



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

**"Far Eastern Federal University"**

(FEFU)

INSTITUTE (SCHOOL) OF LIFE SCIENCES AND BIOMEDICINE (SCHOOL)

AGREED  
Head of OP

(signature)

December 21, 2021

Yu.S. Khotimchenko  
(FULL NAME)



APPROVE

Director of the Department of Pharmacy and Pharmacology

(signature) (I.O. Surname)

December 21, 2021

E.V. Khozhaenko

### WORKING PROGRAM OF THE DISCIPLINE

biostatistics

Area of study 32.04.01 Public health

Master's program "Leadership and governance in public health (program in English for foreign citizens)"

Form of training: full-time

Course 1 semester 1

Lectures - an hour.

Practical classes - 36 hours.

Seminars - not provided

Including using MAO - lek. -hour/pr.10 hour.

Total classroom hours - 36 hours.

Including using MAO 10 hours.

Independent work - 72 hours.

of which 36 hours. to prepare for the exam

Abstract works are provided

Coursework not included

Exam 1 semester

The work program was compiled in accordance with the requirements of the Federal State Educational Standard in the field of study 32.04.01 Public Health, approved by order of the Ministry of Education and Science of Russia dated 31.05.2017 No. 485.

The work program was discussed at the meeting Department of Pharmacy and Pharmacology, Protocol No. 4 dated December 21, 2021

Director of the Department: Ph.D., Associate Professor, E.V. Khozhaenko

Reverse side of the title page of the RPD

1. The work program was revised at a meeting of the Department / department / department (implementing the discipline) and approved at a meeting of the Department / department / department (issuing structural unit), protocol dated “ \_\_\_\_ ” \_\_\_\_\_ 2021 No. \_\_\_\_\_
2. The work program was revised at a meeting of the Department / department / department (implementing the discipline) and approved at a meeting of the Department / department / department (issuing structural unit), protocol dated “ \_\_\_\_ ” \_\_\_\_\_ 2021 No. \_\_\_\_\_
3. The work program was revised at a meeting of the Department / department / department (implementing the discipline) and approved at a meeting of the Department / department / department (issuing structural unit), protocol dated “ \_\_\_\_ ” \_\_\_\_\_ 2021 No. \_\_\_\_\_
4. The work program was revised at a meeting of the Department / department / department (implementing the discipline) and approved at a meeting of the Department / department / department (issuing structural unit), protocol dated “ \_\_\_\_ ” \_\_\_\_\_ 2021 No. \_\_\_\_\_
5. The work program was revised at a meeting of the Department / department / department (implementing the discipline) and approved at a meeting of the Department / department / department (issuing structural unit), protocol dated “ \_\_\_\_ ” \_\_\_\_\_ 2021 No. \_\_\_\_\_

## 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:

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

The work program of the academic discipline B1.O.05 "Biostatistics" was compiled for students in the educational program of the master's program 32.04.01 Public health "Leadership and governance in public health (a program in English for foreign citizens)" in accordance with the requirements of the Federal State Educational Standard for direction of preparation 32.04.01 Public health, approved by order of the Ministry of Education and Science of Russia dated 31.05.2017 No. 485.

Discipline B1.O.05 "Biostatistics" is included in the mandatory part of the master's program 32.04.01 Public Health "Leadership and governance in public health (program in English for foreign citizens)".

The total labor intensity of mastering the discipline is 3 credit units (108 hours). The curriculum provides for practical classes (36 hours) and independent work (72 hours, of which 36 hours for preparing for the exam). Assessment of learning outcomes: Exam.

Successful assimilation 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 discipline "Biostatistics", students should have the following preliminary competencies:

- the ability to take the initiative and make responsible decisions, being aware of the responsibility for the results of their professional activities;
- the ability to creatively perceive and use the achievements of science and technology in the professional field 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, tolerantly perceiving social, ethnic, confessional 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 using information and communication technologies and taking into account the basic requirements of information security;

Universal competencies graduates and indicators of their achievement:

Name of the category (group) of universal competencies	Code and name of universal competence (result of development)	Code and name of the indicator of achievement of competence
	UK-6 Is able to determine and implement the priorities of their own activities and ways to improve it based on self-assessment	UK-6.1 Knows the basics of scientific research with an explanation of the technology of their own activities
		UK-6.2 Knows how to justify the priorities of their own activities
		UK-6.3 Owns ways to formulate goals, objectives of their own activities and ways to improve it based on self-assessment

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
UK-6.1 Knows the basics of scientific research with an explanation of the technology of their own activities	Knows the basics of scientific research Able to explain the technology of their own activities Owns the basic methods of scientific research
UK-6.2 Knows how to justify the priorities of their own activities	Knows priority research in his professional field Knows how to justify the priorities of their own activities
UK-6.3 Owns ways to formulate goals, objectives of their own activities and ways to improve it based on self-assessment	Knows the main tasks of his professional activity Knows how to formulate goals, set goals, determine the path to achieve the goal Has knowledge of scientific areas in health care and how to manage them based on self-assessment

