




MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Autonomous Educational Institution of Higher Education

Far Eastern Federal University
(FEFU)

INSTITUTE OF LIFE SCIENCES AND BIOMEDICINE (SCHOOL)

AGREED


Head of Educational
Program

 V.V. Kumeiko

(Signed) (Surname)

CLAIM

Director of the Production Company
Structural subdivision

 V.V. Kumeiko

(Signed) (Surname)
April 12, 2023

WORK PROGRAM OF THE DISCIPLINE

Biostatistics

Area of study 06.03.01 Biology

Form of training: full-time

The work program is drawn up in accordance with the requirements of the Federal State Educational Standard in the field of training 06.03.01 Biology, approved by the order of the Ministry of Education and Science of the Russian Federation dated 07.08.2020 No. 9 20

The work program was discussed at the meeting of the Department of Medical Biology and Biotechnology, Minutes No. 3 dated April 12, 2023.

Director of the Department of Medical Biology and Biotechnology V.V. Kumeiko

Compiled by: Ph.D. Kumeiko V.V.

Vladivostok
2022

1. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*
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2. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*
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3. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*
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4. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*
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5. *The work program was revised at the meeting of the Department/Department/Division (implementing the discipline) and approved at the meeting of the Department/Department/Division (graduating structural unit), minutes of "*
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Abstract of the discipline

Biostatistics

The total labor intensity of the discipline is 3 credit units / 108 academic hours. It is a discipline of the compulsory part of the EP, studied in the 5th year and ends *with a test*. The curriculum provides for lectures in the amount of *18* hours , practical work of *36* hours, as well as hours for independent work of the student - *54* hours.

Language: Russian.

Objective: formation of competencies in theoretical knowledge, skills and abilities in the use of statistical methods in the processing of the results of medical and biological research, analysis of biological, environmental and other data obtained at different stages of scientific research necessary for subsequent professional activities

Tasks:

1. Familiarization of postgraduate students with the mathematical apparatus of statistics, necessary for solving theoretical and practical problems in the professional sphere.
2. Development of logical thinking.
3. Formulation of a scientific approach to solving various practical problems.
4. To develop the skills of mastering the basic methods of statistics of chemical methods.

For successful study of the discipline, students should have the following preliminary competencies:

- acquires new mathematical and natural science knowledge using modern educational and information technologies;
- searches and collects information using computer technologies;
- develops information products for processing and analyzing information, following the principles of critical assessment and verification of sources.

Competencies are obtained as a result of studying the disciplines of digital technologies in *professional activities*, *digital literacy*, *mathematics*, the student should be ready to study such disciplines as programming in biomedicine, bioengineering, molecular modeling of biostructures that form competencies:

- Ability to build mathematical models of physical processes of living organisms, set parameters and simulate physical problems in common

programming languages, including Python;

-solves scientific and practical problems in the fields of genetics, breeding, genomics, proteomics, in technologies for the production of pharmaceutical substances, medicines and nanotechnologies;

-Ability to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python;

-implements modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language.

To the competence of graduates and indicators of their achievement:

Code and name of professional competence (result of mastering)	Code and name of the competency indicator
PC-5 Able to build mathematical models of physical, chemical and biological processes to solve biomedical problems, possess basic programming skills, use modern methods and resources of bioinformatics and biostatistics	PC-5.1 Able to build mathematical models of physical processes of living organisms, set parameters and simulate physical problems in common programming languages, including Python
	PC-5.2 Able to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python
	PC-5.3 Able to build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python
	PC-5.4 Applies modern information technologies and software tools in solving professional problems
	PC-4.5 Applies modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
PC-5.1 Able to build mathematical models of physical processes of living organisms, set parameters and simulate physical problems in common programming languages, including Python	Knows Mathematical Models of Physical Processes of Living Organisms. Can build mathematical models of physical processes of living organisms, set parameters and conduct modeling. Owns skills in creating mathematical models of physical processes of living organisms, setting parameters and modeling physical problems in common programming languages, including Python

