NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of "Geoinformatics and Aerospace Research of the Earth"

APPROVED
Dean of the Faculty of Land management
Ievsiukov T.O.
«19» May 2022 year

APPROVED
at a meeting of the Department of Geoinformatics
and Aerospace Research of the Earth
Minutes № 12 of 27 April 2022
Head of Department
Kokhan S.S.

AGREED
Guarantor of the educational program
Kovalchuk I.P.

WORKING CURRICULA

STATISTICAL METHODS IN LAND MANAGEMENT

Branch of knowledge	19. Architecture and construction
Specialty	193. Geodesy and land management
Educational program	"Geodesy and Land Management"
Faculty	Land management
Authors	Dr. Sci., Prof. Kokhan S.S. (посада, науковий ступінь, вчене звання)
	Dr. Sci., Associate prof. Koshel A.O. (посада, науковий ступінь, вчене звання)

Kyiv – 2022

1. Description of the course

STATISTICAL METHODS IN LAND MANAGEMENT

Industry knowledge training direction, speciality, education level	
Educational qualification	Bachelor
Field of knowledge	19. Architecture and Construction
Specialty	193. Geodesy and land management
Specialization	
Description of the course	
Type	Sample
Total number of hours	90
Number of credits ECTS	3
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	45
Individual tasks	-
Number of weekly hours for full-time study: classroom	3

2. Task and purpose of the discipline
STATISTICAL METHODS IN LAND MANAGEMENT

Objective:

The discipline " Statistical methods in Land Management " provides a study of the fundamentals of the use of mathematical and statistical methods and applied processing of geodata and indicators of the state of land relations based on the use of modern computer technology.

The aim of the discipline

The task of studying the discipline is the formation of a specialist's theoretical knowledge and practical skills of mathematical and statistical methods of processing geospatial data and their further practical use based on computer technology (spreadsheets and software packages for statistical data analysis) in analyzing data and indicators of land relations and land cadastral data.

A study of the discipline the student must

know:

• basics of probability theory;

• main indicators and methods of basic statistical analysis of geodata.

be able to:

• collect geodata and organize the necessary data;

• perform the primary organization of geodata in the form of spreadsheets;

• be able to use mathematical models for the analysis of geodata and indicators of the state of land relations;

• have basic methods of multidimensional statistics in accordance with the analysis of geodata and indicators on the state of land relations;

• know the possibilities and be able to work with the Statistica package.

The discipline provides the formation of a number of competencies:

- ***general competencies***:

GC01. Ability to learn and master modern knowledge.

GC02. Ability to apply knowledge in practical situations;

GC07. Ability to work autonomously;

GC12. The ability to exercise their rights and responsibilities as a member of society; awareness values of civil (free democratic) society and its necessity sustainable development, the rule of law, rights and human and civil liberties in Ukraine;

GC13. Ability to maintain, multiply moral, cultural, scientific values and achievement of society based on understanding history, patterns of subject development area, its place in the general system of knowledge about nature and society, as well as in development society, machinery and technology, use different types and forms of motor activities for recreation and healthy eating lifestyle.

- ***special competencies***:

SC01. Ability to apply fundamental knowledge for the analysis of natural phenomena and of technogenic origin at performance professional tasks in the field of geodesy and land management;

SC02. The ability to apply theories principles, methods of physical and mathematical, natural, socio-economic, and engineering sciences in the performance of geodesy tasks and land management;

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

SC04. Ability to choose and use effective methods, technologies and equipment to carry out professional activities in the field geodesy and land management;

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

SC06. Ability to perform remote, ground, field and in-house research, engineering calculations for processing research results, draw up research results, prepare reports in solving problems of geodesy and land management;

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

Program results:

RS02. Organize and manage professionally development of individuals and groups;

RS03. Inform specialists and non-specialists information, ideas, problems, solutions, own experience and argumentation;

RS04. Know and apply in professional activities of legal acts, regulatory and technical documents, references materials in the field of geodesy and land management and related industries;

RS05. Apply conceptual knowledge of natural and socio-economic sciences in performing tasks of geodesy and land management;

RS09. Collect, evaluate, interpret and use geospatial data, metadata on 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;

3. Program and structure of the discipline

STATISTICAL METHODS IN LAND MANAGEMENT

for full-time study form:

CONTENT MODULE I. FUNDAMENTALS OF PROBABILITY THEORY AND BASIC STATISTICAL INDICATORS.

