FACULTY OF MEDICINE

STUDY PROGRAM 0912.1 MEDICINE

***NICOLAE TESTEMITANU* CHAIR OF SOCIAL MEDICINE AND HEALTH MANAGEMENT**

APPROVED
at the meeting of the Commission for Quality Assurance and Evaluation of the Curriculum faculty Medicine
Minutes No. 10 of 18.06.20
Chairman, PhD, associate professor
Suman Serghei _____

APPROVED
at the Council meeting of the Faculty Medicine no. 2

Minutes No. 4 of 23.06.20
Dean of Faculty, PhD, associate professor
Beţiu Mircea _____

APPROVED
at the meeting of the *Nicolae Testemitanu* Chair of Social Medicine and Health Management
Minutes No. 7 of 22.01.2020
Head of chair, PhD, associate professor
Elena Raevschi _____

SYLLABUS

DISCIPLINE **BIOSTATISTICS. METHODOLOGY OF SCIENTIFIC RESEARCH**

Integrated studies

Type of course: **Compulsory**

Chisinau, 2020

I. INTRODUCTION

- **General presentation of the discipline: place and role of the discipline in the formation of the specific competences of the professional / specialty training program**

The course "Biostatistics. Methodology of scientific research" covers the theoretical and practical aspects related to the realization of a scientific research and the statistical data analysis. The course has the content similar to other European universities with up-to-date information, and it equips students with necessary baggage of knowledge in order to carry out a scientific research in the field of biomedical science. The course presents a predominantly applicative approach to the statistical methods needed to solve practical problems in the biomedical field.

- **Mission (aim) of the curriculum in professional training**:
  Assimilation of the theoretical and practical knowledge necessary for carrying out a scientific research in the medical sciences, including the licentiate thesis.

- Language (s) of the course: Romanian, English, Russian, French

- Beneficiares: students of the II year, faculty Medicine I and Medicine II, **specialty Medicine**

II. MANAGEMENT OF THE DISCIPLINE

Code of discipline		**U.03.O.025**	
Name of the discipline		Biostatistics. Methodology of Scientific Research	
Person(s) in charge of the discipline		Raevschi E., Penina O., Obreja G.	
Year	II	Semester/Semesters	III
Total number of hours, including:			120
Lectures	17	Practical/laboratory hours	
Seminars	51	Self-training	52
Clinical internship			
Form of assessment	E	Number of credits	4

III. TRAINING AIMS WITHIN THE DISCIPLINE

At the end of the discipline study the student will be able to:

✓ ***at the level of knowledge and understanding:***

- To know and to apply appropriately the notions specific to the discipline, as well as the theoretical and practical contents of the discipline;
- To know the rules and steps of research process;
- To know the types of data and the principles of their classification;
- To know and to understand the scales of measurement of the data;
- To know how to collect the data;
- To know the methods of data summarizing depending on the type of data;
- To know and to understand the principles of performing the descriptive and inferential statistical medical data analysis;
- To know the types of statistical hypothesis and steps of statistical significance testing;
- To know the main types of statistical tests;
- To know the algorithm of selection of a specific test depending on the type of research;
- To be familiar with the rules of use of biostatistics in the analysis of the population's health;
- To know the main types of epidemiological studies, their advantages and disadvantages;
- To know the ethical rules in research;

✓ ***at the application level:***

- To properly apply the methods of descriptive and inferential statistics to quantitative and qualitative data analyzing;
- To properly present qualitative and quantitative data graphically;
- To apply the direct method of standardization of rates and to interpret the results;

- To formulate correctly research hypothesis;
- To select and to apply correctly statistical tests in the hypothesis testing process;
- To analyze and to interpret the results of epidemiological studies;
- To provide a critical overview of a medical scientific article;
- To develop a study project in the biomedical area;
- To create Power Point Presentation;
- To present the results of biomedical research publicly.

✓ ***at the integration level:***

- To assess the place and role of biostatistics and research methodology in the professional medical career;
- To integrate the knowledge in biostatistics and research methodology with clinical disciplines;
- To be able to apply the accumulated knowledge to practical and research activities;
- To be competent to use information critically from scientific publications in own researches using the new information and communication technologies.