<p>PC-5.2 Able to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python</p>	<p>Knows Mathematical Models of Chemical Processes for Solving Biomedical Problems.</p> <p>Can build mathematical models of chemical processes to solve biomedical problems, set parameters and simulate chemical problems in common programming languages, including Python.</p> <p>Owns skills in building mathematical models of chemical processes to solve biomedical problems, setting parameters and modeling chemical problems in common programming languages, including Python.</p>
<p>PC-5.3 Able to build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python</p>	<p>Knows Mathematical Models of Biological Processes.</p> <p>Can build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python.</p> <p>Owns skills in building mathematical models of biological processes, setting parameters and modeling biological problems in common programming languages, including Python.</p>
<p>PC-5.4 Applies modern information technologies and software tools in solving professional problems</p>	<p>Knows modern information technologies and software tools for solving professional problems.</p> <p>Can apply modern information technologies and software tools in solving professional problems.</p> <p>Owns skills in the use of modern information technologies and software tools in solving professional problems.</p>
<p>PC-5.5 Applies modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language</p>	<p>Knows modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language.</p> <p>Can apply methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language.</p> <p>Owns skills in the use of modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language.</p>

To form the above competencies within the framework of the discipline

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

I. Goals and objectives of mastering the discipline

Objective: formation of competencies in theoretical knowledge, skills and abilities in the use of statistical methods in the processing of the results of medical and biological research, analysis of biological, environmental and other data obtained at different stages of scientific research necessary for subsequent professional activities

Tasks:

1. Familiarization of postgraduate students with the mathematical apparatus of statistics, necessary for solving theoretical and practical problems in the professional sphere.
2. Development of logical thinking.
3. Formulation of a scientific approach to solving various practical problems.
4. To develop the skills of mastering the basic methods of statistics of chemical methods.

To the competence of graduates and indicators of their achievement:

Code and name of professional competence (result of mastering)	Code and name of the competency indicator
PC-5 Able to build mathematical models of physical, chemical and biological processes to solve biomedical problems, possess basic programming skills, use modern methods and resources of bioinformatics and biostatistics	PC-5.1 Able to build mathematical models of physical processes of living organisms, set parameters and simulate physical problems in common programming languages, including Python
	PC-5.2 Able to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python
	PC-5.3 Able to build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python
	PC-5.4 Applies modern information technologies and software tools in solving professional problems
	PC-5.5 Applies modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language

Code and name of the competency indicator	Name of the assessment indicator (the result of learning in the discipline)
PC-5.1 Able to build mathematical models of	Knows Mathematical Models of Physical Processes of Living Organisms.

<p>physical processes of living organisms, set parameters and simulate physical problems in common programming languages, including Python</p>	<p>Can build mathematical models of physical processes of living organisms, set parameters and conduct modeling.</p> <p>Owns skills in creating mathematical models of physical processes of living organisms, setting parameters and modeling physical problems in common programming languages, including Python</p>
<p>PC-5.2 Able to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python</p>	<p>Knows Mathematical Models of Chemical Processes for Solving Biomedical Problems.</p> <p>Can build mathematical models of chemical processes to solve biomedical problems, set parameters and simulate chemical problems in common programming languages, including Python.</p> <p>Owns skills in building mathematical models of chemical processes to solve biomedical problems, setting parameters and modeling chemical problems in common programming languages, including Python.</p>
<p>PC-5.3 Able to build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python</p>	<p>Knows Mathematical Models of Biological Processes.</p> <p>Can build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python.</p> <p>Owns skills in building mathematical models of biological processes, setting parameters and modeling biological problems in common programming languages, including Python.</p>
<p>PC-5.4 Applies modern information technologies and software tools in solving professional problems</p>	<p>Knows modern information technologies and software tools for solving professional problems.</p> <p>Can apply modern information technologies and software tools in solving professional problems.</p> <p>Owns skills in the use of modern information technologies and software tools in solving professional problems.</p>
<p>PC-5.5 Applies modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language</p>	<p>Knows modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language.</p> <p>Can apply methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data,</p>

	including the use of the R language. Owns skills in the use of modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language.
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II. Labor intensity of the discipline and types of training in the discipline

