**MEDICAL STATISTICS**

**Table 1.**

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| **1. PURPOSE AND OBJECTIVES OF TRAINING** | |
| Nowadays, knowledge of, and competence in, the application of statistical principles and methods are of utmost importance, not only for an understanding of the biological and medical sciences, but also for effective practice in any of the health professions. Because of the variability of biological, clinical and laboratory data, the science of statistics is necessary and central to their understanding and interpretation.  The course in “Medical statistics” aims at enabling medical students to understand the basic principles and statistical methods used nowadays in different branches of medical science and medical practice.  The content of teaching is organized in two parts:  1. Descriptive statistics – basic concepts, stages of the research process, sampling and types of samples, classification of variables, organization and presentation of data, distributions, descriptive statistics for qualitative and quantitative variables.  2. Inferential statistics - statistical analysis of relationship between dependent (effect) and one or more independent (causes) variables, generalization from a sample to a population, confidence intervals, probability, parametric and non-parametric methods of hypothesis testing.  At the end of the course the students should be able to:   * Define the concepts of population and sample, representative sample and sampling methods; * Determine the different types of variables and their meaning; * Explain the characteristics of normal distribution, standard normal curve and z scores; * Characterize two types of skewed distributions – positively and negatively skewed; * Define the descriptive statistics for qualitative variables, their calculation and graphical presentation; * Define the measures of central tendency, their calculation and graphical presentation; * Define measures of spread, their calculation and graphical presentation; * Use measures of central tendency and spread to establish groups of normality; * Explain the meaning and use of correlation coefficients; * Determine the concept of generalisation of data from a sample to a population and all concepts related to this process – probability, sampling error of the mean, confidence intervals and to make simple calculations of confidence intervals; * Define the main concepts in hypothesis testing – types of hypothesis, type I and type II errors, one-tailed and two-tailed t test, P value; * Test hypotheses using parametric tests and make conclusions using tables of critical values of t test; * Test hypotheses using non-parametric test chi-square and tables of its critical values.     undeer | |
| **2. FACULTY** | |
| **Lecturer:**   * **Assoc. Prof. Dr. Gena Grancharova, MD, PhD**; room 322, tel.: 064 884 224   E- mail: [gena\_grancharova@mu-pleven.bg](mailto:gena_grancharova@mu-pleven.bg)  **Assistant professor:**   * **Eleonora Mineva-Dimitrova*,*** Master in Statistics; room 323, tel. 064 884 226;   E- mail: [eleonora.mineva@abv.bg](mailto:eleonora.mineva@abv.bg) | |
| **3. PROGRAMME OF STUDY (CURRICULUM)** | |
| Medical statistics is an optional subject and is scheduled in second year, fourth semester in the academic plan for the specialty “Medicine”. This is the only subject for medical students that is providing specific knowledge in methodology of medical research, organization and presentation of data, descriptive statistics for summarization of data and statistical techniques for generalization of data from a sample to a population and for hypothesis testing by parametric and non-parametric tests.  The curriculum in Medical Statistics is designed according to the guidelines of the World Health Organization how to teach medical statistics to medical students and corresponds to the introductory courses provided in most of the medical faculties and universities all over the world.  File: MStat-AEO-Programme.docx | |
| **4. LECTURE COURSE** | |
|  | The lecture course consists of 15 academic hours, eralised in 7 and ½ two hour-lectures.  **To the lecture course…** |
| **5. ADDITIONAL MATERIALS** | |
| In order to help students to better understand the basic concepts and methods in medical statistics some additional material are prepared:  Appendix 1. Critical values of one-tailed and two-tailed t-test  Appendix 2. Critical values of chi-square  Appendix 3. Critical values of z score  Appendix 4. Short glossary in medical statistics  Appendix 5. Recommended literature | |
| **6. PRACTICAL TRAINING** | |
| Practical training is organized in the same way as the lecture course. It is intended at helping the medical students to better understand the basic principles, concepts and statistical techniques in relation to medical science and medical practice. The discussions, calculation and interpretation of data are supported by demonstration of IBM SPSS Statistics v.24.    **The theses of the practical trainings can be found in the programmer of study (curriculum).** | |
| **7. Examination synopsis in medical statistics** | |
| The synopsis reflects all lecture presentations and information provided to the students during their practical training.  File: MStat-AEO-Synopsis.docx | |
| **8. Multiple choice tests questions** | |
| During the course the students have to complete two tests.   * The first test is scheduled at the 4th practical training and covers the introduction and descriptive statistics. * The second test is scheduled at the 7th practical training and covers inferential statistics. * The format of both tests corresponds to the exam test and the result of both tests (as average) is taken into account as 30% of the final examination mark.   **Test examples can be found at the end of all lecture presentations and at the link below.**  Files: SampleTest1.docx  SampleTest2.docx | |
| **9. GENERAL COMMENTS AND RECOMMENDATIONS** | |
| This section contains instructions on how to prepare for the course. During the semester the students should follow the information provided on the special sector of the information board at the department of Public Health Sciences.  **The general comments and recommendations can be found using the link below.**  File: General comments and recommendations.docx | |
| **10. FORUM ON THE DISCIPLINE** | |
| The forum in medical statistics is developed to give opportunity for communication between the students. The faculty prefers direct personal contact during the lectures and practical training and they will not participate in the forum. | |
| **11. CONSULTATIONS** | |
| Consultations will be provided according to a predetermined schedule that will be available on the information board at the Department of Public Health Sciences. | |

