

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

**Контрольный
экземпляр**



APPROVED

by First Vice-Rector, Professor

I.N.Moroz

04.07.2022

Reg. # UD- L.738/2223 /edu.

BIOMEDICAL STATISTICS

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

1-79 01 01 «General Medicine»

Curriculum is based on the educational program «Biomedical Statistics», approved 01.07.2022, registration # УД-Л.738/2223/уч; on the educational plan in the specialty 1-79 01 01 «General medicine», approved 18.05.2022, registration # L 79-1-1/2223/mf.

COMPILERS:

T.P.Pavlovich, Head of the Department of Public Health and Healthcare of the educational institution «Belarusian State Medical University», PhD, Associate Professor;

A.N.Charauko, Associate Professor of the Public health and Health Care Department of educational institution «Belarusian State Medical University», PhD;

I.I.Khalyamina, Senior Teacher of the Public health and Health Care Department of educational institution «Belarusian State Medical University»;

H.I.Kapytnik, Assistant of the Public health and Health Care Department of educational institution «Belarusian State Medical University»

RECOMMENDED FOR APPROVAL:

by the Department of Public Health and Healthcare of the educational institution «Belarusian State Medical University»
(protocol # 10 of 26.04.2022);

by the Scientific and Methodological Council of the educational institution «Belarusian State Medical University»
(protocol # 6 of 29.06.2022)

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 goal of the discipline «Biomedical Statistics» is to form universal competencies of planning and performing individual medical-biological statistic 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 teaching the discipline «Biomedical Statistics» are to develop students' scientific knowledge and skills that are necessary for the planning and implementation of independent 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 medico-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 following academic discipline «Public Health and Health Care».

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

UC-1. Master the basics of research, be able to search, analyze and synthesize information in medicine and biology

UC-2. Solve standard tasks of professional activity 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;

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;

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 independent work– 2 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 ACCORDING TO SEMESTERS OF STUDY

| Code, name of the specialty | semester | Number of academic hours | | | | | | Form of intermediate assessment |
|----------------------------------|----------|--------------------------|----------|--|-------------------------------------|-------------------|---------------------------|---------------------------------|
| | | total | in-class | including | | | out-of-class self-studies | |
| | | | | lectures (including supervised student independent work) | supervised student independent work | practical classes | | |
| 1-79 01 01 «General Medicine» | 3 | 108 | 36 | 6 | 2 | 30 | 72 | credit |

THEMATIC PLAN

| Section (topic) name | Number of class hours | |
|--|-----------------------|-----------|
| | lectures | practical |
| 1. Biomedical statistics as a science | 2 | - |
| 2. Method of statistical observation | 2 | - |
| 3. Basics of evidence-based medicine | 2 | - |
| 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 of estimation of reliability of the statistical hypotheses | - | 4 |
| 11. Analyses of variance | | 2 |
| 12. Nonparametric methods of estimation of reliability of the 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

Statistics, definition of terms. 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.

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. Basics of evidence-based medicine

Evidence-based medicine. Principles and methodological basis of evidence-based medicine. Basic concepts in the fields of diagnosis (sensitivity, specificity, classification accuracy, prevalence, screening, etc.), treatment (randomization, double-blind, placebo and nocebo effects) and literature analysis (medical research databases, systematic literature reviews and meta-analysis).

Types of clinical trials. The concept of the endpoint in a clinical trial. The concept of the «gold standard» in a clinical trial. Tables of concordance and their interpretation in evidence-based diagnosis and treatment.

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.

Types of variables, characteristics. Observation unit, registering signs (quantitative, qualitative, factor, resulting).

Grouping and summing, characteristic.

5. Statistical hypotheses

Statistical hypotheses and criteria. Basic Principles of Hypothesis Testing.

The concept of reliability and statistical significance.

Parametric and nonparametric criteria. Classification of methods. 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

Data visualization. Types of graphs, characteristics. Types of diagrams, characteristics. Requirements for presentation of graphs and diagrams. Using in medicine.

8. Variational series

Variational series. Types of variational series. Average values (mode, median, arithmetic mean). Methods of calculation of average values. Use of average values in medicine.

Selective observation. Types, ways and methods of selection, providing a representativeness of the totality.

Absolute and relative indicators of variation (limit, amplitude, standard deviation, dispersion, coefficient of variation, rate oscillations), characteristic. Using in medicine.

9. Distribution of variables in the totality

Checking the normality of the distribution of attributes in the totality.

10. Parametric methods of estimation of reliability of the statistical hypotheses

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

Calculation of average arithmetic error, characteristic.