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

The types of training and work of the student in the discipline are:

Designation	Types of Study Sessions and Student Work
Mild	Lecture
Lex electric.	Lectures in an interactive form
Ave	Practical exercises
Pp electric.	Hands-on training in an interactive form
WED:	Student's independent work during the period of theoretical training
	And other types of work

III. Structure of the discipline

The form of study is full-time.

№	Section Name Discipline	S e m e s t e r	Number of hours by type of training and work of the student						Forms of intermediate attestation
			Mild	Lab	Ave	OK	WE D	Contr ol	
1	Sampling Method and Theory of Parameter Estimation	5	6	-	12	-	18	-	Test Questions No. 1-13
2	Statistical Hypotheses and Their Testing	5	6	-	12	-	18	-	Questions for the test No 14-28
3	Statistical Methods of Experimental Data Processing	5	6	-	12	-	18	-	Questions for the test No 29-42
	Total:		18	-	36	-	54	-	Credit

IV. CONTENT OF THE THEORETICAL PART OF THE COURSE

Lectures (18 hours)

Section 1. Types of statistics

Topic 1. Data. Overview.

Topic: Measurement scales: quantitative (numerical continuous or discrete) and qualitative data (numerical continuous or discrete). Population and sampling. Basic ways to organize sampling. Representativeness of the sample. Dependent and independent samples.

Topic 2. Selective characteristics and their properties.

Topic: Descriptive Statistics Indicators: Position Indicators, Dispersion Indicators, Skewness Indicators, Graphical Ways of Presenting Results. Properties of descriptive statistics. Handling of missing values: delete, restore.

Topic 3. Check the distribution type.

Topic: Types of distribution and their parameters. Criteria for testing the distribution law hypothesis: Shapiro-Wilk, Kolmogorov-Smirnova, etc. Level of statistical significance.

Section 2. Addition research.

Topic 4. Parametric methods for comparing samples.

Topic: Kolmogorov-Smirnov test, Pearson's chi-square agreement test, Student's t-test, analysis of variance.

Topic 5. Nonparametric methods of comparison for dependent and independent samples.

Topic content: Mann-Whitney U-test, Wilcoxon test, Kruskal-Wallis test, Friedman test, Cochran test.

Topic 6. Methods for comparing nominal data.

Topic: χ^2 test (chi-squared) to test the statistical hypothesis that there is a relationship between two qualitative traits; Fisher's exact test Cochran-Mantel-Hensel test for the analysis of paired or stratified categorical features.

Topic 7. Correlation analysis.

Topic content: Pearson correlation coefficient, Spearman and Kendall rank correlation coefficients. Partial correlation. Multiple correlation.

Topic 8. Regression analysis.

Topic: Simple and multiple linear regression. Logistic regression.

Section 3. Multivariate methods of data analysis.

Topic 9. Multivariate methods.

Topic content: Principal Component Analysis, Factor Analysis, Cluster Analysis, Discriminant Analysis, and Canonical Analysis.

V. THE CONTENT OF THE PRACTICAL PART OF THE COURSE AND INDEPENDENT WORK

Practical exercises (36 hours)

Topic 1. Sampling Method and Theory of Parameter Estimation

1. Variation series.
2. Point estimates.
3. Interval estimates.
4. Assessment of the degree of variability of the trait.
5. Accuracy of assessment.
6. Method of moments.
7. The method of greatest plausibility.
8. Types of distributions.
9. Asymmetry and kurtosis.
10. Sampling method.

