



MINISTRY OF SCIENCE AND HIGHER EDUCATION OF RUSSIAN FEDERATION
Federal State Autonomous Educational Institution of Higher Education
Far Eastern Federal University
(FEFU)
SCHOOL OF BIOMEDICINE

AGREED
Head of OP

(Signed) (Full name)



CLAIM
Director of the Department of Medical Biology and
Biotechnology

(Signed) (Acting Name)
December 06, 2022

WORK PROGRAM OF THE DISCIPLINE
Biostatistics
Direction of training 06.04.01 Biology
Master's Programme in Molecular and Cell Biology
Form of training: full-time

Course 1 semester 1
Lectures – 6 hours
Practical classes – 36 hours.
Seminar classes – not provided
Including with the use of MAE - lek. 4 hours/d.6 hours
The total hours of classroom load are 54 hours.
Including with the use of MAE 22 hours.
Independent work – 54 hours.
Abstract works are provided
Coursework is not provided
Credit 1 semester

The work program is drawn up in accordance with the requirements of the Federal State Educational Standard in the direction of training 06.04.01 Biology, approved by the order of the Ministry of Education and Science of Russia dated 11.08.2020 No. 934

The work program was discussed at the meeting of the Department of Medical Biology and Biotechnology Protocol dated December 06, 2022 No. 2

Director of the Department of Medical Biology and Biotechnology , Ph.D.V.V. Kumeiko

Reverse side of the RPD cover page

1. The work program was revised at the meeting of the Department / department / department (implementing the discipline) and approved at the meeting of the Department / department / department (issuing structural unit), the protocol from " ____ _ № ____

2.The work program was revised at the meeting of the Department / department / department (implementing the discipline) and approved at the meeting of the Department / department / department (issuing structural unit), the protocol from " __ № ____

3.The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from " ____ № ____

4.The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from " ____ _ № ____

5.The work program was revised at the meeting of the Department / Department / Department (implementing the discipline) and approved at the meeting of the Department / Department / Department (issuing structural unit), the protocol from " ____ _ № ____

Abstract of the work program of the discipline "Biostatistics"

I. Goals and objectives of mastering the discipline:

The purpose of mastering the discipline "Biostatistics" is to familiarize students with the methods and means of applied statistical analysis in biological research.

Tasks:

- to study the principles of organization, theoretical foundations and computational aspects of the main sections of one-dimensional and applied multidimensional data analysis;
- teach the basic principles of interpreting the results obtained.

The work program of the academic discipline B1.O.07 "Biostatistics" is compiled for students in the educational program of the magistracy 06.04.01 Biology "Molecular and cellular biology (together with the NSCMB FEB RAS)" in accordance with the requirements of the Federal State Educational Standard in the direction of training 06.04.01 Biology, approved by the order of the Ministry of Education and Science of Russia dated 11.08.2020 No. 934.

Discipline B1.O.07 "Biostatistics" is included in the basic part of the compulsory disciplines of the educational program of the magistracy 06.04.01 Biology "Molecular and cell biology (together with the NSCMB FEB RAS)".

The total labor intensity of mastering the discipline is 3 credit units (108 hours). The curriculum includes lectures (18 hours), practical classes (36 hours) and independent work (54 hours). Evaluation of learning outcomes: credit.

Successful mastery of the course requires prior knowledge of the basics of mathematical and statistical analysis, as well as an understanding of the physiology of organisms obtained at the previous level of education.

For the successful study of the disciplines of "Biostatistics", the following preliminary competencies should be formed in students:

- the ability to show initiative and make responsible decisions, realizing responsibility for the results of their professional activities;
- the ability to creatively perceive and use the achievements of science, technology in the professional sphere in accordance with the needs of the regional and world labor market; the ability to use modern methods and technologies (including information) in professional activities;
- the ability to work in a team, tolerant of social, ethnic, religious and cultural differences;
- ability to self-organization and self-education;
- the ability to solve standard tasks of professional activity on the basis of information and bibliographic culture with the use of information and communication technologies and taking into account the basic requirements of information security;
- the ability to understand the basic ideas about the diversity of biological

objects, the importance of biodiversity for the stability of the biosphere, the ability to use methods of observation, description, identification, classification, cultivation of biological objects;