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 (result of development)	Code and name of the indicator of achievement of competence
	OPK-2 The ability to use information technology in professional activities, to comply with the basic requirements of information security	GPC-2.1 Knows and is able to explain the use of information technology
		GPC-2.2 Knows how to justify the criteria for evaluating IT technologies in practice
		GPC-2.3 Has the ability to formulate and explain the need for the use of information technology in the work of medical organizations in compliance with the basic requirements of information security
	OPK-4 The ability to apply modern methods	GPC-4.1 Knows the basics of computer technology in the collection, storage,

	of collecting and processing information, to conduct statistical analysis and interpret the results, to study, analyze, evaluate trends, to predict the development of events in the state of population health	analysis and transmission of information on predicting the development of events in the state of population health
		GPC-4.2 Able to apply computer technologies in the collection, storage, analysis and transmission of information on predicting the development of events in the state of population health
		GPC-4.3 Has the skills to prepare organizational and management documentation in a medical organization for predicting the development of events in the state of population health of the population; possesses methods of multivariate statistics and methods of biological information processing for solving professional problems

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
GPC-2.1 Knows and is able to explain the use of information technology	Knows modern information technologies and software used in professional activities Able to apply modern information technologies and software in solving professional problems. Possesses the skills of collecting, processing, evaluating the reliability of the results and providing the information received through modern information technologies and software
GPC-2.2 Knows how to justify the criteria for evaluating IT technologies in practice	Knows the criteria for evaluating IT technologies in his practice Knows how to substantiate the criteria for evaluating IT technologies in practice Possesses the skill of substantiating the criteria for evaluating IT technologies in practice
GPC-2.3 Has the ability to formulate and explain the need for the use of information technology in the work of medical organizations in compliance with the basic requirements of information security	Knows the principles of using information technology Able to apply knowledge on the use of information technology in practice in compliance with the basic requirements of information security Has skills in working with information technologies in healthcare in compliance with the basic requirements of information security
GPC-4.1 Knows the basics of computer technology in the collection, storage, analysis and transmission of information on predicting the development of events in the state of population health	Knows the basics of computer technology in the collection, storage, analysis and transmission of information Able to predict the development of events and the state of population health of the population Possesses the skill of collecting, storing, analyzing, transmitting information on all issues of his professional activity
GPC-4.2 Able to apply computer technologies in the collection,	Knows the steps of statistical analysis Able to apply computer technologies in the collection,



1	Topic 1. Basic methods of descriptive statistics. Basic concepts and terms of medical and biological statistics				4				
2	Topic 2. Features of conducting a sanitary-statistical study				4				
3	Topic 3. Biological statistics. Methods for calculating generalizing coefficients characterizing various aspects of the studied characteristics				4				
4	Topic 4. Assessment of the reliability of the results of the study. Application of parametric methods. Non-parametric methods for assessing the reliability of results, their significance and practical application				4				
5	Topic 5. Fundamentals of multivariate statistical analysis				4				
6	Topic 6. Methods for assessing the interaction of factors. Correlation analysis. Regression, calculation technique and use in biology				4				
7	Topic 7. Direct standardization method				4				
8	Topic 8. Methods for analyzing the dynamics of the phenomenon. Graphic image in statistics, types of graphic images, their use for the analysis of phenomena				4				
9	Topic 9. Automated a priori analysis of the statistical population in MS Excel				4				
Total:		1	-	-	36	-	36	36	Exam

#### IV. CONTENT OF THE THEORETICAL PARTS OF THE COURSE

Lectures are not included in the curriculum.

## **V. STRUCTURE AND CONTENT OF THE PRACTICAL PART OF THE COURSE AND INDEPENDENT WORK**

Practical lessons (36 hours)

Topic 1. Basic methods of descriptive statistics. Basic concepts and terms of medical and biological statistics

Topic 2. Features of conducting a sanitary-statistical study

Topic 3. Biological statistics. Methods for calculating generalizing coefficients characterizing various aspects of the studied characteristics

Topic 4. Assessment of the reliability of the results of the study. Application of parametric methods. Non-parametric methods for assessing the reliability of results, their significance and practical application

Topic 5. Fundamentals of multivariate statistical analysis

Topic 6. Methods for assessing the interaction of factors. Correlation analysis. Regression, calculation technique and use in biology

Topic 7. Direct standardization method

Topic 8. Methods for analyzing the dynamics of the phenomenon. Graphic image in statistics, types of graphic images, their use for the analysis of phenomena

Topic 9. Automated a priori analysis of the statistical population in MS Excel

### **Schedule for the implementation of independent work on the discipline "Biostatistics"**

<b>No. p/n</b>	<b>Date/Due dates</b>	<b>Type of independent work</b>	<b>Approximate lead times</b>	<b>form of control</b>
1	1 – 3 weeks	Work with literature and lecture notes. Preparation for the seminar and laboratory work on topic 1	6 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	6 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 on topic 3	6 hours	Work at the seminar, oral answer, test.
4	10 -12 weeks	Work with literature and lecture notes. Preparation for the seminar and laboratory work on topic 4	6 hours	Work at the seminar, laboratory work, oral answer.
5	13 - 15 weeks	Work with literature and lecture	6 hours	Work at the



		notes. Preparation for the seminar and test work on topic 5		seminar, oral answer, test.
6	16 - 18 weeks	Work with literature and lecture notes. Preparation for the seminar and testing on topic 6	6 hours	Work at the seminar, test, oral answer.
		Exam preparation	36 hours	
		Total	72 hours	

## **V. EDUCATIONAL AND METHODOLOGICAL SUPPORT FOR STUDENTS' INDEPENDENT WORK**

Independent work is defined as an individual or collective learning activity carried out without the direct guidance of a teacher, but according to his instructions and under his control. Independent work is a cognitive learning activity, when the sequence of a 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 at the 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 field of study, experience in creative and research activities.