Topic 2. Statistical Hypotheses and Their Testing

1. Testing hypotheses about the equality of the middle two populations.
2. Testing hypotheses about the equality of the average two or more populations.
3. Testing hypotheses about the equality of trait fractions in two populations.
4. Testing hypotheses about the equality of trait fractions in two or more populations.
5. Testing hypotheses about the equality of variances of two or more populations.
6. Testing hypotheses about numerical parameter values.
7. Testing hypotheses about the normal distribution of the population.
Pearson's criterion for consent.
8. Determination of the minimum sample size.

Topic 3. Statistical Methods of Experimental Data Processing

1. Types of connections. Correlation coefficient.
2. Correlation coefficient for small and large samples.
3. Correlation Relationship
4. Linear correlation. Regression equation.
5. Regression coefficient.
6. Regression line.
7. Least squares method.
8. Processing of experimental data.
9. Application of statistical methods.

10. Fundamentals of disperse analysis.
11. Practical use of statistical methods.

Self-study (54 hours)

Schedule of independent work in the discipline

№ p/n	Due Date/Deadlines	Type of independent work	Approximate time limits for execution	Form of control
1	During the semester	Preparation for practical classes, study of literature, notes	14 hours	WP-6 Practical Work UO-1 - (interview)
2	Week 14-15 of the semester	Self-Study Report	10 hours	UO-3-(report, presentation)
3	During the semester	Preparing for testing	10 hours	PR-1 (tests)
4	Week 15-18 of the semester	Preparation for the test	20hrs	Credit
Total:			54 hours	

VI. EDUCATIONAL AND METHODOLOGICAL SUPPORT OF STUDENTS' INDEPENDENT WORK

Educational and methodological support of independent work of students in the discipline "Biostatistics" includes:

- characteristics of tasks for independent work of students and methodological recommendations for their implementation;
- requirements for the presentation and execution of the results of independent work;
- criteria for evaluating the performance of independent work.

VII. MONITORING THE ACHIEVEMENT OF THE COURSE OBJECTIVES

Item No.	Supervised sections/topics of the discipline	Code and name of the indicator of achievement	Learning Outcomes	Evaluation Tools	
				Current control	Intermediate Certification
1	Types of statistics	PC-5.1 Able to build mathematical models of physical processes of living organisms, set parameters and simulate physical problems in common programming languages, including Python	<p>Knows Mathematical Models of Physical Processes of Living Organisms.</p> <p>Can build mathematical models of physical processes of living organisms, set parameters and conduct modeling.</p> <p>Owns skills in creating mathematical models of physical processes of living organisms, setting parameters and modeling physical problems in common programming languages, including Python</p>	Oral Questioning	Test Questions No. 1-9
		PC-5.2 Able to build mathematical models of chemical processes to solve biomedical problems, set parameters and model chemical problems in common programming languages, including Python	<p>Knows Mathematical Models of Chemical Processes for Solving Biomedical Problems.</p> <p>Can build mathematical models of chemical processes to solve biomedical problems, set parameters and simulate chemical problems in common programming languages, including Python.</p> <p>Owns skills in building mathematical models of chemical processes to solve biomedical problems, setting</p>		

			parameters and modeling chemical problems in common programming languages, including Python.		
2	Dependency Study	PC-5.3 Able to build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python	<p>Knows Mathematical Models of Biological Processes.</p> <p>Can build mathematical models of biological processes, set parameters and simulate biological problems in common programming languages, including Python.</p> <p>Owns skills in building mathematical models of biological processes, setting parameters and modeling biological problems in common programming languages, including Python.</p>	Test	Questions for the test No 10-19
3	Multivariate Data Analysis Methods	PC-5.4 Applies modern information technologies and software tools in solving professional problems	<p>Knows modern information technologies and software tools for solving professional problems.</p> <p>Can apply modern information technologies and software tools in solving professional problems.</p> <p>Owns skills in the use of modern information technologies and software tools in solving professional problems.</p>	Oral Questioning	Questions for the test No 20-30
		PC-5.5 Applies modern methods of processing and analysis of scientific and technical information, statistical analysis	<p>Knows modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language.</p>	Test	Questions for the test No 31-42