Topic 1. The main provisions of probability theory and mathematical statistics.

Introduction to the course. Basic concepts and definitions. Introduction to the basics of probability theory and the formation of an understanding of the term "statistics". The difference between probability theory and reality. Rules of action with probable events and probabilities of their implementation.

Topic 2. Elementary analysis of geodata and indicators on the state of land relations.

Disclosure of the basics of elementary statistical analysis. Elementary statistical analysis on the example of geodata and indicators on the state of land relations in relation to the number of landowners and land users of land plots and their areas. Work with tables, graphs and charts.

Topic 3. Basic statistical models. Basic statistics of geodata and indicators on the state of land relations.

The concept of statistical models and their types. Basic statistical models based on data and indicators on the state of land relations in relation to rating. Classification and ranking of basic system features. Data grouping. Statistical and variational series. Basic statistical characteristics of land management objects and factors and their calculation. Distribution of land cadastral data, types of distribution and their characteristics.

CONTENT MODULE II. BASICS OF STATISTICAL ANALYSIS OF GEODATICS AND INDICATORS REGARDING THE STATE OF LAND RELATIONS.

Topic 4. Methods of statistical evaluation of averages.

The concept of the coefficient of variation and its calculations and interpretation. Mean square error, its calculations and interpretation. The concept of confidence interval. Asymmetry and excess of distribution. Quantiles and quartiles. Criteria for evaluating land management data according to the Student's indicator.

Topic 5. Statistical models of geodata and indicators on the state of land relations based on samples.

General population and sample on the example of geodata and indicators on the state of land relations for land valuation. The concept of repetition and repetition, imaginary repetition. Reducing the dimension and choosing the most informative features. The main ways of organizing the sample. Point and interval estimates. Significance.

Topic 6. Fundamentals of statistical analysis of sample geodata.

Correlation and correlation analysis of geodata and indicators on the state of land relations. Regression analysis of evaluation indicators. Analysis of variance - one-, two- and multifactor.

Topic 7. Multidimensional models of geodata.

Fundamentals of cluster analysis. Factor analysis and principal components method. Discriminant analysis and canonical analysis. Compliance analysis and multidimensional scaling of data and indicators on the state of land relations.

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		6	2		4		
Topic 2. Elementary analysis of geodata and indicators on the state of land relations		6	2		4		
Topic 3. Basic statistical models. Basic statistics of data and indicators on the state of land relations		6	2		4		
Total by Content module		18	6		12		
Content module 2. Fundamentals of land management geodata statistical analysis							
Topic 4. Methods of statistical evaluation of averages		4	2		2		10
Topic 5. Statistical models of geodata and indicators on the state of land relations based on samples		6	2		4		5
Topic 6. Fundamentals of statistical analysis of sample geodata		10	2		2		6
Topic 7. Multidimensional models of geodata		37	3		10		24
Total by Content module		57	9		18		45
Total		**90**	**19**		**30**		**45**

4. Themes of seminars

№	Name of theme	Hours

5. Topics of practical classes

№	Name of theme	Hours

6. 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

7. Individual tasks

1. Get the task with geodata of the land resources characteristics in the Kyiv region
2. Sort and range the geodata for performance by years.
3. Compute the geodata frequencies.
4. Build a distribution bar chart. Conduct comparative analysis of the distribution of frequencies as compared by the years.
5. Calculate the values of skewness and kurtosis and conclude that the nature of the variation curve.
6. Test the hypothesis of normality by Kolmogorov-Smirnov and Shapiro-Wilks tests. Make a conclusion about the normality.
7. Calculate the frequency distribution parameters for different distribution laws (with parameters mismatch normality).
8. Test the hypothesis match the actual frequency distribution of the calculated frequencies for different laws (by chi-square, «Observed versus expected X») and conclude that statistically significant distribution law.
9. Calculate basic statistical characteristics of market indicators earth. Conduct comparative analysis of basic statistics for years.
10. Test the hypothesis of equality of variances of geodata by years. Make a conclusion about the equality of variances.
11. Check for the hypothesis of equality of mean values and belonging to a samples of the population. (Note if the distribution does not match normality – used non-parametric criteria). Make a conclusion about where the geodata parameters for all the years to same population.