Forms of independent work of students:

- work with basic and additional literature, Internet resources;
- self-acquaintance with the lecture material presented on electronic media in the library of an educational institution;
- preparation of abstract reviews of sources of periodicals, reference notes, predetermined by the teacher;
- search for information on the topic with its subsequent presentation to the audience in the form of a report, presentations;
- preparation for the implementation of classroom control work;
- performance of home control works;
- performance of test tasks, problem solving;
- drawing up crossword puzzles, schemes;
- preparation of reports for presentation at a seminar, conference;
- filling out a workbook;
- essay writing, term paper;
- preparation for business and role-playing games;
- compiling a resume;
- preparation for tests and exams;
- other activities organized and carried out by the educational institution

and student self-government bodies.

## V. ACHIEVEMENT CONTROL COURSE OBJECTIVES

The following evaluation tools can be used for control:

UO-1 - individual interview, mainly in the exam;

UO-4 - seminar-debate;

PR-1 - test;

PR-2- control work

### Calendar-thematic plan of the discipline "Biostatistics"

No. p / p	controlled modules / sections / discipline topics	Codes and stages of formation of competencies		Appraisal tools - name	
				current control	intermediate attestation
1.	Topic 1. Basic methods of descriptive statistics. Basic concepts and terms of medical and biological statistics	UK-6.1; UK-6.2; UK-6.3;	Knows the basic methods of scientific research in health care  Knows how to use knowledge about scientific research in medicine based on the priorities of their own activities  Has knowledge of scientific areas in health care and how to manage them based on self-assessment	UO-1, UO-4, PR-1	UO-1
2.	Topic 2. Features of conducting a sanitary-statistical study	UK-6.1; UK-6.2; UK-6.3;	Knows the basic methods of scientific research in health care  Knows how to use knowledge about scientific research in medicine based on the priorities of their own activities  Has knowledge of scientific areas in health care and how to manage them based on self-assessment	UO-1, UO-4, PR-2	UO-1

3.	Topic 3. Biological statistics. Methods for calculating generalizing coefficients characterizing various aspects of the studied characteristics	GPC-2.1; GPC-2.2; GPC-2.3;	<p>Knows the principles of using information technology</p> <p>Able to apply knowledge on the use of information technology in practice in compliance with the basic requirements of information security</p> <p>Has skills in working with information technologies in healthcare in compliance with the basic requirements of information security</p>	UO-1, UO-4, PR-2	UO-1
	Topic 4. Assessment of the reliability of the results of the study. Application of parametric methods. Non-parametric methods for assessing the reliability of results, their significance and practical application	GPC-2.1; GPC-2.2; GPC-2.3;	<p>Knows the principles of using information technology</p> <p>Able to apply knowledge on the use of information technology in practice in compliance with the basic requirements of information security</p> <p>Has skills in working with information technologies in healthcare in compliance with the basic requirements of information security</p>	UO-1, UO-4, PR-2	UO-1
	Topic 5. Fundamentals of multivariate statistical analysis	GPC-2.1; GPC-2.2; GPC-2.3;	<p>Knows the principles of using information technology</p> <p>Able to apply knowledge on the use of information technology in practice in compliance with the basic requirements of information security</p> <p>Has skills in working with information technologies in healthcare in compliance with the basic requirements of information security</p>	UO-1, UO-4, PR-2	UO-1

	<p>Topic 6. Methods for assessing the interaction of factors. Correlation analysis. Regression, calculation technique and use in biology</p>	<p>GPC-4.1; GPC-4.2; GPC-4.3</p>	<p>Knows the steps of statistical analysis</p> <p>Able to apply computer technologies in the collection, storage, analysis and transmission of biological information on the state of population health</p> <p>Owens the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results; methods of studying, analyzing, evaluating trends, to predicting the development of events in the state of population health</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>
	<p>Topic 7. Direct standardization method</p>	<p>GPC-4.1; GPC-4.2; GPC-4.3</p>	<p>Knows the steps of statistical analysis</p> <p>Able to apply computer technologies in the collection, storage, analysis and transmission of biological information on the state of population health</p> <p>Owens the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results; methods of studying, analyzing, evaluating trends, to predicting the development of events in the state of population health</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>
	<p>Topic 8. Methods for analyzing the dynamics of the phenomenon.</p>	<p>GPC-4.1; GPC-4.2;</p>	<p>Knows the steps of statistical analysis</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>

	<p>Graphic image in statistics, types of graphic images, their use for the analysis of phenomena</p>	<p>GPC-4.3</p>	<p>Able to apply computer technologies in the collection, storage, analysis and transmission of biological information on the state of population health</p> <p>Owns the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results; methods of studying, analyzing, evaluating trends, to predicting the development of events in the state of population health</p>		
	<p>Topic 9. Automated a priori analysis of the statistical population in MS Excel</p>	<p>GPC-4.1; GPC-4.2; GPC-4.3</p>	<p>Knows the steps of statistical analysis</p> <p>Able to apply computer technologies in the collection, storage, analysis and transmission of biological information on the state of population health</p> <p>Owns the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results; methods of studying, analyzing, evaluating trends, to predicting the development of events in the state of population health</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>