		of biomedical data, including the use of the R language	Can apply methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language. Owns skills in the use of modern methods of processing and analysis of scientific and technical information, statistical analysis of biomedical data, including the use of the R language.		
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VIII. LIST OF REFERENCES AND INFORMATIONAL AND METHODOLOGICAL SUPPORT OF THE DISCIPLINE

Reference citations

1. Nivorozhkina L.I., Arzhenovsky S.V. *Mnogomernye statistical'nye metody v ekonomiki: uchebnik* [Multidimensional statistical methods in economics: textbook]. — Moscow : RIOR : INFRA-M, 2023. — 203 p. — (Higher education). — DOI: <https://doi.org/10.12737/21773>. - ISBN 978-5-369-01621-3. - Text : electronic. - URL: <https://znanium.com/catalog/product/1048326>
2. Dubina I. N. *Mathematiko-statisticheskie metody i instrumenty v empirichicheskikh sotsial'no-ekonomicheskikh issledovaniyah: uchebnoe posobie* [Mathematical and statistical methods and tools in empirical socio-economic research: textbook]. — Saratov: Vuzovskoe obrazovaniye, 2018. — 415 c. — ISBN 978-5-4487-0264-8. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/76234.html>
3. Kulaichev, A. P. *Metody i sredstvo kompleksnogo statisticheskogo analiza dannykh* [Methods and means of complex statistical analysis of data]. Textbook / A.P. Kulaichev. — 5th ed., rev. and add. — Moscow: INFRA-M, 2018. — 484 p. — (Higher education: Bachelor's degree). — www.dx.doi.org/10.12737/25093. - ISBN 978-5-16-012834-4. - Text : electronic. - URL: <https://znanium.com/catalog/product/975598>
4. Dubrovskiy S. A., Dudina V. A., Sadyeva Y. V. *Metody obrabotki i analiza eksperimental'nykh dannykh* [Methods of processing and analysis of experimental data: textbook]. - Lipetsk: Lipetsk State Technical University, EBS ASV, 2015. — 62 c. — ISBN 978-5-88247-719-5. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/55640.html>
5. *Theory of probability: a course of lectures* / L. V. Kiryanova, V. P. Ivanov, A. Yu. - Moscow: Moscow State University of Civil Engineering, EBS ASV, 2012. — 88 c. — ISBN 978-5-7264-0630-5. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/20040.html>
6. Shilova Z. V., Shilov O. I. *Teoriya probablnosti i matematicheskaya statistiki* [Probability Theory and Mathematical Statistics: Textbook]. - Saratov : IPR Books, 2015. — 158 c. — ISBN 978-5-906-17262-4. — Text : electronic // Digital educational resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/33863.html>
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8. Moyzes B. B., Plotnikova I. V., Redko L. A. Statistical Methods of Quality Control and Processing of Experimental Data: Textbook. — Tomsk: Tomsk Polytechnic University, 2016. — 119 p. — ISBN 978-5-4387-0700-4. — Text: electronic // Digital Educational Resource IPR SMART : [site]. — URL: <https://www.iprbookshop.ru/83986.html>

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Further reading

1. Lisitsyn Y.P., Ulumbekova G.E. Public Health and Health Care: Textbook. Moscow: GEOTAR – Media, 2016. 542 p. (in Russian).

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2. Medik, V. A. Public Health and Health Care [Elektronnyi resurs]: uchebnik / Medik V. A., Yuryev V. K. - 2nd ed., ispr. i dop. - M. : GEOTAR-Media, 2016. – 608 p. (in Russian).