IV. PROVISIONAL TERMS AND CONDITIONS

1. Language requirements;
2. Basics of the school mathematics;
3. Basic computer skills (MS Office Word, EXCEL, PowerPoint);
4. Ability to communicate and to work in a team.
5. Non-work-related activities are strictly forbidden during classes, disconnected mobile phones;
6. Lateness is not tolerated.

V. THEMES AND ESTIMATE ALLOCATION OF HOURS

Lectures, practical hours/ laboratory hours/seminars and self-training

Nr. d/o	THEME	Number of hours		
		Lectures	Practical hours	Self-training
1.	Biostatistics and Research Methodology. An Introduction. Types of variables. Scales of measurement. Graphical presentation of data.	2	6	6
2.	Descriptive statistics for quantitative data description. Measures of Central Tendency. Measures of variability.	2	6	6
3.	Descriptive statistics for qualitative data description: ratio, proportion, rate. Data standardization.	2	6	6
4.	Inferential statistics: basic theoretical concepts. Hypothesis testing. Methods of inference for quantitative and qualitative data. Parametric and non-parametric tests.	2	9	9
5.	Correlation and regression	2	3	3
6.	Methodology of Scientific Research. An Introduction. Definitions, terminology, theoretical concepts. Steps of the scientific research	2	3	3
7.	Types of epidemiological study designs. Descriptive and analytical study designs. Clinical trials	3	9	9
8.	Public presentation of a research project. Software / software packages used to create a scientific paper. Ethics of medical research. Plagiarism.	2	9	10
Total		**17**	**51**	**52**

VI. REFERENCE OBJECTIVES OF CONTENT UNITS

Objectives	**Content units**
Theme (chapter) 1. Descriptive statistics	

Objectives	Content units
• *To define* the basic terminology used in descriptive statistics; • *To know* the types of data and scales of measurement • *To demonstrate* capacities to precise the type of a variable and the scale of measurement, as well as data frequency distribution; • *To apply* the methods of graphical presentation of statistical data depending on their type; • *To integrate* the knowledge obtained in the given field for the appropriate processing of qualitative and quantitative data obtained in a scientific research.	**Topic 1. Biostatistics and Research Methodology. An introduction. Types of variables. Data measurement scales. Graphical representation of data.** - Population; - Sample; - Statistical unit; - Variable; - Statistic; - Parameter; - Classification of variables: ✓ quantitative (continuous, discrete) ✓ qualitative (alternative, non-alternative) - Scales of measurement: ✓ Nominal scale ✓ Ordinal scale ✓ Interval scale ✓ Ratio scale - Data summary and graphical illustration of the results - table and figure: ✓ for qualitative variables ✓ for quantitative variables - Frequency distribution: ✓ for qualitative variables ✓ for quantitative variables - Relative frequency. Cumulative frequency. Cumulative relative frequency for qualitative and quantitative data.
• *To define* the particularities of measures of central tendency and variability • *To know* the distribution of individual values according to the law of normal distribution • *To demonstrate* capacity to calculate measures of central tendency and of variability for ungrouped data and interpret the results • *To apply* numerical methods for the description of quantitative data in analysing the results of medical activity and scientific research • *To integrate* the knowledge obtained in the given field for the appropriate processing of quantitative data obtained in a medical and scientific activity	**Topic 2. Descriptive statistics for the description of quantitative data** - *Measures of central tende*ncy. Calculation and interpretation of the results: ✓ arithmetic mean ✓ median ✓ mode - *Measures of variability*. Calculation and interpretation of the results: ✓ Amplitude ✓ Variance ✓ Standard deviation ✓ Coefficient of variation ✓ Interquartile range (IQR) - Law of normal distribution - Measures of relative position: quartiles (Q_1, Q_2, Q_3) - "Boxplot" - Frequency distribution curve: ✓ Unimodal and bimodal ✓ Normal and skewed
• *To define* correctly the main notions regarding ratio, proportion and rate; • *To know* importance of the correct utilisation of relative measures for the description, analysis and surveillance of the health status of the population; • *To demonstrate* the correct interpretation of the crude and standardised rates in the analysis of mortality, natality and morbidity; • *To apply* properly relative measures in analysing the health status of the population;	**Topic 3. Descriptive statistics for the description of qualitative data** - Calculation and graphical presentation of relative measures of *rate* type (intensive statistical measures) - Calculation and graphical presentation of relative measures of *proportion* type (extensive statistical measures) - Calculation and graphical presentation of relative measures of *ratio* type - Direct method of standardization of rates. Steps of standardization - Vital statistics: mortality, natality and morbidity - Incidence and prevalence

