

MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS
Educational Institution
BELARUSIAN STATE MEDICAL UNIVERSITY

**Контрольный
экземпляр**

APPROVED

by Rector of the Educational
Institution «Belarusian State
Medical University»

S.P.Rubnikovich

26.06.2024

Reg. # UD-091-078/2425/edu.

BIOMEDICAL STATISTICS

**Curriculum of the educational institution
in the academic discipline for the specialty**

7-07-0911-01 «General Medicine»

Curriculum is based on the educational program «Biomedical statistics», approved 26.06.2024, registration # УД-091-078/2425/уч; on the educational plan in the specialty 7-07-0911-01 «General Medicine», approved 15.05.2024, registration # 7-07-0911-01/2425/mf.

COMPILERS:

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RECOMMENDED FOR APPROVAL:

by the Department of Public Health and Healthcare of the educational institution «Belarusian State Medical University»
(protocol № 11 of 17.06.2024);

by the Scientific and Methodological Council of the educational institution «Belarusian State Medical University»
(protocol № 18 of 26.06.2024)

EXPLANATORY NOTE

«Biomedical Statistics» – is an academic discipline of the module «Information Technologies in Health Care» that contains the systematized scientific knowledge about the theoretical basics and organizational principles of the application of statistical methods to research health conditions of the population, activities of health care organizations, and the impact on them social and other factors.

The aim of the discipline «Biomedical Statistics» are to form universal competencies of planning and performing individual medical and biological statistical research as well as to get skills for objective evaluation and effective application of the results received by other researchers and introduced in literature.

The objectives of the discipline «Biomedical statistics» are to form students' scientific knowledge about statistical criteria depending on the goals and types of data from biomedical statistical research, to learn basic rules for conducting scientific medical and statistical research, methods of calculation of statistical criteria, methods of analysis, results of the medical and statistical study and the formulation of statistically proved conclusions, skills required for:

- development of the design of scientific medical and statistical research;
- analysis using modern statistical methods of medical data;
- interpretation and modern evaluation of scientific achievements and discoveries in medicine.

The knowledge, skills, and abilities acquired during the study of the academic discipline «Biomedical statistics» are necessary for successful mastering of the module «Public Health and Health Care».

Studying the educational discipline «Biomedical statistics» should ensure the formation of students' universal competencies:

- apply methods of scientific cognition in research, generate and implement innovative ideas;
- solve professional, scientific and innovative tasks based on the use of information and communication technologies.

As a result of studying the discipline «Biomedical statistics» the student should

know:

- basic terminology of biomedical statistics;
- rules for conducting a scientific medical and statistical research;
- statistical criteria (methods) which are used in biomedical scientific research;
- rules of medical ethics and deontology;

be able to:

- make a plan and a program of scientific medical and statistical research;
- prepare the collected data for statistical processing;
- choose statistical criteria (methods) that are appropriate to the tasks of a research and to the type of data;
- analyze population health indicators;

objectively evaluate and effectively use the results obtained by other researchers and presented in the literature;

master:

basic techniques of statistical processing of scientific data;

methods of calculation of statistical criteria;

skills of statistical analysis.

Total number of hours for the study of the discipline is 108 academic hours. Classroom hours according to the types of studies: lectures – 6 hours (including supervised student independent work –3 hours), practical classes – 30 hours, student independent work (self-study) – 72 hours.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of a credit (3 semester).

Form of higher education – full-time.

ALLOCATION OF ACADEMIC TIME

Code, name of the specialty	semester	Number of academic hours						Form of intermediate assessment
		total	in-class	including			out-of-class self-studies	
				lectures	supervised student independent work	practical classes		
7-07-0911-01 «General Medicine»	3	108	36	3	3	30	72	a credit

THEMATIC PLAN

Section (topic) name	Number of class hours	
	lectures (incl. SSIW)	practical
1. Biomedical statistics as a science. Basics of evidence-based medicine	1,5	–
2. Method of statistical observation	3	–
3. Fundamentals of analytical statistics in medicine	1,5	–
4. Organization of medical and statistical research	–	2
5. Statistical hypotheses	–	2
6. Relative values	–	2
7. Graphic images	–	2
8. Variational series	–	2
9. Distribution of variables in the totality	–	2
10. Parametric methods for testing statistical hypotheses	–	4
11. Analyses of variance	–	2
12. Nonparametric methods for testing statistical hypotheses	–	2
13. Correlation. Pearson correlation coefficient	–	2
14. Regression analysis	–	2
15. Spearman's rank correlation coefficient	–	2
16. Analysis of qualitative data	–	4
Total hours	6	30

CONTENT OF THE EDUCATIONAL MATERIAL

1. Biomedical statistics as a science. Basics of evidence-based medicine

Statistics, definition of terms. Basic concepts of statistics. Organization of statistical accounting and reporting in the Republic of Belarus. Basic principles of state statistics. The tasks of state statistics. Requirements for statistical data.