- the ability to apply modern experimental methods of working with biological objects in the field and laboratory conditions, skills to work with modern equipment;

- the ability to substantiate the role of the evolutionary idea in the biological worldview; possession of modern ideas about the basics of evolutionary theory, about micro- and macroevolution;

- the ability to apply basic ideas about the basics of general, systemic and applied ecology, the principles of optimal nature management and nature protection, monitoring, assessment of the state of the natural environment and wildlife protection;

- the ability to apply modern ideas about the basics of biotechnological and biomedical production, genetic engineering, nanobiotechnology, molecular modeling;

- the ability to use knowledge of the basics and principles of bioethics in professional and social activities;

- readiness to use the legal norms of research works and copyright, as well as the legislation of the Russian Federation in the field of nature protection and nature management;

- ability and willingness to conduct a discussion on socially significant problems of biology and ecology;

- the ability to operate modern apparatus and equipment for research field and laboratory biological work;

- the ability to put into practice the techniques of compiling scientific and technical reports, reviews, analytical maps and explanatory notes, to present and critically analyze the information received and to present the results of field and laboratory biological research;

- the ability to apply modern methods of processing, analysis and synthesis of field, production and laboratory biological information, the rules for drawing up scientific and technical projects and information.

General professional competencies of graduates and indicators of their achievement:

Name of the category (group) of general professional competencies	Code and name of general professional competence (the result of mastery)	Code and name of the competency achievement indicator
	OPK-6 Is able to creatively apply and modify modern computer technologies, work with professional databases, professionally	OPK-6.1 Develops ways and prospects for the application of modern computer technologies in biological sciences and education. OPK-6.2 Uses with professional databases and data banks in the chosen

	design and present the results of new developments.	field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images, has experience in modifying computer technologies for the purpose of professional research. OPK-6.3 Uses modern computer technologies, works with professional databases, draws up and presents the results of new developments.
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Code and name of the competency achievement indicator	Name of the assessment indicator (the result of training in the discipline)
OPK-6.1 Develops ways and prospects for the application of modern computer technologies in biological sciences and education.	Knows modern information technologies and software tools used in professional activities Able to apply modern information technologies and software tools in solving professional problems. It is equipped with the skills of collecting, processing, evaluating the reliability of the results and providing the information obtained through modern information technologies and software tools.
OPK-6.2 Uses with professional databases and data banks in the chosen field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images, has experience in modifying computer technologies for the purpose of professional research.	Knows professional databases and data banks in his professional activities, Able to use professional databases and data banks in the chosen field of professional activity, the necessary mathematical apparatus, analysis and algorithm for storing electronic images He has the skill of applying the mathematical apparatus in his professional field, the skill of working with databases, modifying computer technologies for the purpose of professional research.
OPK-6.3 Uses modern computer technologies, works with professional databases, draws up and presents the results of new developments.	It uses modern methods of processing and analysis of scientific and technical information You can process, evaluate the results obtained, analyze the data, draw conclusions and provide the results of the data obtained. He is equipped with the skills of processing and analyzing information in the chosen field of professional activity

To form the above competencies within the discipline "Biostatistics", the following educational technologies and methods of active / interactive learning are used: business game, work in small groups, round table.

II. Labor intensity of discipline and types of training sessions in the discipline

The total labor intensity of the discipline is 3 z.u. (108 academic hours), (1 credit corresponds to 36 academic hours).

Types of training sessions and work of the student in the discipline are:

Designation	Types of training sessions and work of the student
L	Lectures
L. electr.	