Objectives	Content units
• *To integrate the* knowledge accumulated in the given field for the appropriate processing of qualitative data obtained in a medical and scientific activity	
Theme (chapter) 2. Inferential statistics. Correlation and regression	
- *To define* the basic theoretical concepts related to the inferential statistics; - *To know* the vocabulary used in the field of hypothesis testing and the main steps of application of a statistical test; - *To demonstrate* the correct interpretation of a statistical test using a *p*-value; - *To apply* the methods of inferential statistics for means and relative measures studied within the course; - *To integrate* the obtained knowledge in the field of inferential statistics with clinical disciplines to carry out a scientific research.	**Topic 4. Inferential statistics: the basic theoretical concepts. Hypothesis testing. Inferential methods for quantitative and qualitative data** - Classical definition of probability - The Law of Large Numbers - The random sampling distribution of means. Standard error - Testing of statistical hypothesis: null hypothesis (H_0) and alternative hypothesis (H_1) - Type I and type II errors - The significance (alpha) level and *p*-value. - Statistical power of the study - Steps of statistical hypothesis testing - Confidence intervals: types and methods of calculation - Inferential methods for quantitative data (means) ✓ Type *t* tests for one sample: the comparation between a sample mean and a population mean ✓ Type *t* tests for two independent samples: the comparation between means of two independent samples ✓ Type *t* tests for two pared samples: the comparation between two repeated measurements of the same group - Inferential methods for qualitative data: ✓ Contingency tables ✓ Chi-squared test ✓ Fisher exact test
- *To define* the basic theoretical concepts related to the correlation and regression; - *To know* the conditions of application of correlation coefficients and their interpretation; - *To demonstrate* the capacity of a correct interpretation of scatterplot and of coefficient of determination; - *To apply* the methods of calculation of the main correlation and regression measures; - *To integrate* the obtained knowledge in the field of analysis of correlation and regression for the appropriate processing of statistical data obtained in a clinical and scientific activities.	**Topic 5. Correlation and regression** - Correlation: direction and size of association - Correlation coefficient r (Pearson) - Rank correlation coefficient (Spearman) - Conditions of application and interpretation of coefficients of correlation - Graphical visualization and analysis of scatterplot - Coefficient of determination (r^2) - Simple and multiple linear regression - Logistic regression - Tests of significance and confidence interval for the correlation coefficient r
Theme (chapter) 3. Research methodology	
To define the main concepts of the scientific research methodology ; *To know* the content of the main steps of a scientific research ; *To demonstrate* the knowledge of the fundamental concepts of a survey ; *To apply* formulas for calculating the sample size; *To integrate* the knowledge gained in the field of Research Methodology with clinical and scientific activities.	**Topic 6. Research Methodology. An introduction: definitions, terminology, theoretical concepts. Steps in a research process** - Research: definition, classification, research characteristics - Steps in a research process. Development of a research plan - The main methods of data collection - Survey. Questionnaire - Methods of sampling (probabilistic and non-probabilistic methods). Sample size Causality in statistical association. Validity of a study. Study design evidence strength.