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

### Main literature

1. Multivariate statistical methods in economics: textbook / L.I. Nivorozhkina, S.V. Arzhenovsky. — M. : RIOR : INFRA-M, 2018. — 203 p. - (Higher education). - [www.dx.doi.org/10.12737/21773](http://www.dx.doi.org/10.12737/21773). - Access mode:<http://znanium.com/catalog/product/975772>
2. Dubina I.N. Mathematical and statistical methods and tools in empirical socio-economic research [Electronic resource]: study guide / I.N. Cudgel. — Electron. text data. - Saratov: Higher education, 2018. - 415 p. — 978-5-4487-0264-8. - Access mode:<http://www.iprbookshop.ru/76234.html>
3. Methods and means of complex statistical data analysis: textbook. allowance / A.P. Kulaichev. - 5th ed., revised. and additional - M. : INFRA-M, 2018. - 484 p. — (Higher education: Bachelor's degree). - [www.dx.doi.org/10.12737/25093](http://www.dx.doi.org/10.12737/25093). - Access mode:<http://znanium.com/catalog/product/975598>
4. Multidimensional statistical methods in economics: textbook / L.I. Nivorozhkina, S.V. Arzhenovsky. - M. : RIOR : INFRA-M, 2017. - 203 p. - (Higher education). - [www.dx.doi.org/10.12737/21773](http://www.dx.doi.org/10.12737/21773). - Access mode:<http://znanium.com/catalog/product/615064>
5. Dubrovsky S.A. Methods of processing and analysis of experimental data [Electronic resource]: textbook / S.A. Dubrovsky, V.A. Dudina, Ya.V. Sadiyev. — Electron. text data. - Lipetsk: Lipetsk State Technical University, EBS DIA, 2015. - 62 p. — 978-5-88247-719-5. - Access mode:<http://www.iprbookshop.ru/55640.html>

### additional literature

1. Lisitsyn Yu.P., Ulumbekova G.E. Public health and health care: a textbook. - M. : GEOTAR - Media, 2016. - 542 p.<http://lib.dvfu.ru:8080/lib/item?id=chamo:781664&theme=FEFU>
2. Public health and healthcare [Electronic resource]: textbook / Medic V. A., Yuriev V. K. - 2nd ed., corrected. and additional - M. : GEOTAR-Media, 2016. - 608s.<http://www.studentlibrary.ru/book/ISBN9785970437100.html>
3. Medic V.A., Yuriev V.K. . Public health and healthcare. Textbook. - M. : GEOTAR-Media, 2014. - 287 p.<http://lib.dvfu.ru:8080/lib/item?id=chamo:730369&theme=FEFU>

4. Eliseeva I. Statistics. Textbook for high schools. - Yuriit. - 2013. - 558 p. <http://lib.dvfu.ru:8080/lib/item?id=chamo:693676&theme=FEFU>
5. Nasledov A. IBM SPSS 20 Statistics and AMOS: Professional Statistical Data Analysis St. Petersburg, Peter. - 2013. - 413 p. <http://lib.dvfu.ru:8080/lib/item?id=chamo:698490&theme=FEFU>
6. Trukhacheva N.V. Mathematical statistics in biomedical research using the GEOTAR Statistica package - Media, 2012.-384 p. <http://lib.dvfu.ru:8080/lib/item?id=chamo:730137&theme=FEFU>
7. Kozlov A.Yu. Statistical data analysis in MS Excel. Publishing House "INFRA-M", 2012. - 320 p. EBS ZNANIUM: <https://lib.dvfu.ru:8443/lib/item?id=Znanium:Znanium-238654&theme=FEFU>
8. Mathematical statistics in biomedical research using the Statistica package / NV Trukhacheva. Moscow: GEOTAR-Media, 2012. - 379 p. EC NB FEFU: <http://lib.dvfu.ru:8080/lib/item?id=chamo:730137&theme=FEFU>
9. Statistical methods of analysis in health care. A short course of lectures. Prepared by a team of authors consisting of: d.m.s., prof. Leonov S.A., with the participation of Ph.D. Vaisman D.Sh., Moravskaya S.V., Mirskov Yu.A. - M.: Publishing House "Health Manager", 2011. - 172 p. EC NB FEFU: [http://lib.dvfu.ru:8080/lib/item?id=Geotar:/usr/vtls/ChamoHome/visualizer/data\\_geotar/geotar.xml.part1571..xml&theme=FEFU](http://lib.dvfu.ru:8080/lib/item?id=Geotar:/usr/vtls/ChamoHome/visualizer/data_geotar/geotar.xml.part1571..xml&theme=FEFU)
10. Trukhacheva N.V. Mathematical statistics in biomedical research using the Statistica package / N.V. Trukhachev.- 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: 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>

### **List of resources of the information and telecommunications 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 "Urayt". Access mode: <https://urait.ru/>
4. Information and legal portal "Garant". Access mode: <http://www.garant.ru/>
5. Single window of access to educational resources. Access mode: <http://window.edu.ru/>