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1. <http://elibrary.ru/> - Scientific Electronic Library
2. <http://molbiol.ru/> - Molecular Biology Information Resource
3. <http://macroevolution.narod.ru/> is an electronic resource on evolutionary biology.
4. <http://science.km.ru/> - electronic resource on different sections of biology
5. <http://elementy.ru/> is an informational and educational resource dedicated to natural sciences.
6. <http://www.iprbookshop.ru/> is the IPRbooks electronic library system.
7. <http://znanium.com/> - EBS "Znanium".
8. <https://nplus1.ru/> - N+1, a popular science online publication about science, engineering and technology
9. <http://antropogenez.ru/> is a popular science information resource about human evolution
10. <http://web.a.ebscohost.com/ehost/search/basic?sid=851485f8-6200-4b3e-aaab-df4ba7be3576@sessionmgr4008&vid=1&tid=2003EB> is a collection of books on various sections from the EBSCOhost database.
11. <http://rosalind.info/problems/locations/>- resource for self-study of bioinformatics Rosalind.
12. <http://www.ncbi.nlm.nih.gov/> website of the- National Center for Biotechnology Information (NCBI).
13. <http://www.mendeley.com/>- *Mendeley*: Free reference manager and PDF organizer; Librarian Program.
14. [http:// www.ebi.ac.uk](http://www.ebi.ac.uk/)- website of the European Bioinformatics Institute
15. [http:// www.scopus.com](http://www.scopus.com) – Scopus bibliographic database and citation index
16. <http://thomsonreuters.com/thomson-reuters-web-of-science/> Web of Science bibliographic database and citation index

List of information technologies and software

1. Microsoft Office Professional Plus 2013 is an office suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.);
2. 7Zip 16.04 - free file archiver with high data compression ratio;
3. Adobe Acrobat XI Pro is a software package for creating and viewing electronic publications in PDF format;
4. AutoCAD Electrical 2015 - three-dimensional computer-aided design and drafting system;

5. ESET Endpoint Security 5 is a comprehensive protection solution for Windows-based workstations. Virtualization support + new technologies;
6. WinDjView 2.0.2 is a program for recognizing and viewing files with the same DJV and DjVu formats; SolidWorks 2016 is a CAD software package for automating the work of an industrial enterprise at the stages of design and technological preparation of production
7. Compass-3D LT V12 - Three-Dimensional Simulation System
8. Notepad++ 6.68 – Text Editor

IX. METHODOLOGICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE

Lecture

The lecture is the- main active form of classroom classes, the explanation of the fundamental and most difficult theoretical sections of molecular biology and the theory of genetic engineering, which involves intensive mental activity of the student and is especially important for mastering the subject. A lecture should always be cognitive, developmental, educational and organizing. Lecture notes help to assimilate the theoretical material of the discipline. When listening to a lecture, you need to take notes main information, preferably with your own wording, which allows you to better remember the material. An outline is useful when it is written by the student independently.

In the lecture, the teacher gives only a small part of the material on certain topics that are presented in the textbooks. In addition, the instructor informs students about what additional information can be obtained on the topics discussed, and from what sources. Therefore, when working with lecture notes, it is always necessary to use the main textbooks, additional literature and other recommended sources on this discipline. It is this serious work of the student with the lecture material that allows him to achieve success in mastering new knowledge.

To present a lecture course on the discipline "Biostatistics", the following are used as forms of active learning: lecture-conversation, lecture-visualization, which are built on the basis of knowledge received by students in the framework of subjects preceding the course. Electronic presentations, tables, video files, and blackboard diagrams are used to illustrate verbal information. In the course of the lecture material, problematic questions or questions with elements of discussion are posed.

Lecture – visualization

The lecture is accompanied by the demonstration of tables, electronic presentations, video files - such a combination of ways of presenting information significantly simplifies its mastering by students. Verbal presentation of the material should be accompanied and combined with the visual form. The information

presented in the form of diagrams on the board, tables, slides allows you to form problematic questions, and contribute to the development of professional thinking of future specialists.