Biomedical statistics as a science, its content and objectives. Methods of biomedical statistics, characteristic.

Evidence-based medicine. Principles and methodological basis of evidence-based medicine. Systematic literature reviews and meta-analyses.

2. Method of statistical observation

Statistical observation as the most important method of statistical research. Forms, types and methods of statistical observation. Statistical observation errors.

Classification and characterization of statistical data. Requirements for statistical data: reliability, completeness, comparability, reasonable sample, timeliness of data.

Statistical totality. The concept of general and sample totality.

Characterization of continuous and discontinuous study. Methods for discontinuous study. Characterization of selective observation. The concept of representativeness of a sample totality. Main representativeness criteria (similarity measure, the sample size). Types and methods of sampling. Randomization as a gold standard criterion in the conduct of studies. Characterization of simple, block, stratified randomization.

The law of the normal distribution of a random variable and its application in solving practical problems.

3. Fundamentals of analytical statistics in medicine

Statistical hypotheses. Principles of testing statistical hypotheses.

The concept of reliability and statistical significance.

Parametric and nonparametric methods. Classification and characteristics of methods that allow testing statistical hypotheses when comparing the values of independent samples and repeated measurements. Calculation of confidence intervals.

Methods to determine the existence of a connection between phenomena. The concept of correlation, conditions for using correlation and regression.

Analysis of qualitative data. Contingency tables. Fisher's exact test is a test of statistical significance used in contingency table analysis for small sample sizes. Nonparametric methods for analyzing qualitative characteristics for repeated observations (McNemar criterion).

4. Organization of medical and statistical research

Stages of medical and statistical research. Plan and program of research, characteristic. Errors in forming of the plan and the program.

Methods of data collecting (observation, documentary method, sociological survey). Protocol of research, questionnaire, requirements.

Characteristics of statistical variables. The unit of observation is the primary element of the statistical population. Classification of accounting characteristics (quantitative, qualitative, factor, resulting).

Contents of the statistical summary. Objectives, types, methodology of statistical grouping.

5. Statistical hypotheses

Statistical hypotheses and criteria.

Parametric and nonparametric criteria. General algorithm for applying the criteria for statistical significance of differences. The level of statistical significance.

6. Relative values

Relative values: intensive, extensive, ratio, obvious. Identification, methods of calculation, field of use. Use of statistical values in medicine.

7. Graphic images

Application of the graphical method in biomedical statistics. Classification of statistical graphs according to the shape of the graphic image (linear, planar, volumetric). Classification of statistical graphs according to the method of

construction and the purpose of the image (diagrams, statistical maps). Requirements for the design of statistical graphs. Graphic representation of statistical values.

8. Variational series

Definition, order of construction of a variation series. Types of variation series. Average values (mode, median, arithmetic mean). Algorithms for calculating average values. Use of average values in medicine.

Objectives and organization of sample observation. Types and methods of selection that ensure representativeness of the sample. Evaluation of the results of sample observation.

Characteristics of diversity in a sample. Absolute and relative indicators of diversity (limit, amplitude, standard deviation, dispersion, coefficient of variation, rate oscillations), characteristic, using in medicine.

9. Distribution of variables in the totality

Characteristics of the distribution of variables in a sample. Checking the normality of the distribution of variables in a sample.

10. Parametric methods for testing statistical hypotheses

Error of representativeness. Student's t-test. The probability of faultless prognosis.

Algorithms for calculating the Standard error of the arithmetic mean, the Margin error of the arithmetic mean.

Algorithms for calculating the error of the relative values, the Margin error for the relative values.

Sample size determination.

Comparison of the averages of the two independent samples of the equal and random volumes. Calculation of Student's t-test, evaluation. Errors in using of Student's t-test.

Calculation of paired Student's t-test, evaluation. Errors in using of paired Student's t-test.

Calculation of Student's t-test for relative values, evaluation. Errors in using of Student's t-test for relative values.