## **List of information technologies and software**

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

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

3. Microsoft Office Professional Plus 2010;

4. an office suite that includes software for working with various types of documents (texts, spreadsheets, databases, etc.);

5. 7Zip 9.20 - free file archiver with a high degree of data compression;

6. ABBYY FineReader 11 - software for optical character recognition;

7. Adobe Acrobat XI Pro - a software package for creating and viewing electronic publications in PDF format;

8. ESET Endpoint Security - comprehensive protection of workstations based on Windows OS. Virtualization support + new technologies;

9. WinDjView 2.0.2 is a program for recognizing and viewing files with the same name format DJV and DjVu.

## **IX. METHODOLOGICAL INSTRUCTIONS FOR MASTERING THE DISCIPLINE**

Successful mastering of the discipline involves the active work of students in all classes of the classroom form: 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, the performance of control and creative work.

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

An intermediate certification in the discipline "Bioinformatics" is a test. A student is considered certified in the discipline, provided that all types of current control and independent work provided for by the curriculum are performed.

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

## **X. LOGISTICS OF THE DISCIPLINE**



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

The list of material, 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
Audience for practical classes Computer class of the School of Biomedicine aud. M723, 15 jobs	Motorized Screen 236*147cm Trim Screen Line; Projector DLP, 3000 ANSI Lm, WXGA 1280x800, 2000:1 EW330U Mitsubishi; Subsystem of specialized equipment fastenings CORSA-2007 Tuarex; Video switching subsystem: DVI DXP 44 DVI Pro Extron matrix switcher; DVI over twisted pair cable DVI 201 Tx/Rx Extron; Subsystem of audio switching and sound amplification; acoustic system for ceiling mounting SI 3CT LP Extron; Extron DMP 44 LC digital audio processor; extension for IPL T CR48 control controller; wireless LANs for students 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 ProOpe 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 Internet access speed 500 Mbps. Workplaces for people with disabilities are equipped with Braille displays and printers; equipped with: portable devices for reading flat-print texts, scanning and reading machines, a video enlarger with the ability to regulate color spectra; magnifying electronic loupes and ultrasonic markers
Audience for independent work of students Vladivostok, about. Russian village Ajax, 10, Building 25.1, room M621 Area 44.5 m2	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 series; wireless LAN for students provided by a system based on access points 802.11a / b / g/n 2x2 MIMO(2SS).
Audience for lectures Vladivostok, about. Russian, p. Ajax d.10, room. 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 automatic cable retraction system TLS TAM 201 Stan; Document camera Avervision CP355AF; Sennheiser EW 122 G3 UHF lavalier radio system as part of a wireless microphone and receiver; LifeSizeExpress 220-Codeonly-Non-AES video conferencing codec; Network video camera Multipix MP-HD718; Two LCD panels 47", Full HD, LG M4716CCBA; Audio switching and sound amplification subsystem; centralized uninterruptible power supply

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

## X. VALUATION FUND

### FOS passport

Universal competencies graduates and indicators of their achievement:

Name of the category (group) of universal competencies	Code and name of universal competence (result of development)	Code and name of the indicator of achievement of competence
	UK-6 Is able to determine and implement the priorities of their own activities and ways to improve it based on self-assessment	UK-6.1 Knows the basics of scientific research with an explanation of the technology of their own activities
		UK-6.2 Knows how to justify the priorities of their own activities
		UK-6.3 Owns ways to formulate goals, objectives of their own activities and ways to improve it based on self-assessment

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
UK-6.1 Knows the basics of scientific research with an explanation of the technology of their own activities	Knows the basics of scientific research Able to explain the technology of their own activities Owns the basic methods of scientific research
UK-6.2 Knows how to justify the priorities of their own activities	Knows priority research in his professional field Knows how to justify the priorities of their own activities
UK-6.3 Owns ways to formulate goals, objectives of their own activities and ways to improve it based on self-assessment	Knows the main tasks of his professional activity Knows how to formulate goals, set goals, determine the path to achieve the goal Has knowledge of scientific areas in health care and how to manage them based on self-assessment

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 (result of development)	Code and name of the indicator of achievement of competence
	OPK-2 The ability to use information technology in professional activities, to comply with the basic requirements of information security	GPC-2.1 Knows and is able to explain the use of information technology
		GPC-2.2 Knows how to justify the criteria for evaluating IT technologies in practice
		GPC-2.3 Has the ability to formulate and explain the need for the use of information technology in the work of medical organizations in compliance with

		the basic requirements of information security
	OPK-4 The ability to apply modern methods of collecting and processing information, to conduct statistical analysis and interpret the results, to study, analyze, evaluate trends, to predict the development of events in the state of population health	GPC-4.1 Knows the basics of computer technology in the collection, storage, analysis and transmission of information on predicting the development of events in the state of population health
		GPC-4.2 Able to apply computer technologies in the collection, storage, analysis and transmission of information on predicting the development of events in the state of population health
		GPC-4.3 Has the skills to prepare organizational and management documentation in a medical organization for predicting the development of events in the state of population health of the population; possesses methods of multivariate statistics and methods of biological information processing for solving professional problems