Ave	Practical exercises
Pr electr.	
WED:	Independent work of the student during the period of theoretical training
including control	Independent work of the student and contact work of the student with the teacher during the period of intermediate certification
	And other types of work

III. Structure of the discipline:

Form of study – full-time

№	Name of the section Discipline	Se me ster	Number of hours by types of training sessions and work of the student						Intermediate attestation forms
			Lek	Lab	Ave	OK	WE D	Cont rol	
1	Topic 1. Basic concepts of data analysis. Basic with knowledge from probability theory		6						
2	Topic 2. Ways to describe one-dimensional quantities		6						
3	Topic 3. Parameter estimation		6						
4	Topic 1. Testing statistical hypotheses (6 hours)				6				
5	Topic 2. Correlation analysis				6				
	Topic 3. Paired linear regression. Multiple regression				6				
	Topic 4. Discriminant analysis. Component and factor analysis				6				
	Topic 5. Cluster analysis				6				
	TeMa 6. Multidimensional Scaling			6					
Total:		1	18	-	36	-	54	-	Credit

IV. CONTENT OF THE THEORETICAL PART OF THE COURSE

Lectures (18 hours)

Topic 1. Basic concepts of data analysis. Basic information from probability theory (6 hours)

The place of this discipline among other branches of science. The need to master the methods of data analysis in science and production. The main stages of data analysis. Iterative data exploration scheme Classification of data analysis methods. Different data generation schemes. A representation of the source data. The concept of symptom scales. Weak (nominal, ordinal) and strong (ratios, intervals, absolute) scales. Navigating scales.

The concept of a random event and a random variable. Reliable and impossible events. Probability definitions. Discrete and continuous random variables. Laws of distribution. Probability calculus theorems. Probability distribution and density functions. Some one-dimensional distributions: Bernoulli, binomial, Poisson, normal, lognormal, Student, Fisher, chi-square.

Topic 2. Ways to describe one-dimensional quantities (6 hours)

Scale and position characteristics: limits, scope, average, median, fashion, dispersion, standard deviation. Properties of the arithmetic mean and dispersion. Algorithms for calculating indicators. Quantiles, polygon, histogram, cumulates. Tabulation of data. Questions of the applicability of these indicators to the features measured in different scales.

Topic 3. Parameter evaluation (6 hours)

The problem of assessment. Point and interval estimates. Characteristics of point estimates: non-bias, efficiency, consistency. Variance and corrected variance. Characteristics of interval evaluations: reliability and efficiency. Obtaining the confidence interval for the arithmetic mean. Determine the required sample size.

V. CONTENT OF THE PRACTICAL PART OF THE COURSE

Practical training (36 hours)

Topic 1. Testing statistical hypotheses (6 hours)

Statistical hypotheses. Formulation of hypotheses, null and competing hypotheses. Mistakes of the first and second kind. Significance level. Power of test. Bilateral and unilateral critical areas. General algorithm for testing a statistical hypothesis. Criteria of difference, homogeneity, consent. Student's t-criterion. Nonparametric (free from distribution) criteria.

Topic 2. Correlation analysis (6 hours)

Covariance, Pearson's paired correlation coefficient. Purpose, properties, features of application. Visual analysis of scattering diagrams. Hypotheses related to the correlation coefficient. Other communication indicators. Determination of the reliability of the connection.

Topic 3. Paired linear regression. Multiple regression (6 hours)

Paired linear regression problems. Dependent and independent variables. Free penis and angular coefficient. Unsympathetic. Method of least squares. Grounds of the method. Estimation of regression coefficients, confidence intervals. Hypothesis testing with respect to coefficients. Analysis of residues.

The problem of prediction by a complex of variables. Multiple and partial correlation. The foundations of the method. Principles of variable selection. Step regression.

Topic 4. Discriminant analysis. Component and factor analysis (6 hours)

The purpose of the method. Fisher's discriminant. Cases of optimal solution. Discrimination in the case of more than two classes. Canonical discriminant analysis. Ways to assess the quality of discrimination. Selection of predictors. Step discrimination. Forward and reverse stepping procedures. Examples of application.

Analysis of the main components. Basics of the method. Methods of calculations. Features of rationing. Interpretation of eigenvalues and eigenvectors. Factor analysis. Basic ways of calculations. Rotation of factors. Methods of interpretation. Examples of application.

Topic 5. Cluster analysis (6 hours)

The purpose of the method. Similarity indicators: measures of similarity, differences, distances. Methods for obtaining similarity matrices. Methods of analysis and representation of matrices. Hierarchical cluster procedures. Non-hierarchical methods. Optimization of classification quality indicators. Clustering in dialog mode. Methods of dimensionality reduction. Other methods of cluster analysis.