11. Analysis of variance

Methodology for calculating intragroup, intergroup, total variances. Fisher's F-criterion calculation, estimation. Variance Sum Law. Calculation of determination coefficient (η^2), evaluation.

12. Nonparametric methods for testing statistical hypotheses

Alternative distribution. Description of skewed distributions to illustrate central tendency (distribution center) and diversity characteristics (median and quantiles).

Ranking method. Method for calculating the Mann-Whitney test, evaluation. Errors in using the Mann-Whitney test.

Wilcoxon signed-rank test. Method of calculating, evaluation. Errors in using the Wilcoxon test.

13. Correlation. Pearson correlation coefficient

Types of connections in nature. Direction, form, and dispersion strength. Methods of correlation analysis. Limitation criteria in the use of the Pearson method. Methodology for calculating the Pearson correlation coefficient, its errors. Interpretation of the results obtained.

14. Regression analysis

Regression analysis. The regression coefficient, regression equation, characteristic. Types of regression equations depending on the form of correlation. Finding the linear regression parameters by least squares. Assessment of its significance. Regression scales, practical use, data required for calculation and graphical representation of the regression scale. Analysis of the results.

15. Spearman's rank correlation coefficient

Criteria for using the Spearman correlation analysis method. Method for calculating Spearman's correlation coefficient. Calculation of the error of the correlation coefficient. Interpretation of the results obtained.

16. Analysis of qualitative data

Cross-tables. The concept of actual and expected values. Chi-Square Statistic (χ^2) for arbitrary and 4-field contingency tables. Limitation criteria in the use of the method.

Indications for using the McNemar test. Methodology for calculating the McNemar criterion, evaluation.

Indications for using Fisher's exact test. Factorial of a number. Fisher's exact test, evaluation.

ACADEMIC DISCIPLINE CURRICULAR CHART «BIOMEDICAL STATISTICS»

Section, topic №	Section (topic) name	Number of hours		Supervised student independent work	Literature	Practical skill	Form of control	
		lectures	practical				of practical skill	of current*/ intermediate evaluation
	Lectures	3	-	3				
1.	Biomedical statistics as a science. Basics of evidence-based medicine	1,5	-	-	1,3			
2.	Method of statistical observation	-	-	1,5	1,3			Interview, defense of an abstract (report)
3.	Fundamentals of analytical statistics in medicine	1,5	-	1,5	1,3			Interview, defense of an abstract (report)
	Practical classes	-	30	-				
1.	Organization of medical and statistical research	-	2	-	1, 2, 3	Plan and program for medical and statistical research	Solving a situational task	Survey, electronic test, report on practical exercise
2.	Statistical hypotheses	-	2	-	1, 2, 3	Selecting a statistical test	Solving a situational task	Survey, electronic test, report on practical exercise
3.	Relative values	-	2	-	1, 2, 3	Calculation of relative values	Solving a situational task	Survey, electronic test*, report on practical exercise
4.	Graphic images	-	2	-	1, 2, 3	Graphic representation of statistical values	Solving a situational task	Survey, electronic test*, report on practical exercise

5.	Variational series	–	2	–	1, 2, 3	Calculation of average values	Solving a situational task	Survey, electronic test, report on practical exercise
6.	Distribution of variables in the totality	–	2	–	1, 2, 3	Characteristics of the distribution of variables in a sample	Solving a situational task	Survey, electronic test*, report on practical exercise
7.	Parametric methods for testing statistical hypotheses (comparing the means of two samples)	–	2	–	1, 2, 3	Calculation of confidence intervals Calculation of Student's t-test, evaluation	Solving a situational task Solving a situational task	Survey, report on practical exercise
8.	Parametric methods for testing statistical hypotheses (comparing relative values)		2	–	1, 2, 3	Calculation of paired Student's t-test, evaluation	Solving a situational task	Survey. Colloquium*
9.	Analyses of variance	–	2	–	1, 2, 3	Interpretation of the results of one-way analysis of variance	Solving a situational task	Survey, electronic test, report on practical exercise
10.	Nonparametric methods for testing statistical hypotheses	–	2	–	1, 2, 3	Test for differences between two samples of independent measurements (using the Mann-Whitney method) or paired/dependent measurements (using the Wilcoxon test).	Solving a situational task	Survey, electronic test, report on practical exercise
11.	Correlation. Pearson correlation coefficient	–	2	–	1, 2, 3	Determining the correlation between two variables using the Pearson method	Solving a situational task	Survey, electronic test*, report on practical exercise
12.	Regression analysis	–	2	–	1, 2, 3	Regression analysis	Solving a situational task	Survey, electronic test, report on practical exercise