Code and name of the indicator of achievement of competence	Name of the assessment indicator (the result of training in the discipline)
GPC-2.1 Knows and is able to explain the use of information technology	Knows modern information technologies and software used in professional activities Able to apply modern information technologies and software in solving professional problems. Possesses the skills of collecting, processing, evaluating the reliability of the results and providing the information received through modern information technologies and software
GPC-2.2 Knows how to justify the criteria for evaluating IT technologies in practice	Knows the criteria for evaluating IT technologies in his practice Knows how to substantiate the criteria for evaluating IT technologies in practice Possesses the skill of substantiating the criteria for evaluating IT technologies in practice
GPC-2.3 Has the ability to formulate and explain the need for the use of information technology in the work of medical organizations in compliance with the basic requirements of information security	Knows the principles of using information technology Able to apply knowledge on the use of information technology in practice in compliance with the basic requirements of information security Has skills in working with information technologies in healthcare in compliance with the basic requirements of information security
GPC-4.1 Knows the basics of computer technology in the collection, storage, analysis and transmission of information on predicting the development of	Knows the basics of computer technology in the collection, storage, analysis and transmission of information Able to predict the development of events and the state of population health of the population Possesses the skill of collecting, storing, analyzing,

events in the state of population health	transmitting information on all issues of his professional activity
GPC-4.2 Able to apply computer technologies in the collection, storage, analysis and transmission of information on predicting the development of events in the state of population health	Knows the steps of statistical analysis Able to apply computer technologies in the collection, storage, analysis and transmission of information on predicting the development of events in the state of population health Owns methods of using computer technologies in the collection, storage, analysis and transmission of information on predicting the development of events in the state of population health
GPC-4.3 Has the skills to prepare organizational and management documentation in a medical organization for predicting the development of events in the state of population health of the population; possesses methods of multivariate statistics and methods of biological information processing for solving professional problems	Knows organizational and management documentation in a medical organization Able to prepare medical documentation, predict the development of events in the state of population health Owns the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results; methods of studying, analyzing, evaluating trends, to predicting the development of events in the state of population health

No. p / p	controlled modules / sections / discipline topics	Codes and stages of formation of competencies	Appraisal tools - name		
			current control	intermediate attestation	
1.	Topic 1. Basic methods of descriptive statistics. Basic concepts and terms of medical and biological statistics	UK-6.1; UK-6.2; UK-6.3;	Knows the basic methods of scientific research in health care  Knows how to use knowledge about scientific research in medicine based on the priorities of their own activities  Has knowledge of scientific areas in health care and how to manage them based on self-assessment	UO-1, UO-4, PR-1	UO-1
2.	Topic 2. Features of conducting a sanitary-statistical study	UK-6.1; UK-6.2; UK-6.3;	Knows the basic methods of scientific research in health care  Knows how to use knowledge about scientific research in medicine based on the priorities of their own	UO-1, UO-4, PR-2	UO-1

			<p>activities</p> <p>Has knowledge of scientific areas in health care and how to manage them based on self-assessment</p>		
3.	<p>Topic 3. Biological statistics. Methods for calculating generalizing coefficients characterizing various aspects of the studied characteristics</p>	<p>GPC-2.1; GPC-2.2; GPC-2.3;</p>	<p>Knows the principles of using information technology</p> <p>Able to apply knowledge on the use of information technology in practice in compliance with the basic requirements of information security</p> <p>Has skills in working with information technologies in healthcare in compliance with the basic requirements of information security</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>
	<p>Topic 4. Assessment of the reliability of the results of the study. Application of parametric methods. Non-parametric methods for assessing the reliability of results, their significance and practical application</p>	<p>GPC-2.1; GPC-2.2; GPC-2.3;</p>	<p>Knows the principles of using information technology</p> <p>Able to apply knowledge on the use of information technology in practice in compliance with the basic requirements of information security</p> <p>Has skills in working with information technologies in healthcare in compliance with the basic requirements of information security</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>
	<p>Topic 5. Fundamentals of multivariate statistical analysis</p>	<p>GPC-2.1; GPC-2.2; GPC-2.3;</p>	<p>Knows the principles of using information technology</p> <p>Able to apply knowledge on the use of information technology in practice in compliance with the basic requirements of information security</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>

			Has skills in working with information technologies in healthcare in compliance with the basic requirements of information security		
	Topic 6. Methods for assessing the interaction of factors. Correlation analysis. Regression, calculation technique and use in biology	GPC-4.1; GPC-4.2; GPC-4.3	Knows the steps of statistical analysis  Able to apply computer technologies in the collection, storage, analysis and transmission of biological information on the state of population health  Owns the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results; methods of studying, analyzing, evaluating trends, to predicting the development of events in the state of population health	UO-1, UO-4, PR-2	UO-1
	Topic 7. Direct standardization method	GPC-4.1; GPC-4.2; GPC-4.3	Knows the steps of statistical analysis  Able to apply computer technologies in the collection, storage, analysis and transmission of biological information on the state of population health  Owns the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results;	UO-1, UO-4, PR-2	UO-1