Topic 6. Multidimensional scaling (6 hours)

Basic principles of the method. Input. Ways to assess the quality of the solution. An indicator of stress. Dimension selection. Methods of interpretation.

VI. MONITORING THE ACHIEVEMENT OF COURSE OBJECTIVES

The following assessment tools may be used for monitoring:

UO-1 – individual interview, mainly on the exam;

UO-4 – seminar-debate;

PR-1- test;

PR-2 - control work

No p/n	Controlled modules /partitions / topics of discipline	Codes and stages of competence formation		Valuation tools - name	
				current control	Intermediate certification
1.	Topics "Basic concepts of data analysis. Basic information from probability theory", "Methods of describing one-dimensional quantities", "Estimating parameters"	OPK-6.1; OPK-6.2; OPK-6.3	Knows the basic sections of one-dimensional and applied multidimensional data analysis Able to collect, process and analyze data with the help of modern computer technologies Has the skills to process the results of microbiological studies, using multivariate analysis	UO-1, UO-4, PR-1	UO-1 (exam questions #1-9)
2.	Topics "Testing statistical hypotheses", "Correlation analysis", "Pair linear regression. Multiple regression"	OPK-6.1; OPK-6.2; OPK-6.3	Knows the possibilities of using programs for statistical processing of microbiological research results Able to use mathematical methods in their scientific and production-technological activities Has the skills to assess the reliability of the results obtained during microbiological studies	UO-1, UO-4, PR-2	UO-1 (exam questions No. 10-17)
3.	Topics "Discriminant analysis. Component and factor analysis", "Cluster analysis", "Multivariate scaling"	OPK-6.1; OPK-6.2; OPK-6.3	Knows the basic sections of one-dimensional and applied multidimensional data analysis Able to collect, process and analyze data with the help of modern computer technologies Has the skills to process the results of microbiological studies, using multivariate analysis	UO-1, UO-4, PR-2	UO-1 (exam questions No18-25)

VII. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF INDEPENDENT WORK OF STUDENTS

Independent work is defined as an individual or collective educational activity carried out without the direct guidance of the teacher, but according to his tasks and under his control. Independent work is a cognitive learning activity, when the sequence of the student's thinking, his mental and practical operations and actions depends and is determined by the student himself.

Independent work of students contributes to the development of independence, responsibility and organization, a creative approach to solving problems of educational and professional levels, which ultimately leads to the development of the skill of independent planning and implementation of activities.

The purpose of independent work of students is to master the necessary competencies in their direction of training, experience in creative and research activities.

Forms of independent work of students:

- work with the main and additional literature, Internet resources;
- independent acquaintance with the lecture material presented on electronic media in the library of the educational institution;
- preparation of abstract reviews of periodical sources, reference notes, predetermined by the teacher;
- search for information on the topic with its subsequent presentation in the audience in the form of a report, presentations;
- preparation for classroom control work;
- performance of home control works;
- execution of test tasks, problem solving;
- compilation of crosswords, schemes;
- preparation of messages for the presentation at the seminar, conference;
- filling out a workbook;
- writing essays, term papers;
- preparation for business and role-playing games;
- resume writing;
- preparation for tests and exams;
- other activities organized by the educational institution and student self-government bodies.

Schedule for the implementation of independent work in the discipline "Biostatistics"

№ p/n	Due Date/Deadlines	Type of independent work	Approximate norms of execution time	Form of control
1	1 – 3 weeks	Work with literature and lecture notes. Preparation for the seminar and laboratory work on topic 1	9 hours	Work at the seminar, laboratory work, oral answer.
2	4 – 6 weeks	Work with literature and lecture notes. Preparation for the seminar and laboratory work on topic 2	9 hours	Work at the seminar, laboratory work, oral answer.
3	7 - 9 weeks	Work with literature and lecture notes. Preparation for the seminar and test work on topic 3	9 hours	Work at the seminar, oral answer, control work.
4	10 -12 weeks	Work with literature and lecture notes. Preparation for the seminar and laboratory work on topic 4	9 hours	Work at the seminar, laboratory work, oral answer.
5	13 - 15 weeks	Work with literature and lecture notes. Preparation for the seminar and test work on topic 5	9 hours	Work at the seminar, oral answer, control work.
6	16 - 18 weeks	Work with literature and lecture notes. Preparation for the seminar and testing on topic 6	9 hours	Work at the seminar, test, oral answer.
		Total	54 hours	