Objectives	Content units
To define the methodological principles of the epidemiologic studies; *To know* advantages and disadvantages of epidemiologic studies; *To demonstrate* the understanding and interpretation of the analytical study design results; *To apply* methods of calculation of the association measures used in analytical study design and interpret the results; *To integrate* the knowledge gained in the field of epidemiological study design analysis with clinical and scientific activities of a physician.	**Topic 7. Epidemiological study design. Descriptive and analytical study design. Clinical trials** - Classification of the epidemiological study design - Observational descriptive study design: ✓ Case-report and case-series ✓ Cross-sectional ✓ Advantages and disadvantages - Observational analytical study design. Case-control study design: ✓ Methodological principles ✓ Advantages and disadvantages ✓ Odds ratio (OR) - Observational analytical study design. Cohort study design: ✓ Methodological principles ✓ Advantages and disadvantages ✓ Relative Risk (RR) and Attributable Risk (AR) - Experimental study design (Clinical trials): ✓ Methodological principles of a clinical trial ✓ Types of clinical trials o Controlled trials with parallel control o Sequential controlled trials (crossover) o Self-control ✓ Advantages and disadvantages of clinical trials ✓ Processing and analysing results of the clinical trials o Experimental Event Rate (EER) o Control Event Rate (CER) o Relative Risk (RR) o Relative Risk Reduction (RRR) o Absolute Risk Reduction (ARR) o Number Needed to Treat (NNT)
To define the methods of presentation of final results of a research; *To know* the structure of scientific paper and the main rules in its writing; *To demonstrate* the ability of clear distinguishing between already known information and interpretation of the results obtained from its own research; *To apply* the knowledge to the respective topic for carrying out a research project in a Power Point format and its public defence; *To integrate* the accumulated knowledge for conducting personal research in the licence thesis, publications and scientific conferences.	**Topic 8. Presentation of a research results** - Definition and types of scientific papers - The structure of a scientific paper - The basic rules in writing a scientific paper - Bibliography and citation of other authors - Software/software packages used for the creation of a scientific paper - Medical research ethics. Plagiarism - Public defence of a research project (Power Point) by the student.

VII. PROFESSIONAL (SPECIFIC (SC)) AND TRANSVERSAL (TC) COMPETENCES AND STUDY OUTCOMES

✓ **Professional (specific) (SC) competences**

CP2.
- To know and to apply properly the fundamental concepts required to carry out scientific research and statistical processing of data;
- To apply correctly a statistical protocol specific to a particular epidemiological study design (observational, experimental);
- To perform descriptive statistical analysis of the experimental data, including their graphic representation;
- To formulate correctly the statistical hypothesis, to select and to use the most appropriate statistical tests depending on the nature of the data and the type of study;

- To identify the main sources of systematic biases and random errors in an epidemiological study.

CP4. - To apply statistical analysis techniques for solving practical biomedical problems
CP5. - To use properly the methods of population health data analysis
CP6. - Ability to elaborate a scientific paper in the medical field (e.g., licentiate thesis, writing a scientific article, conference report, etc.), to analyse and to interpret critically the specialised scientific papers.

✓ **Transversal competences (TC)**

CT1.
- To understand the importance of statistical analysis of data in the modern context of "evidence-based medicine";
- To use the knowledge of statistical analysis in the context of other disciplines, as well as in solving practical problems.

CT2.
- Student's development and empowerment;
- Student's openness to lifelong learning.

CT3.
- To demonstrate the involvement in scientific activities, such as the elaboration of scientific articles and researches in the biomedical field;
- The oral and written communication of the results of a scientific research, including the licentiate thesis.

✓ **Study outcomes**

The student at the end of the course will be able:
- To explain the basic concepts with regard to the organization of a scientific research and publication of the results;
- To develop a research project in the biomedical field;
- To present the description of experimental data depending on its nature and to explain correctly the results of the statistical inference;
- To determine the statistical methods for data analysis taking into account the study design characteristics, the scale of measurement, the number of variables involved;
- To characterize the basic features of the epidemiological study designs (observational and experimental), their advantages and limitations;
- To perform an epidemiological study (observational or experimental) and interpret its results correctly;
- To develop a scientific paper, including the license thesis, and to capitalize on its results;
- To assess the role and importance of biostatistics and the research methodology in the modern context of "evidence-based medicine";
- To have openness to lifelong learning.

Note. Study outcomes (are deduced from the professional competencies and formative valences of the informational content of the discipline).

VIII. STUDENT'S SELF-TRAINING

No.	Expected product	Implementation strategies	Assessment criteria	Implementation terms
1.	Working with information sources	To read the material carefully for the corresponding theme from the textbook. To answer to the questions given at the end of each theme. Formulation of conclusions.	The ability to extract the essentials, the ability to interpret and to present the didactic material.	During the semester
2.	Performing a PowerPoint research project and its public defence.	Selection of the research theme, elaboration of the research plan and program, carrying out the research with respect to the planned stages according to the plan for the realization of the Research Project for students in the discipline "Biostatistics. Methodology of Scientific Research".	The volume of work, the degree of penetration into the researched problem, the correctness of applying the descriptive and inferential statistics methods, the quality of the conclusions, the quality of the public presentation.	During the semester
3.	Solving the practical problems	Practical problems are solved after analysing the information on the topic in the textbook. Some practical problems can be solved on the	Solving the problems of the situation, the quality of conclusions.	During the semester

		computer with MS Office EXCEL in the computer room of the Department.		