			methods of studying, analyzing, evaluating trends, to predicting the development of events in the state of population health		
	<p>Topic 8. Methods for analyzing the dynamics of the phenomenon.</p> <p>Graphic image in statistics, types of graphic images, their use for the analysis of phenomena</p>	<p>GPC-4.1; GPC-4.2; GPC-4.3</p>	<p>Knows the steps of statistical analysis</p> <p>Able to apply computer technologies in the collection, storage, analysis and transmission of biological information on the state of population health</p> <p>Owens the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results; methods of studying, analyzing, evaluating trends, to predicting the development of events in the state of population health</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>
	<p>Topic 9. Automated a priori analysis of the statistical population in MS Excel</p>	<p>GPC-4.1; GPC-4.2; GPC-4.3</p>	<p>Knows the steps of statistical analysis</p> <p>Able to apply computer technologies in the collection, storage, analysis and transmission of biological information on the state of population health</p> <p>Owens the methods of multidimensional statistics of biological information processing for solving professional problems, conducting statistical analysis and interpreting the results; methods of studying, analyzing, evaluating</p>	<p>UO-1, UO-4, PR-2</p>	<p>UO-1</p>

			trends, to predicting the development of events in the state of population health		
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For the discipline under study, the following evaluation tools are used for current control:

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

UO-4 - seminar-debate;

PR-2 - control work.

oral questioning- the most widespread method of control of knowledge of students. During an oral survey, direct contact is established between the teacher and students, during which the teacher gets ample opportunities to assess the quantity and quality of learning by students of educational material. It is the most common and adequate form of control of students' knowledge, includes an interview (mainly at the exam and test), colloquium, report.

Criteria for assessing the oral response:

"5 points" is given to the student if he gives the correct answers to the questions under discussion, which are distinguished by the depth and completeness of the disclosure of the topic, are 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 correct 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" is given to the student if he gives answers to the questions under discussion that do not fully reveal him, there is no logical construction of the answer, and he makes several mistakes.

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

Seminar-dispute involves a collective discussion of a problem in order to establish ways to reliably solve it. The seminar-dispute is held in the form of dialogue between the participants. It assumes a high mental activity of the participants, instills the ability to debate, discuss the material, defend views and



beliefs, concisely and clearly express their thoughts. Often a seminar-discussion is based on reports, reports on the topics of abstracts prepared by students in advance, 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 presentation, the teacher and students ask questions and make additions and comments.

The dispute can be called by the teacher during the lesson or planned in advance by him and formed as a process of dialogical communication, during which the formation of practical experience in discussing theoretical and practical problems takes place. In the course of the controversy, students develop 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 sustainedly refute opponents.

For all questions, 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

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

Test contains a list of questions and various answers. Each question is worth 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, a test is provided.

1. and factor analyzes
2. Cluster analysis, purpose of the method
3. Multidimensional scaling, interpretation methods

#### Evaluation tools for intermediate certification

##### Questions for the exam

1. The concept of biological statistics.
2. Features of biological research.

3. Representation of the general and sample population: methods for collecting a variant in a sample.
4. Laws of distribution of random variables.
5. Variation series and its graphic representation; interval and non-interval variational series.
6. Asymmetry and kurtosis.
7. Average values: power and structural averages.
8. Indicators of sample variation.
9. Statistical estimates of general parameters.
10. Interval estimates of general parameters.
- eleven. Statistical comparisons; reliability criteria for differences between samples: (Student's t-test, Fisher's F-test).
12. Correlation, correlation coefficient.
13. Description of the correlation between qualitative features.
14. Correlation analysis.
15. Regression analysis.
16. cluster analysis.
17. Discriminant analysis.
18. Formulate a statistical conclusion: what does it mean to accept or reject the null hypothesis (But): a) when comparing empirical and theoretical distributions; b) when comparing two sample sets; c) in correlation analysis; d) in dispersion analysis;
19. Characteristics of the data analysis process in software products: Statistica, Stadia, MS Excel.
20. Quantitative and qualitative features.
21. Basic concepts of biometrics.
22. The main genetic and mathematical parameters of the population (each separately - arithmetic mean, sigma, coefficient of variation, sample size, etc.).
23. Structure of trait diversity.
24. Analysis of the trait diversity structure.
25. Normal distribution.
26. Binomial distribution. Poisson distribution.
27. Correlation, regression and their use.
28. Normalized deviation.
29. The concept of levels of reliability and probability of error-free forecasts.
- thirty. Sample parameter errors. Confidence intervals.
31. Reliability of the difference of sample parameters.
32. Criterion  $\chi^2$ , its application for solving biological problems.
33. Classification of models of biological systems.

34. Models characterizing the growth of populations. 33. Software for data analysis on personal computers.

35. Research planning, evaluation and selection of accounting methods.

36. Assessment of population density and abundance and density of species.

37. Study of the relationship of individual species with habitat types.

#### Exam Grading Criteria

Exam grade Requirements for the formed competencies

"Great" An "excellent" mark is given to a student if he has deeply and firmly mastered the program material, sets it out exhaustively, consistently, clearly and logically, is able to closely link theory with practice, freely copes with tasks, questions and other types of application of knowledge, and does not find it difficult to respond when modifying tasks, uses monographic literature in the response, correctly substantiates the decision made, possesses versatile skills and techniques for performing practical tasks;

"Fine" A "good" grade is given to a student if he knows the material well, presents it competently and to the point, avoiding significant inaccuracies in answering the question, correctly applies theoretical provisions in solving practical issues and tasks, possesses the necessary skills and techniques for their implementation;

"satisfactorily" The grade "satisfactory" is given to the student if he has knowledge only of the basic material, but has not mastered its details, allows inaccuracies, insufficiently correct wording, violations of the logical sequence in the presentation of the program material, has difficulty in performing practical work;

"unsatisfactory" The "unsatisfactory" mark is given to a student who does not know a significant part of the program material, makes significant mistakes, performs practical work uncertainly, with great difficulty.