Calculation of error of relative values, characteristic.

The volume of totality, methods of its calculation.

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 of estimation of reliability of the 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

| Section, topic # | Section (topic) name | number of hours | | | Self-studies | Form of control |
|------------------|--|------------------------------------|-------------------------|-----------|--------------|--|
| | | Lectures (supervised student work) | supervised student work | practical | | |
| 1. | Biomedical statistics as a science | 2 | 0,5 | - | 2 | Studying topics and problems that have not been discussed at the lectures, Interviews, tests |
| 2. | Method of statistical observation | 2 | 0,5 | - | 2 | Preparation of reports, essays, presentations |
| 3. | Basics of evidence-based medicine | 2 | 1 | - | 2 | Preparation of reports, essays, presentations |
| 4. | Organization of medical and statistical research | - | - | 2 | 5 | Interview, tests, accounts of classroom practical exercises with oral defense |
| 5. | Statistical hypotheses | - | - | 2 | 5 | Interview, reports, tests, accounts of classroom practical exercises with oral defense |
| 6. | Relative values | - | - | 2 | 5 | Interview, tests, accounts of classroom practical exercises with oral defense, control questioning |
| 7. | Graphic images | - | - | 2 | 5 | Interview, tests, accounts of classroom practical exercises with oral defense |
| 8. | Variational series | - | - | 2 | 5 | Interview, tests, accounts of classroom practical exercises with oral defense |

| | | | | | | | |
|-----|---|----------|----------|----------|-----------|-----------|--|
| 9. | Distribution of variables in the totality | - | - | - | 2 | 5 | Interview, tests, written classroom (home) practical exercises |
| 10. | Parametric methods of estimation of reliability of the statistical hypotheses (error of representativeness. Student's t-test. The probability of faultless prognosis. The volume of totality, methods of its calculation) | - | - | - | 2 | 3 | Interview, reports, electronic tests, accounts of classroom practical exercises with oral defense |
| | Parametric methods of estimation of reliability of the statistical hypotheses (comparison of the results of two samples) | - | - | - | 2 | 2 | Colloquiums, interview, reports, electronic tests, accounts of classroom practical exercises with oral defense |
| 11. | Analyses of variance | - | - | - | 2 | 5 | Interview, tests, assessment based on role-playing |
| 12. | Nonparametric methods of estimation of reliability of the statistical hypotheses | - | - | - | 2 | 5 | Interview, tests, accounts of classroom practical exercises with oral defense |
| 13. | Correlation. Pearson correlation coefficient | - | - | - | 2 | 5 | Interview, tests, accounts of classroom practical exercises with oral defense |
| 14. | Regression analysis | - | - | - | 2 | 5 | Interview, tests, accounts of classroom practical exercises with oral defense |
| 15. | Spearman's rank correlation coefficient | - | - | - | 2 | 5 | Interview, tests, accounts of classroom practical exercises with oral defense |
| 16. | Analysis of qualitative data (Chi-Square Statistic χ^2) | - | - | - | 2 | 3 | Interview, electronic tests, accounts of classroom practical exercises with oral defense |
| | Analysis of qualitative data (McNemar test, Fisher's exact test) | - | - | - | 2 | 3 | Credit |
| | Total hours | 6 | 2 | 2 | 30 | 72 | |

INFORMATION AND INSTRUCTIONAL UNIT

LITERATURE

Basic:

1. Medical Statistics at a Glance : a textbook / A. Petri, C. Sabin. – Wiley, 2019. – 208p.

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

Main forms of supervised student independent work:

preparation of reports, essays, presentations;
 presentation of reports;
 studying topics and problems that have not been discussed at the lectures;
 computer testing;
 preparation of didactic materials;
 participation in active forms of education.

Control of supervised student independent work is carried out in the form of:

test paper;
 final class, colloquium in the form of written work, testing;
 discussion of reports, essays;
 protection of study assignments;
 assessment of an oral reply to a question, presentation, report or problem solving;
 checking up abstracts, written reports, accounts, prescriptions;
 individual interview.

LIST OF AVAILABLE DIAGNOSTIC TOOLS

The following forms are used for competences assessment:

Oral form:

interviews;
 colloquiums;
 reports;
 assessment based on role-playing.

Written form:

tests;
 control questioning;
 written classroom (home) practical exercises;
 reports.

Oral-written form:

accounts of classroom practical exercises with oral defense;
 credit.

Technical form:

electronic tests.

LIST OF AVAILABLE TEACHING METHODS

Traditional method (lecture, laboratory practicals);

Active (interactive) methods:

- Problem-Based Learning (PBL);
- Team-Based Learning (TBL);
- Case-Based Learning (CBL);
- Research-Based Learning (RBL).

