statistical models based on geodata and indicators of the state of land relations in relation to land use planning. Be able to perform classification and ranking of basic system signs. Understand the concept of grouping geodata , making statistical and variational series. Know the basic statistical characteristics of land-use objects and factors and their calculation. Perform distribution land and cadastral geodata, know types distribution and their characteristics	
Modular control		**30**
Together by content module 1		**100**
Module 2. PROCESSING OF LAND INFORMATION IN WORD PROCESSORS		
Laboratory work 4. Verification hypothesis about laws of distribution Individual work 3. Use trees	ELO2, 3, 4, 5, 9. Including r understand the concept of the coefficient of variation and its calculation and interpretation. Know the concept mean square error, her calculations and interpretation. Understand the	

solutions for processing geodata. Software product ArcGIS for goals statistical analysis geospatial data	concept confidence interval. Understand the concepts of skewness and kurtosis distribution. Understand concepts of quantiles and quartiles. Know the criteria for evaluating land surveyors data from a Student's t-test.	
Laboratory work 5. Correlation analysis geodata and indicators of state land relationships. Regressive geodata analysis and indicators of state land relations	ELO2, 3, 4, 5, 9. Including r understand The concept of a general population and a sample using the example of geodata and indicators regarding the state of land relations regarding land valuation. Understand the concepts of repetition and repetition, questionable repetitions. Understand the concept dimensionality reduction and selection of the most informative features. Know the basic methods of organizing a sample. Be able to perform point and interval estimates. Understand concept correlations and correlation analysis of geodata and indicators regarding the state of land relations. Perform regression analysis of estimated indicators.	**15**
Laboratory work 6. Single-factor dispersive analysis geodata and indicators of state land relationships. Multifactorial dispersive analysis geodata and indicators of state land relations Individual work 4. Mathematical and statistical methods processing geospatial data	ELO4, 5, 9. Including to be able to perform analysis of variance – one-, two- and multifactorial. To be able to apply mathematical and statistical methods processing geospatial data	
Laboratory work 7. Cluster analysis geodata and status indicators land relations . Discriminatory analysis geodata and indicators of land conditions relations	ELO4, 5, 9. Including from the basics of clustering analysis. Be able to apply the acquired knowledge to analyze geodata and indicators of land conditions relations	
Laboratory work 8. Factorial analysis cadastral geodata and method main Component. Multidimensional scaling geodata and indicators regarding the condition land relations	ELO4, 5, 9. Including conducting factor analysis and method of main component, perform discriminant analysis and canonical analysis, do compliance analysis and ultidimensional scaling of geodata and status indicators land relations.	
Modular control		**30**
Together by content module 2		**100**
Only for 1 semester		**70**
Test		**30**

8.2. Higher education student knowledge assessment scale

Higher education applicant rating, points	Assessment according to the national system	
	exams	credits
90-100	perfectly	enrolled
74-89	good	
60-73	satisfactorily	
0-59	unsatisfactorily	not included

8.3. Evaluation Policy

Deadline and resubmission policy	Works that are submitted late without good reason, are evaluated on lower assessment. Reassembling modules is happening from permission lecturer by availability respected reasons (for example, sick leave).
Academic Integrity Policy	Writing off under time control works and exams are prohibited (including using mobile devices). Abstracts, presentations must have correct textual link on the literature used.
Visitation Policy	Attendance at classes is mandatory. For objective reasons (e.g. illness, international internship) studies may take place individually (in online form by by agreement from dean faculty).

9. **Educational and methodological support:**

- electronic educational course of the academic discipline (on the educational portal of the NUBiP of Ukraine eLearn - **https://elearn.nubip.edu.ua/course/view.php?id=1561 ;**
- lecture notes and their presentations on the educational portal of the NUBiP of Ukraine eLearn - **https://elearn.nubip.edu.ua/course/view.php?id=1561 ;**
- methodical instructions
  - ✓ Кошель А.О. Статистичні методи в землеустрої / Кошель А.О., Новиков О.І. – Київ, 2018. – 44 с.

10. Recommended sources of information

Main:

1. Віктор Барковський, Ніна Барковська, Олексій Лопатін. Теорія ймовірностей та математична статистика. Центр навчальної літератури. 2019. 494 с.
2. Probability, Random Variables, Statistics, and Random Processes: Fundamentals & Applications. Wiles and Sons Inc. 2019. 416 p.
3. Матковський С.О., Гальків Л.І., Гринькевич О.С, Сорочак О.З. Статистика: Навчальний посібник - Львів.: "Новий Світ", 2009. - 430 с.
4. Fotheringham, A.S., Brunsdon, C. and Charlton, M., 2003. Geographically weighted regression: the analysis of spatially varying relationships. John Wiley & Sons.
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.

Auxiliary:

1. Steven S. Skiena. The Data Science Design Manual. Computer Science Department Stony Brook University. 2017. 453 p.
2. Сеньо П.С. Теорія ймовірностей та математична статистика. – К.: Центр навчальної літератури, 2004.

Informational resource:

1. Державна служба статистики України. URL: www.ukrstat.gov.ua
2. Державна служба України з питань геодезії, картографії та кадастру. URL: https://land.gov.ua/
3. Eurostat. URL: https://ec.europa.eu/eurostat