**Table 2.**

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| **Lecture 1: Introduction to statistics** |
| Definition and major objectives of statistics. Basic concepts – population and sample. Types of studies – 100% studies, monographic studies, genuine sample studies. Stages of the research process – planning, formulating hypotheses or aims, research design, data collection, organization and presentation of data, data analysis. Sampling and sample types. Classification of variables. Organizing and presenting the data. Table presentation. Graphical presentation.  Test examples.    [Presentation of Lecture 1.](http://do2.mu-pleven.bg/mod/resource/view.php?id=13664) File: Statlecture 1-2019.pptx |
| **Lecture 2: Distributions and descriptive statistics for qualitative data** |
| Distributions. Types of distributions. Normal distribution. Standard scores and standard normal curve. Z scores and z tables. Asymmetric distributions. Characteristics of positively skewed and negatively skewed distributions.  Simple descriptive statistics for categorical data. Characteristics and calculations of ratios, proportions, percentages, rates. Graphical presentation of qualitative (categorical) variables.  Test examples.    [Presentation of Lecture 2](http://do2.mu-pleven.bg/mod/resource/view.php?id=13664) File: statlecture2-2019.pptx |
| **Lecture 3: Descriptive measures of quantitative data. Measures of central tendency.** |
| **Introduction to summarization of numerical data. Basic terms in central tendency. Characteristics of the mean. Three approaches in determining arithmetic mean – in ungrouped data, in grouped data and in an interval array of data. Characteristics and determination of the median. Definition of the mode. Comparison of the three basic measures of central tendency. Relations of the mean, median and mode in different types of frequency distributions.** Measures of location: quantiles and percentiles. Types and estimation of quantiles. Characteristics and use of percentiles. Comparison of different types of quantiles. Test examples.  [Presentation of Lecture](http://do2.mu-pleven.bg/mod/resource/view.php?id=13664) 3 File: statlecture3-2019.pptx |
| **Lecture 4: Descriptive measures of quantitative data. Measures of spread. The concept of norms and normal groups’ limits.** |
| Measures of spread (dispersion, variability). The essence of the concept of spread. The main reasons to measure the dispersion. Description of the most common measures of variability or spread: range; standard deviation; the variance; inter- and semi-quartile range; coefficient of variation. Five steps in calculation and understanding the meaning of standard deviation. Interquartile range and its characteristics. Semi-quartile range. Coefficient of variation (relative variability) and its advantage in comparing variability in samples measured in different units.  The concept of norms and normal groups’ limits. Basic principle of a normal distribution. The concept of “norms” or “normal limits”. Two approaches to establishing normal group limits: by mean and standard deviation in cases of normal distribution and by percentiles in all types of distribution. Characteristics of percentiles and their advantage in establishing the reference limits of normality in clinical and other areas of investigation. Test examples.    [Presentation of Lecture](http://do2.mu-pleven.bg/mod/resource/view.php?id=13664) 4  File: statlecture4-2019.pptx |
| **Lecture 5: Correlation** |
| * The importance of establishing relationships between two or more sets of observations or variables in medicine and clinical practice. Definition of the correlation coefficient. Scattergram as a visual presentation of different types of relationships. Types of correlation: linear correlation (positive and negative) and non-linear correlation. Selection of correlation coefficient for establishing relationships in different types of variables and scales of measurement. Characteristics of correlation coefficients by their directions and strength. Coefficient of determination. Degrees of correlation. Four main groups of statistical methods for calculation of correlation coefficients: for qualitative variables with only two categories – φ (phi); for qualitative variables with more than two categories - φ (phi); when both x and y are measured on, or transformed to, ordinal scales – Spearman correlation coefficient; when both x and y are quantitative and measured on interval or ratio scale – rank correlation - Pierson coefficient. Uses of correlation in health sciences for prediction, for measuring the reliability and predictive validity of assessment, for estimating shared variance. Correlation and causation. Test examples.     [Presentation of Lecture](http://do2.mu-pleven.bg/mod/resource/view.php?id=13664) 5  File: statlecture5-2019.pptx |
| **Lecture 6. Inferential statistics.** **Statistical estimation: from sample to population.** |
| Why do we need to study samples? Statistical estimation – definition. Two types of estimation: point estimation and interval estimation. Basic conceptsin interval estimation: standard (sampling) error of the mean; probability and probability coefficient; degrees of freedom; confidence interval. From sample to population - basic steps in interval estimation. Basic steps in interval estimation. Test examlpes.      Presentation of Lecture 6 File: statlecture6-2019.pptx |
| **Lecture 7. Hypothesis testing.** |
| Introduction and logic of hypothesis testing. What is statistical hypothesis testing? Tests of significance. Basic concepts: Null hypothesis - H0; Alternative hypothesis – H1 orHA; Directional hypothesis or one-tailed hypothesis; Non-directional hypothesis or two-tailed hypothesis; statistical significance (P); two types of statistical tests - parametric tests and non-parametric tests. Description of the basic steps in hypothesis testing. Type I and Type II errors. Now to choose the test statistic? Two types of tests: one-tailed test and two-tailed test. Decision rules. Interpretation of P-values.  Parametric methods for hypothesis testing. T-test for independent and dependent samples. Non-parametric tests. The χ2 (chi-square) test. Uses of tables of critical values of t test and chi-square test.    [Presentation of Lecture](http://do2.mu-pleven.bg/mod/resource/view.php?id=13664) 7  Files: statlecture7a-2019.pptx and statlecture7b-2019.pptx |
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