LIST OF PRACTICAL SKILLS

1. Preparation of the plan and program of medical and statistical research.
2. Calculation of relative values.
3. Graphic representation of statistical values.
4. Calculation of average values.
5. Characteristics of the diversity of variables in the sample totality.
6. Characteristics of the distribution of variables in the sample totality.
7. Calculation of the confidence interval.
8. Estimation of reliability of difference of statistical values (Student's t-test).
9. Test of differences between two samples of independent measurements (Mann-Whitney test) or paired/dependent measurements (Wilcoxon signed-rank test).
10. Determination of the correlation (Pearson correlation coefficient).
11. Conducting the regression analyses.
12. Determination of the correlation (Spearman's correlation coefficient).
13. Interpretation of variance analysis results.
14. Determination Indications for the analysis of qualitative signs (chi-square, McNemar test, Fisher's exact test), evaluation.

LIST OF EQUIPMENT USED

Multimedia equipment (laptop, projector, screen).

Standard workstation with a personal computer.

Tables of critical values to determine the level of statistical significance of the calculated indicators.

LIST OF LECTURES

1. Biomedical statistics as a science.
2. Method of statistical observation.
3. Basics of evidence-based medicine.

LIST OF PRACTICAL STUDIES

1. Organization of medical and statistical research.
2. Statistical hypotheses.
3. Relative values.
4. Graphic images.
5. Variational series.
6. Distribution of variables in the totality.

7. Parametric methods of estimation of reliability of the statistical hypotheses (error of representativeness. Student's t-test. The probability of faultless prognosis. The volume of totality, methods of its calculation).

8. Parametric methods of estimation of reliability of the statistical hypotheses (comparison of the results of two samples).

9. Analyses of variance.

10. Nonparametric methods of estimation of reliability of the statistical hypotheses.

11. Correlation. Pearson correlation coefficient.

12. Regression analysis.

13. Spearman's rank correlation coefficient.

14. Analysis of qualitative data (Chi-Square Statistic χ^2).

15. Analysis of qualitative data (McNemar test, Fisher's exact test).

**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 #) |
|--|--------------------------------|---|---|
| 1. Medical and biological physics | Medical and biological physics | No amendments | protocol # 10 of 26.04.2022 |

COMPILERS/AUTHORS:

Head of the Department of Public Health and Healthcare of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor



T.P. Pavlovich

Associate Professor of the Department of Public Health and Healthcare of the Educational Institution «Belarusian State Medical University», PhD



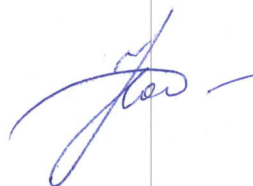
A.N. Charauko

Senior teacher of the Department of Public Health and Healthcare of the Educational Institution «Belarusian State Medical University»



I.I. Khalyamina

Assistant of the Department of Public Health and Healthcare of the educational institution «Belarusian State Medical University»



H.I. Kapytnik

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»



O.S. Ishutin

28.06. 2022





Methodologist of the educational institution «Belarusian State Medical University»



S.V. Zaturanova

28.06. 2022

Information about the authors (compilers) of the curriculum

| | |
|---|--|
| Name | PAVLOVICH TATIANA PETROVNA |
| Position, scientific degree, title | Head of the Department of Public Health and Healthcare of the Educational Institution «Belarusian State Medical University», Candidate of Medical Sciences, Associate Professor |
|  service | +375 (017) 379 89 65 |
| <i>E-mail:</i> | ozz@bsmu.by |
| Name | CHARAUKO ALA NIKOLAEUNA |
| Position, academic degree, academic rank | Associate Professor of the Department of Public Health and Healthcare of the Educational Institution «Belarusian State Medical University» |
|  service | +375 (017) 379 89 65 |
| <i>E-mail:</i> | MinskOZZ@yandex.ru |
| Name | KHALYAMINA IRINA IGOREVNA |
| Position, scientific degree, title | Senior teacher of the Department of Public Health and Healthcare of the Educational Institution «Belarusian State Medical University» |
|  service | +375 (017) 379 89 65 |
| <i>E-mail:</i> | ozz@bsmu.by |
| Name | KAPYTNIK HANNA IGOREVNA |
| Position, scientific degree, title | Assistant of the Department of Public Health and Healthcare of the educational institution «Belarusian State Medical University» |
|  service | +375 (017) 379 89 65 |
| <i>E-mail:</i> | ozz@bsmu.by |