8. Teaching Methods

In conducting lectures appropriate to use verbal teaching methods: explanation, narration, discussion, educational debate, with a combination of visual learning methods: illustration, showing.

In carrying out laboratory work should be used such as verbal learning method of instruction on the combination of visual learning methods of illustration and demonstration, the aspect of these studies is that they facilitate communication theory and practice, providing students acquiring skills using standard and specialized software , application of information technology to cadastral and form students' initial skills of research activities. Laboratory work in the laboratory are equipped computers.

9. Forms of control

The main methods of control of knowledge and skills students have to study the subject are: oral examination, written and practical test, standardized control in the form of modular test papers, assessment for individual learning task, the final test.

The total value of these methods is to make the best possible to ensure timely and comprehensive feedback between students and teachers, by which establishes how students perceive and learn the material.

The purpose determines the choice of control methods, it should be borne in mind that these methods can be applied in all kinds of control - only complete applications allows regularly and objectively identify the dynamics of the formation of knowledge and skills of students. Each control method has its advantages and disadvantages, scope of application, none of them can not be the only one able to diagnose all aspects of the learning process. So:

- to control the absorption of lectures: oral questioning, written modular test papers, current testing score for an individual learning task, the final test.

- for the monitoring and evaluation of laboratory work: practical test and evaluation of each laboratory work.

10. Ratio between national and ECTS values and rating from the discipline

Student Assessment takes place according to "On the examinations and tests NUBiP Ukraine" dated 12/27/2019. The protocol №5 of Table 1.

National value	Rating, points
EXCELLENT	90-100
GOOD	74-89
SATISFACTORY	60-73
UNSATISFACTORY	1-59

To determine the ranking of mastering discipline student RDYS (100 points) received certification RAT ranking (30 points) added to the student rating for Academic RNR (70 points): RDYS RNR = + RAT.

11. Methodological Support

1. Методичні вказівки "Статистичні методи в землеустрої". Н.М. Назаренко, О.О. Іванюта. – Київ, 2013. – 44 с.

12. Suggested Reading

Basic

2. Віктор Барковський, Ніна Барковська, Олексій Лопатін. Теорія ймовірностей та математична статистика. Центр навчальної літератури. 2019. 494 с.
3. Probability, Random Variables, Statistics, and Random Processes: Fundamentals & Applications. Wiles and Sons Inc. 2019. 416 p.
4. Матковський С.О., Гальків Л.І., Гринькевич О.С, Сорочак О.З. Статистика: Навчальний посібник - Львів.: "Новий Світ", 2009. - 430 с.
5. Fotheringham, A.S., Brunsdon, C. and Charlton, M., 2003. Geographically weighted regression: the analysis of spatially varying relationships. John Wiley & Sons.
6. Rogerson, P.A., 2014. Statistical methods for geography: a student's guide. Sage.
7. Schabenberger, O. and Gotway, C.A., 2004. Statistical methods for spatial data analysis. CRC press.
8. Kang-Tsung Chang (2015) Introduction to Geographic Information Systems, Eighth Edition, McGraw Hill.
9. Deterministic and Geostatistical Interpolation Methods sections, Geospatial Analysis: Web site, M. J. de Smith, M. F. Goodchild, P. A. Longley, http://www.spatialanalysisonline.com/HTML/index.html.

Support

10. Steven S. Skiena. The Data Science Design Manual. Computer Science Department Stony Brook University. 2017. 453 p.
11. Сеньо П.С. Теорія ймовірностей та математична статистика. – К.: Центр навчальної літератури, 2004.
12. FAO. 2021a. FAOSTAT: Land use. In: FAO.org [online]. Available at http:/ www.fao.org/faostat/faostat/en/#data/EL.

13. Information Resources

13. www.ukrstat.gov.ua
14. https://land.gov.ua/