Evaluation tools for current certification

Typical tasks for independent work

Type 1. Answer the theoretical questions:

1. What does the concept of biological or variational statistics mean?
2. At the junction of what sciences is the scientific branch of biometrics?
3. What is a fundamental biological concept?
4. What is meant by sampling?
5. What are the individual traits called?
6. How many stages does biomedical research?
7. What are the methods of biological research?
8. What determines population size?

9. What coefficients characterize the relationship of a part to a whole?
10. What generalizing value estimates the size of a feature that changes in its value in the aggregate?
- eleven. What are the quantitative methods of statistical data processing called?
12. What are quantitative methods of statistical data processing called, the application of which does not require knowledge of the law of distribution of the studied features in the aggregate and calculation of their main parameters?
13. What concept means the relationship between features?
14. With the help of what is the task set to find out how quantitatively one quantity changes when another quantity changes by one?
15. What is the technique for calculating standardized indicators?
16. What indicators in the analysis of the dynamic series characterize the intensity of its changes?
17. What requirements must be observed when constructing graphic images?
18. What two problems are solved on the basis of a priori analysis of the initial statistical material?

Type 2. On a model example

- make a variation series, calculate: arithmetic mean by the method of moments, standard deviation, coefficient of variation, mean error of the arithmetic mean.

Type 3. On a model example

- calculate the correlation coefficient between the two indicators.
- calculate the correlation coefficient by the method of squares, evaluate the reliability of the relationship.
- determine the confidence limits with the probability of an error-free forecast of 99%.
- calculate the compliance criterion  $\chi^2$  and determine whether the difference between the numbers obtained in the process of statistical research and the "expected values" is significant or insignificant;
- calculate standardized indicators, compare them with derived values, draw appropriate conclusions.

Type 4. On a model example

- make a model of human biorhythms;
- build several graphs in the same axes, illustrating the values of several variational series of biological values of indicators;
- build a dot diagram illustrating the dependence of one value of a biological indicator on another;

- to implement the technology of work in the "Data Analysis" mode in MS Excel: "Histogram"; "Sample"; "Descriptive statistics"; "Rank and Percentile"; "Generation of random numbers"; "Two-sample t-test for means"; "Two-sample t-test with the same variances"; "Two-sample t-test with different variances"; "Two-sample F-test for variances"; "Paired two-sample t-test for averages"; "Single-way analysis of variance"; "Two-way analysis of variance without repetitions"; "Two-way analysis of variance with repetitions"; "Covariance"; "Correlation"; "Regression"; "Moving Average"; "Exponential smoothing"; "Fourier Analysis".

#### Criteria for evaluating independent work reports

Evaluation of the defense of independent work is carried out when submitting a report in electronic form, on a two-point scale: "passed", "not passed".

The mark "passed" is given to the student if he submits a report on independent work for defense that meets the requirements for the assigned tasks, for registration, demonstrates the possession of methods and techniques of theoretical and / or practical aspects of work.

The grade "not passed" is given to the student if he does not know the methods and techniques of the theoretical and / or practical aspects of the work, makes significant mistakes in the work, submits a report with significant deviations from the rules for the preparation of written work.

#### Typical test tasks

(indicate the number of one correct answer)

1. What is a population?
  - a. part of a whole;
  - b. all objects of the category under study;
  - c. the size of the attribute of the object.
2. What is a sample?
  - a. the value of the attribute of the object
  - b. trait score
  - c. part of the general population.
3. What indicators of variability do you know?
  - a. fashion;
  - b. median;
  - c. limits, standard deviation, coefficient of variation.
4. What determines the option (date) in the statistics?
  - a. numerical value of the feature size of the object
  - b. distance between objects
  - c. rate of evolution in biology

5. What is regression?
  - a. change in hereditary material;
  - b. partial return of offspring to the average level for the population;
  - c. variability of characteristics of an organism group.
6. What factor determines the correlation?
  - a. independent divergence of chromosomes in meiosis;
  - b. relationship between features;
  - c. change in genetic material.
7. Indicate the degree of relationship between the signs?
  - a. positive, negative;
  - b. direct, reverse;
  - c. strong, medium, weak.
8. What constants of the variational series are considered basic?
  - a. coefficients of heritability and repeatability;
  - b. average. arithmetic standard deviation, stat. errors;
  - c. correlation and regression coefficients.
1. What indicates the degree of conformity of the sample parameters with the parameters of the general population?
  - a. statistical errors
  - b. correlation coefficient
  - c. regression coefficient
10. How to establish the reliability of the results of the statistical error?
  - a. If parameter  $>$  its error by 3 times or more, then it is reliable;
  - b. the number of errors in the recombination of genetic material;
  - c. method heteroploidy.

#### Test Evaluation Criteria

Evaluation is carried out in an e-learning session on a 100-point scale.

The test includes 100 tasks, the maximum score for the test is 100.

Within the framework of the current level of assimilation of knowledge in the discipline, the test result is allowed, not lower than 61 points.