13.	Spearman's rank correlation coefficient	–	2	–	1, 2, 3	Determining the correlation between two variables using the Spearman rank method	Solving a situational task	Survey, electronic test, report on practical exercise
14.	Analysis of qualitative data (Chi-Square Statistic)	–	2	–	1, 2, 3	Rationale for using the χ^2 criterion, interpretation of results, formulation of conclusions	Solving a situational task *	Survey, electronic test
15.	Analysis of qualitative data (McNemar criterion, Fisher's exact test)	–	2	–	1, 2, 3	Rationale for the use of methods for analyzing qualitative characteristics (McNemar test, Fisher exact test), interpretation of results, formulation of conclusions	Solving a situational task	Survey, electronic test. Credit.
Total hours		3	30	3				

INFORMATION AND INSTRUCTIONAL UNIT

LITERATURE

Basic:

1. Глушанко В.С. Общественное здоровье и здравоохранение = Public health and health service : пособие. – Витебск : ВГМУ, 2020. – 188 с.

Additional:

2. Medical Statistics at a Glance, 4rd Edition : a textbook / A. Petri, C. Sabin. – Wiley, 2019. – 208p.

Electronic courseware for the academic discipline «Biomedical Statistics»:

3. <https://etest.bsmu.by/course/view.php?id=300>

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

The time allocated for independent work can be used by students to:

- preparation for practical classes;
- preparation for testing in an academic discipline;
- elaboration of topics (questions) submitted for independent study;
- performing research and creative tasks;
- preparation of thematic reports, abstracts, presentations.

METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF SUPERVISED STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

Main forms of supervised student independent work:

- preparation and presentation of reports, abstracts;
- taking notes of original sources (sections of anthologies, collections of documents, monographs, textbooks);
- preparation of tests for the organization of mutual assessment;
- preparation of didactic materials.

Control of supervised student independent work is carried out in the form of:
 defense of an abstract (report);
 individual interview.

LIST OF AVAILABLE DIAGNOSTIC TOOLS

The following forms are used for competence assessment:

- defense of an abstract (report);
- survey;
- solving a situational problem;
- report on practical exercise;
- electronic test;
- colloquium.

LIST OF AVAILABLE TEACHING METHODS

Traditional method (lecture, practical lessons);

Active (interactive) methods:

Problem-Based Learning (PBL);

Team-Based Learning (TBL);

Research-Based Learning (RBL).

LIST OF PRACTICAL STUDIES

Name of practical skill	Practical skill control form
1. Plan and program for medical and statistical research	Solving a situational task
2. Selecting a statistical Test	Solving a situational task
3. Calculation of relative values	Solving a situational task
4. Graphic representation of statistical values	Solving a situational task
5. Calculation of average values	Solving a situational task
6. Characteristics of the distribution of variables in a sample	Solving a situational task
7. Calculation of confidence intervals	Solving a situational task
8. Calculation of Student's t-test, evaluation	Solving a situational task
9. Calculation of paired Student's t-test, evaluation	Solving a situational task
10. Interpretation of the results of one-way analysis of variance	Solving a situational task
11. Test for differences between two samples of independent measurements (using the Mann-Whitney method) or paired/dependent measurements (using the Wilcoxon test)	Solving a situational task
12. Determining the correlation between two variables using the Pearson series method	Solving a situational task
13. Regression analysis	Solving a situational task
14. Determining the correlation between two variables using the Spearman rank method	Solving a situational task
15. Rationale for using the χ^2 criterion, interpretation of results, formulation of conclusions	Solving a situational task
16. Rationale for the use of methods for analyzing qualitative characteristics (McNemar test, Fisher exact test), interpretation of results, formulation of conclusions	Solving a situational task

**PROTOCOL OF THE CURRICULUM APPROVAL
BY OTHER DEPARTMENTS**

Title of the discipline requiring approval	Department	Amendments to the curriculum in the academic discipline	Decision of the department, which designed the curriculum (date, protocol #)
Public Health and Healthcare	Public Health and Healthcare	No amendments	Protocol № 11 of 17.06.2024

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Curriculum content, composition and the accompanying documents comply with the established requirements.

Dean of the Medical Faculty for International Students of the educational institution «Belarusian State Medical University»

24.06.2024

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24.06.2024

S.V. Zaturanova