IX. METHODOLOGICAL SUGGESTIONS FOR TEACHING-LEARNING-ASSESSMENT

- ***Teaching and learning methods used***

For more effective learning and achieving the objectives of the teaching process in the course "Biostatistics. Methodology of Scientific Research", both traditional methods (exposure, conversation, exercise) and those considered today to be more effective for university education (problem-based learning, case study, project method, modelling) are used. Practical methods use frontal methods, individual activity methods, group activity methods. Practical training within the course uses computer-assisted training / self-training (MS Office EXCEL, PowerPoint).

- ***Applied teaching strategies / technologies*** *(specific to the discipline)*

Communication Technologies such as PowerPoint presentations are used during the theoretical lectures and practical seminars.

- ***Methods of assessment*** *(including the method of final mark calculation)*

Current:

Theoretical part:

1. Computer-assisted midterm test nr.1 - Descriptive statistics
2. Computer-assisted midterm test nr.2 - Inferential statistics
3. Computer-assisted midterm test nr.3 - Methodology of scientific research

Practical part:

4. Critical reading of a scientific paper (coefficient 0.3) + Research project (coefficient 0.6) + solving of problems during seminars (coefficient 0.1).

The semester mark is calculated as the average of three midterm tests and the research project mark.

Final: examination.

The examination for the discipline “Biostatistics. Research Methodology” represents the computerised grid-test. It includes 50 random questions from each of the studied themes with 40% single-choice questions and 60% multiple-choice questions. The student has at his/her disposal 50 minutes to answer to the grid-test.

Those students who have the semester mark less than 5.0 and / or did not recover their absence(s) for the practical seminars and theoretical lectures are not admitted to the final examination.

The subjects for the final examination are approved at the chair meeting and are notified to the students one month before the exam.

The **final mark** is calculated as the average of the semester mark (coefficient is 0.5) and the mark for the test-grid obtained at the exam (coefficient is 0.5).

The evaluation of the knowledge is appreciated with marks from 1.00 to 10.00, as follows:

Method of mark rounding at different assessment stages

Intermediate marks scale (annual average, marks from the examination stages)	National Assessment System	ECTS Equivalent
1.00-3.00	**2**	**F**
3.01-4.99	**4**	**FX**
5.00	**5**	**E**
5.01-5.50	**5.5**	
5.51-6.0	**6**	
6.01-6.50	**6.5**	**D**
6.51-7.00	**7**	
7.01-7.50	**7.5**	**C**
7.51-8.00	**8**	
8.01-8.50	**8.5**	**B**
8.51-8.00	**9**	
9.01-9.50	**9.5**	**A**
9.51-10.0	**10**	

The average annual mark and the marks of the final examination - are expressed in numbers according to the mark scale (according to the table), and the final mark obtained is expressed in number with two decimals, which is transferred to student’s record-book.

Absence on examination without good reason is recorded as "absent" and is equivalent to 0 (zero). The student has the right to have two re-examinations.

X. RECOMMENDED LITERATURE:

A. Compulsory:

1. **RAEVSCHI E., TINTIUC D.**, 2012. *Biostatistics & Research Methodology*. Methodological recommendation for medical students. Chisinau: Medicina, 94 p.
2. **RAEVSCHI E., PENINA O.**, 2016. *Reporting of Findings of Medical Research: Term Project Presentation Guide*. Methodological recommendations for the course in Biostatistics and Research Methodology for medical students. Chisinau: Medicina, 27 p. (available in an electronic format for students in SIMU).

B. Additional

1. **GLASER ANTHONY N.**, 2013, *High-Yield Biostatistics, Epidemiology, and Public Health*, Fourth edition, Philadelphia, LWW, 168 p.
2. **TINTIUC D., BADAN V., RAEVSCHI E.**, et al., 2011. *Biostatistica şi Metodologia Cercetării Ştiinţifice* (suport de curs). Chișinău: Medicina, 344 p. (în română).
3. **URDAN T. C.**, 2010, *Statistics in Plain English, Third Edition*, 3 edition, New York, Routledge, 224 p.