Lecture-conversation

Lecture-conversation, "dialogue with the audience", is the most common form of active learning and allows students to be involved in the educational process, since there is direct contact between the teacher and the audience. Such contact is achieved during the lecture, when students are asked questions of a problematic or informational nature, or when they are invited to ask the teacher questions themselves. Questions are offered to the entire audience, and any of the students can offer their own answer; another can complement it. In the course of the educational process, this allows you to identify the most active students and activate those who do not participate in the work. This form of lecture allows you to involve students in the work process, attract their attention, stimulate thinking, gain collective experience, and learn how to form questions. The advantage of a lecture-conversation is that it allows you to draw students' attention to the most important issues of the topic, determine the content and pace of the presentation of educational material, as well as determine the topics that are most interesting to students, in order to possibly adjust the form of the material taught.

Colloquia

Colloquium is a collective form of consideration and consolidation of educational material. Colloquia is one of the types of practical classes designed for in-depth study of the discipline, held in an interactive mode. In the classes on the topic of the colloquium, questions are analyzed, and then, together with the teacher, they are discussed, which is aimed at consolidating the material, forming polemic skills, developing independence and critical thinking, the ability of students to navigate in large information flows, to develop and defend their own position on problematic issues of the academic discipline.

As methods of interactive learning at colloquiums, the following are used: an extended conversation, a dispute, a press conference.

An extended conversation involves the preparation of students on each issue of the lesson plan with a single list of recommended mandatory and additional literature. Reports are prepared by students on a pre-proposed topic.

A dispute in a group has a number of advantages. A dispute can be caused by the teacher during the lesson or planned by him in advance.

Press conference. The teacher assigns several students to prepare short (thesis) reports. After the presentations, students ask questions, which are answered by the speakers and other members of the expert group. Based on the questions and answers, a creative discussion unfolds together with the teacher.

Case study method.The case-study method is a method of active problem-situational analysis based on learning by solving specific problems (case solving). The method of specific situations (case-study method) refers to non-game imitation active teaching methods and is considered as a tool that allows you to apply theoretical knowledge to solving practical problems. At the end of the lesson, the teacher tells a series of situations and offers to find solutions for those problems that are voiced in them. At the same time, the problem itself does not have unambiguous solutions. Students must analyze the situation, understand the essence of the problems, propose possible solutions and choose the best one. Thanks to the knowledge gained at the lecture, it is easy for the student to correlate the theoretical knowledge received with a real practical situation. As an interactive teaching method, it gains a positive attitude from students, who see it as an opportunity to take the initiative, feel independent in mastering theoretical provisions and mastering practical skills. No less important is the fact that the analysis of situations has a strong impact on the professionalization of students, contributes to their maturation, forms interest and positive motivation for learning. The method is aimed not so much at mastering specific knowledge or skills, as at developing the general intellectual and communicative potential of the student and the teacher.

It is a learning method designed to improve skills and gain experience in the following areas:

- identifying, selecting and solving problems;
- working with information – comprehending the meaning of the details described in the situation;
- analysis and synthesis of information and arguments;
- working with assumptions and conclusions;
- evaluation of alternatives;
- decision-making;
- Listening to and understanding other people is a group work skill. The main function of the case method is to teach students to solve complex unstructured problems that cannot be solved in an analytical way. The case activates students, develops analytical and communicative skills, leaving students face to face with real situations.

The case study is designed to increase the effectiveness of educational activities: as an illustration for solving a certain problem, explaining a particular phenomenon, studying the features of its manifestations in real life, developing competence aimed at solving various life and work situations (the use of the case involves individual and group work of students).

Brainstorming is a widely used way of generating new ideas to solve scientific and practical problems. Its goal is to organize collective thinking to find non-traditional ways to solve problems.