VIII. LIST OF EDUCATIONAL LITERATURE AND INFORMATION AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE

Main literature

1. Informatics and medical statistics / [G. N. Tsarik, V. M. Ivoilov, I. A. Polyanskaya et al.]; ed. by G. N. Tsarik. Moscow: GEOTAR-Media, 2017. 302 s.
2. Probability theory and mathematical statistics: a textbook for universities / B. N. Ivanov; Far Eastern Federal University, School of Natural Sciences, Department of Algebra, Geometry and Analysis. Vladivostok: Izd-vo Dalnevostochnogo federal'skogo universiteta, 2016. 223 s.
3. Shelobaeva I.S. Statistics. Practicum: a textbook for universities / I. S. Shelobaeva, S. I. Shelobaev.- 2nd ed., pererab. and add.- M.: UNITI-DANA, 2014.- 207 p. Access mode:
<http://lib.dvfu.ru:8080/lib/item?id=chamo:725924&theme=FEFU>
4. Trukhacheva N.V. Mathematical statistics in medical and biological research with the use of the Statistica package / N.V. Trukhacheva.- M.: GEOTAR-Media,

2012.- 379 p. Access mode:

<http://lib.dvfu.ru:8080/lib/item?id=chamo:730137&theme=FEFU>

5. Lyalin V.S. Statistics: theory and practice in Excel: a textbook for universities / V.S. Lyalin, I.G. Zvereva, N.G. Nikiforova.- M.: Finance and statistics INFRA-M, 2010.- 447 p. Access mode:

<http://lib.dvfu.ru:8080/lib/item?id=chamo:294755&theme=FEFU>

Further reading

1. Orlov, A.I. Probability and Applied Statistics: Key Facts: Handbook; [ucheb. posobie dlya vuzov] / A.I. Orlov.- M.: KnoRus, 2010.- 192 p. Mode of access:

<http://lib.dvfu.ru:8080/lib/item?id=BookRu:BookRu-916526&theme=FEFU>

2. Statistics: [textbook for universities (+CD)] / ed. by I. I. Eliseeva.- S.-P.: Piter, 2010.- 362 p. Access mode:

<http://lib.dvfu.ru:8080/lib/item?id=chamo:418895&theme=FEFU>

List of resources of the information and telecommunication network

"Internet"

1. Electronic library system Znanium. Access Mode: <https://znanium.com/>

2. Scientific electronic library eLIBRARY.RU. Access Mode: <https://www.elibrary.ru/defaultx.asp>

3. Educational platform "Yurait". Access Mode: <https://urait.ru/>

4. Information and legal portal "Garant". Access Mode: <http://www.garant.ru/>

5. A single window of access to educational resources. Access Mode: <http://window.edu.ru/>

List of information technologies and software

1. In the implementation of the educational process, students use the following software: Microsoft Office (Access, Excel, PowerPoint, Word, etc.), electronic resources of the FEFU website, including FEFU EBS.

2. Scientific electronic library eLIBRARY, electronic library system of the publishing house "Lan", electronic library "Student Consultant", information system "SINGLE WINDOW" access to educational resources access to electronic order of books in the FEFU library.

IX.METHODICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE

Successful development of the discipline involves the active work of students in all classroom classes: lectures and practices, the implementation of certification activities. In the process of studying the discipline, the student needs to focus on the study of lecture material, preparation for practical classes, performance of control and

creative work.

Mastering the discipline "BioInformatics" involves a rating system for assessing students' knowledge and provides for the teacher's current control over students' attendance at lectures, preparation and implementation of all practical tasks, and the performance of all types of independent work.

Intermediate certification in the discipline "BioInformatics" is credit. The student is considered certified in the discipline, subject to the fulfillment of all types of current control and independent work provided for by the curriculum.

The scale for assessing the formation of educational results in the discipline is presented in the evaluation fund (FOS).

X. LOGISTICS OF DISCIPLINE

Training sessions on the discipline are held in rooms equipped with appropriate equipment and software.

The list of material and technical and software of the discipline is given in the table.

Logistics and Software Discipline

Name of equipped premises and premises for independent work	List of main equipment
Classroom for practical exercises Computer Class of the School of Biomedicine Aud. M723, 15 workplaces	Screen with electric drive 236 * 147 cm Trim Screen Line; Projector DLP, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; Subsystem of specialized fasteners of equipment CORSA-2007 Tuarex; Video switching subsystem: DVI DXP 44 DVI Pro Extron matrix switch; DVI twisted pair extender DVI 201 Tx/Rx Extron; Subsystem of audio switching and sound amplification; acoustic system for ceiling mounting SI 3CT LP Extron; digital audio processor DMP 44 LC Extron; extension for IPL T CR48 management controller; Wireless LANs for trainees are provided with a system based on 802.11a/b/g/n 2x2 MIMO(2SS) access points.
Reading rooms of the FEFU Scientific Library with open access to the fund (building A - level 10)	HP All-in-One 400 All-in-One 19,5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW,GigEth,Wi-Fi,WT,usb kbd/mse,Win7Pro (64-bit)+Win8.1Pro(64-bit),1-1-1 Wty Internet access speed 500 Mbps. Workplaces for people with disabilities are equipped with Braille displays and printers; equipped with: portable devices for reading flat-printed texts, scanning and reading machines video magnifier with the ability to regulate color spectra; magnifying electronic magnifiers and ultrasonic markers
Auditorium for independent work of students	Monoblock Lenovo C360G-i34164G500UDK 19.5" Intel Core i3-4160T 4GB DDR3-1600 SODIMM (1x4GB)500GB Windows Seven Enterprise - 17 pieces; Wired LAN - Cisco 800

Vladivostok, Russky, Ajax, 10, Building 25.1, Oud. M621 Area 44.5 m ²	series; wireless LANs for students are provided with a system based on access points 802.11a / b / g / n 2x2 MIMO (2SS).
Auditorium for lectures Vladivostok, Russky Island, Ajax village , 10, aud. M422	Multimedia audience: Monoblock Lenovo C360G-i34164G500UDK; Projection screen Projecta Elpro Electrol, 300x173 cm; Multimedia projector, Mitsubishi FD630U, 4000 ANSI Lumen, 1920x1080; Mortise interface with TLS TAM 201 Stan automatic cable retraction system; Avervision CP355AF Visualizer; Microphone cordless radio system UHF band Sennheiser EW 122 G3 consisting of a wireless microphone and receiver; LifeSizeExpress 220- Codeconly- Non-AES video conferencing codec; Network video camera Multipix MP-HD718; Two 47" LCD panels, Full HD, LG M4716CCBA; Subsystem of audio switching and sound amplification; centralized uninterrupted power supply

In order to provide special conditions for the education of disabled people and persons with disabilities at FEFU, all buildings are equipped with ramps, elevators, lifts, specialized places equipped with toilets, signs of information and navigation support.

VALUATION FUND FOS Passport

Calendar-thematic plan of the discipline "BioStatistics"

No p/n	Controlled modules /partitions / topics of discipline	Codes and stages of competence formation		Valuation tools - name	
				current control	Intermediate certification
1.	Topics "Basic concepts of data analysis. Basic information from probability theory", "Methods of describing one-dimensional quantities", "Estimating parameters"	OPK-6.1; OPK-6.2; OPK-6.3	Knows the basic sections of one-dimensional and applied multidimensional data analysis Able to collect, process and analyze data with the help of modern computer technologies Has the skills to process the results of microbiological studies, using multivariate analysis	UO-1, UO-4, PR-1	UO-1 (exam questions #1-9)
2.	Topics "Testing statistical hypotheses", "Correlation analysis", "Pair linear regression. Multiple regression"	OPK-6.1; OPK-6.2; OPK-6.3	Knows the possibilities of using programs for statistical processing of microbiological research results	UO-1, UO-4, PR-2	UO-1 (exam questions No. 10-17)