The use of the brainstorming method in the educational process allows you to solve the following tasks:

- creative assimilation of educational material by students;
- connection of theoretical knowledge with practice;
- • activation of educational and cognitive activities of students;
- formation of the ability to concentrate attention and mental efforts on the solution of an urgent task;
- formation of the experience of collective thinking activity.

The problem formulated in the brainstorming class should have theoretical or practical relevance and arouse the active interest of students. A common requirement that must be taken into account when choosing a problem for brainstorming is the possibility of many ambiguous solutions to the problem, which is put forward to students as a learning task.

Quizzes & Testing

Current control of material assimilation is assessed by oral answers, tests, as well as paper testing.

Assessments of laboratories, colloquiums, tests and testing mainly form the grade for this discipline.

LOGISTICAL SUPPORT FOR DISCIPLINE

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

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

Logistical and software of the discipline

Name of special rooms and rooms for independent work	Equipment special rooms and rooms for self-study	List of licensed software. Details of the supporting document
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 605	Multimedia audience: Electric Screen 236*147cm Trim Screen Line; DLP Projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; CORSA-2007 Tuarex Specialized Equipment	-

	<p>Fastening Subsystem; Video Switching Subsystem: Extron DXP 44 DVI Pro DVI Matrix Switcher; Extron DVI 201 Tx/Rx twisted-pair DVI extender Audio switching and sound amplification subsystem; Extron SI 3CT LP ceiling mount speaker system; Extron DMP 44 LC Digital Audio Processor; Extension for IPL T CR48 control controller; Wireless LAN for students is provided by a system based on 802.11a/b/g/n 2x 2 MIMO (2SS) access points.</p> <p>Моноблок HP ProOne 400 All-in-One 19.5 (1600x900), Core i3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi-Fi, BT, usb kbd/mse, Win7Pro (64-bit)+Win8.1Pro(64-bit), 1-1-1 Wty</p>	
<p>690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 422</p>	<p>Multimedia audience:</p> <p>HP ProOne 400 G1 AiO 19.5" Intel Core i3-4130T 4GB DDR3-1600 SODIMM (1x4GB)500GB All-in-One PC; 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; Avervision CP355AF visualizer; Sennheiser EW 122 G3 UHF lavalier microphone radio system consisting of a wireless microphone and receiver; LifeSizeExpress 220- Codeconly- Non-AES video conferencing codec; Multipix MP-HD718 Network Video Camera; Two 47" LCD panels, Full HD, LG M4716CCBA;</p>	

	Audio switching and sound amplification subsystem; Centralized, uninterrupted power supply	
690922, Primorsky Krai, Vladivostok, Russky Island, Saperny Peninsula, Ajax village, 10, aud. M 627	Light microscope Carl Zeiss GmbH Primo Star 3144014501 (13 pcs.); Light microscope with digital camera Altami BIO8 (2 pcs.).	-
Computer class of the School of Biomedicine aud. M723, 15 workplaces	Electric Screen 236*147cm Trim Screen Line; DLP projector, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; CORSA-2007 Tuarex Specialized Equipment Fastening Subsystem; Video Switching Subsystem: Extron DXP 44 DVI Pro DVI Matrix Switcher; Extron DVI 201 Tx/Rx twisted-pair DVI extender Audio switching and sound amplification subsystem; Extron SI 3CT LP Ceiling Mount Speaker System Extron DMP 44 LC Digital Audio Processor; extension for IPL T CR48 control controller; Wireless LAN for students is provided by a system based on 802.11a/b/g/n 2x2 MIMO(2SS) access points. Monoblock HP RgoOpe 400 All-in-One 19.5 (1600x900), Core and3-4150T, 4GB DDR3-1600 (1x4GB), 1TB HDD 7200 SATA, DVD+/-RW, GigEth, Wi- Fi, VT, usb kbd/mse, Win7Pro (64-bit)+Win8.1Pro(64-bit), 1-1-1 Wty	-