			<p>Able to use mathematical methods in their scientific and production-technological activities</p> <p>Has the skills to assess the reliability of the results obtained during microbiological studies</p>		
3.	<p>Topics "Discriminant analysis. Component and factor analysis", "Cluster analysis", "Multivariate scaling"</p>	<p>OPK-6.1; OPK-6.2; OPK-6.3</p>	<p>Knows the basic sections of one-dimensional and applied multidimensional data analysis</p> <p>Able to collect, process and analyze data with the help of modern computer technologies</p> <p>Has the skills to process the results of microbiological studies, using multivariate analysis</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1 (exam questions No18-25)</p>

For the discipline studied, the following assessment tools are used for current control:

UO-1– individual interview based on the results of presentations of scientific research results;

UO-4 – seminar-debate;

PR-2 – control works.

Oral questioning is the most common method of monitoring students' knowledge. During oral questioning, direct contact is established between the teacher and students, during which the teacher receives ample opportunities to assess the quantity and quality of students' assimilation of educational material. It is the most common and adequate form of monitoring students' knowledge, includes an interview (mainly in an exam and test), a colloquium, a report.

Criteria for evaluating an oral response:

"5 points" are given to the student if he gives the right answers to the questions under discussion, which are distinguished by the depth and completeness of the disclosure of the topic, is able to draw conclusions and generalizations, give reasoned answers that are logical and consistent.

"4 points" is given to the student if he gives the right answers to the questions under discussion, which differ in the depth and completeness of the disclosure of the

topic, is able to draw conclusions and generalizations, but one or two errors in the answers are allowed.

"3 points" are given to the student if he gives answers to the discussed questions that do not fully disclose it, there is no logical construction of the answer, makes several mistakes.

"2 points" are given to the student if he gives answers to the questions under discussion, which show that he does not own the material of the topic, cannot give reasoned answers, serious errors are made in the content of the answer.

A seminar-debate involves a collective discussion of a problem in order to establish ways to reliably solve it. A seminar-debate is held in the form of dialogic communication of the participants. It involves high mental activity of the participants, instills the ability to conduct polemics, discuss the material, defend views and beliefs, concisely and clearly express their thoughts. Often the seminar-debate is based on reports, reports on the topics of abstracts prepared by students in advance, in within the framework of each practical lesson. The teacher announces the question and offers to make a message for 5-7 minutes to one of the students - either at their request or at their choice. After the message, the teacher and students ask questions and make additions and comments.

The dispute can be caused by the teacher during the lesson or is planned in advance by him and is formed as a process of dialogic communication, during which the formation of practical experience in discussing theoretical and practical problems takes place. In the course of the debate, students form resourcefulness, speed of mental reaction. At such a seminar, students learn to accurately express their thoughts and argue their point of view, as well as to refute opponents.

On all issues, it is necessary to work out the relevant material from the textbook, lecture notes, additional literature and relevant laboratory work.

Answers to questions, speeches and activity of students in the classroom are evaluated by the current assessment.

Written works

Tests are a means of testing the skills to apply the acquired knowledge to solve problems of a certain type on a topic or section. A test work is an intermediate stage of monitoring students in order to identify the level of residual knowledge. For students, a test work is a good opportunity to test and consolidate their knowledge with practice.

The test contains a list of questions and various answers. Each question is evaluated at a certain number of points. The result of the test depends on the number of questions that were answered correctly.

As the final stage of the intermediate (semester) certification, credit is provided.

Criteria for scoring on the test

The "credit" grade is given when the student is fluent in the theoretical material of the discipline being studied, does not make mistakes when answering the questions asked, using visual tables, or admits some inaccuracies in the answers, but quickly corrects errors when asking him leading questions. In addition, the student is guided in the collection of histological preparations in their determination.

The grade "not counted" is given when the student does not own the materials of the discipline being studied, does not answer additional questions of the teacher and does not navigate the collection of histological preparations when determining them.

Evaluation materials

Questions for credit

1. Presentation of the initial data. Three types of data matrices.
2. Symptom scales.
3. Methods of describing one-dimensional quantities: limits, scope, average, variance, standard deviation, coefficient of variation.
4. Structural characteristics of the sample: median, quantile, quartile scope, fashion.
5. Data tabulation. Frequencies, in particular. Graphical representation of frequency tables. Polygon, histogram, cumulates.
6. Point assessment. Characteristics of assessments – efficiency, consistency, non-bias.
7. Interval evaluation. Accuracy. Reliability. Confidence interval. Trust boundaries. Confidence probability.
8. Confidence interval for the arithmetic mean.
9. Determination of the required sample size to estimate the arithmetic mean with a given accuracy.
10. Statistical hypotheses. Basic principles of testing statistical hypotheses.
11. Errors of the first and second kind. Power of test. Area of acceptance and critical area.
12. Criteria for testing hypotheses regarding average values.
13. Criteria for testing hypotheses regarding variances.
14. Pearson's chi-squared criterion. Purpose and application.
15. Pearson's paired correlation coefficient. Hypotheses related to correlation coefficient.
16. Paired linear regression. Bases of the model. Method of least Squares.
17. Estimation of linear regression coefficients.
18. Discriminant analysis. Basic concepts. Ways to evaluate accuracy

Discrimination.

19. Discrimination of three or more aggregates. (Canonical analysis).

20. Analysis of the main components.

21. Cluster analysis. Basic concepts. Types of Cluster Procedures

22. Measures of similarity, differences, distances. Similarity matrices.

23. Hierarchical and non-hierarchical cluster procedures. Ways

Measurements of proximity between clusters.

24. Factor analysis.

25. Multivariate scaling.

Test on the topics "Basic concepts of data analysis. Basic information from probability theory", "Methods of describing one-dimensional quantities", "Estimating parameters"

Variance is

1) the arithmetic mean of the squares of deviations of each value of the feature from the total mean.

2) it is the collection of necessary data on phenomena, processes of public life.

3) it is an integral element of the object, which is the carrier of the signs to be registered and the basis of the account.

The mean squared deviation is

1) a generalizing characteristic of the absolute size of the variation of the feature in the aggregate.

2) it is an integral element of the object, which is the carrier of the features to be registered and the basis of the account.

Dispersion properties (Specify all correct answers)

1) A decrease or increase in the weights (frequencies) of a variable feature by a certain number of times does not change the variance.

2) Decreasing or increasing each feature value by the same constant value A of variance does not change.

3) Reducing or increasing each value of the feature by a certain number of times k , respectively, reduces or increases the variance by k^2 times, and the mean quadratic deviation by a factor of one.

4) The variance of a feature with respect to an arbitrary quantity is always greater than the variance relative to the arithmetic mean by the square of the difference between the mean and the arbitrary

Magnitude: $S^2 \geq S_A^2 \geq (\bar{x} - A)^2$. If A is zero, then we come to the following equality:

$S^2 \geq \bar{x}^2 - \bar{x}^2$, i.e. the variance of the feature is equal to the difference between the average square of the values of the feature and the square of the mean.

5) All answers are correct

The oscillation coefficient is

1) reflects the relative oscillation of the extreme values of the feature around the mean.

2) is the most common measure of oscillation used to estimate the typicality of averages.

3) both answers are correct

Test paper on the topics "Testing statistical hypotheses" and "Correlation analysis":

1. Significance level. Power of test.
2. Criteria of difference, homogeneity, consent. Student's t-criterion.
3. Covariance, Pearson's paired correlation coefficient.
4. Hypotheses related to the correlation coefficient. Other communication indicators. Determination of the reliability of the connection.

Test work on the topics: "Pair linear regression. Multiple regression", "Discriminant analysis. Component and factor analysis", "Cluster analysis", "Multivariate scaling":

1. Paired linear regression problems. Dependent and independent variables.
2. Multiple and partial correlation.
3. Discriminant analysis. Component and factor analysis
4. Cluster analysis, the purpose of the method
5. Multidimensional scaling, methods of interpretation