Semmelweis University, Faculty of Medicine - undivided, one-tier training in general medicine
Name of the host institution (and any contributing institution):
Biofizikai és Sugárbiológiai Intézet

Name of subject in Hungarian: Orvosi statisztika, informatika és telemedicina
Name of subject in English: Medical Statistics, Informatics and Telemedicine
Name of subject in German: Medizinische Statistik, Informatik und Telemedizin

---

Credit value of the course: 2
Semester: 5th semester
(in which the subject is taught according to the curriculum)

Weekly hours	Lecture	Practice	Seminar
2.5	1.0	1.5	0.0

Semester hours	Lecture	Practice	Seminar
0.0	0.0	0.0	0.0

Type of course:
obligatory

Academic year:
2026/27

Language of instruction (for optional and elective subjects):
English

Course code:
AOKFIZ974_1A
(in the case of a new course, to be completed by the Dean’s Office, following approval)

Course coordinator name: Dr. Kellermayer Miklós (Intézet igazgató)
Course coordinator location of work, telephone availability: SE Biofizikai és Sugárbiológiai Intézet, 06-1-4591500/60200
Course coordinator position: egyetemi tanár, igazgató
Course coordinator Date and number of habilitation: 2004 PTE ÁOK 7/2004/habil

---

Objectives of the course, and its place in the curriculum of the medical training program:

In recent years, medicine relies more intensively on statistics, as well as on the use and interactive management of databases. Our aim is to introduce students to the fundamentals of data analysis and decision support methods that are most common in medical practice.

The subject focuses on the presentation of basic principles and concepts. We focus on logical

thinking rather than computational techniques. The aim of the exercises is to deepen the knowledge conveyed in the lectures in a problem-oriented way and to apply it realistically. The calculation tasks that occasionally occur in the exercises are performed using simple, easy-to-use software on specified databases. During the internships, students have to acquire knowledge on making basic descriptive figures and tables, basic inferential statistics and regression models, as well as interpret scientific publications results.

Format of the course (lectures, group work, practical lessons, etc.):

The lecture materials are available in detailed summary and video form on the university's common educational platform ("Moodle"). Students are required to process this part of the curriculum based on these materials; however, there is, of course, an opportunity to deepen this knowledge during the exercises. During the exercises, students individually work on the theoretical and practical curriculum using a computer program. The solutions to the tasks must be uploaded to the educational platform by completing a "questionnaire" structured similarly to the exam.

Competencies acquired through completion of course:

The aim of the student is to acquire the following “theoretical” competencies (listed according to the planned lectures):

- biostatistics in science: understand what statistics do and do not answer - be familiar with the basic statistics behaviour of clinical studies: 1. its steps (planning, data collection, data description, data analysis, interpretation of ressults) 2. its type (observational and experimental studies) - know the different data type - know the simple concept of a variable and its outcome
- know and be able to interpret the basics of the following concepts: descriptive statistics, frequency, relative frequency, cumulative frequency, mean, median, standard deviation, quantiles, data range, interquartile range; frequency (empirical) distribution, normal distribution - know and able to interpret the following graph types: histogram, bar plot, box plot, scatter plot, mosaic plot, percentile curves
- know and be able to interpret the basics of the following concepts: event, frequency and probability of an event; elementary event, independent events, mutually exclusive events - know the concept of conditional probability, recognize in text what the condition is - know the basic properties of normal and binomial distribution, its occurrence in the clinical practice - know and can simply tell the theorem of the central limit theorem, be aware of its relevance

- know the concept of: sampling error; estimation, estimand, estimate; point and interval estimations; estimation intervals and reference interval - know and be able to interpret the concept of estimation error (as standard error), - know the concept of confidence interval - know the concept of effect size
- know the basic thread of thought of the hypothesis tests, the underlying philosophy (falsification) and logic (existing knowledge, new hypothesis) - know the concept of: effect size, relevant difference, null hypothesis, null distribution, test statistics, first and second type error, significance level, significant difference, statistical power - know what is true and not true about Pearson p-value
- know the basic concept of t-tests and chi-square tests - know and be able to interpret the assumptions related to the t-test: 1. independence 2. homogeneity 3. normality - identify if the conditions for the t-test are met - be aware of the problem caused by multiple comparisons
- know the concept of correlation, regression, cause and effect, differences - know the concept of the outcome variable, explanatory variable - be aware of the meaning and scope of OLS - know the concept of residuals in the case of OLS - be familiar with the concept of slope and intercept of a fitted line - know the meaning of Pearson's correlation coefficient in a simple case
- know the basic of argumentation technics and phallacies
- be familiar with the concept and "role" of biases and confounding in clinical research - know the weaknesses and strengths of the types of clinical studies (based on bias, confounding) - know the possibility of “treating” confounding through regression - be familiar with the concept of control variables - know about generalizability of regression models: categorical explanatory variable, categorical target variables, correlated outcomes - know the concepts of odds, risks, odds ratio and logit
- know the basic concepts of epidemiology related to diagnostic tests (sensitivity, specificity…) - know importance (situations) of the test parameters
- be familiar with the comparability of diagnostic tests in certain respects - know the concept of incidence, prevalence, limitations of their use, "correctness" - know the concepts of likelihood ratios
- know when and how to consult a statistician (know what information you should provide for) - know the most important pitfalls of the questionnaires, how to avoid them
- know the basic concepts of decision theory - know a priori and a posteriori distributions, probabilities concepts - know the basis of Bayesian thinking
- get to know some of the possibilities and limitations of AI - be familiar with some data sets that are important in clinical practice

The aim of the student is to acquire the following “practical” competencies (listed according to the planned practices):

- be able to classify variables (based on measurement results, outputs) into different data types
- be able to create and interpret histograms, bar charts
- be able to select the type of plot corresponding to the type of variables - be able to create a box plot, scatter plot, mosaic plot (using a given computer program) and interpret it - be able to calculate and interpret the mean, median, quantiles, IQR - be able to read and interpret perecentile curves
- be able to answer simple clinical questions based on a binomial distribution
- be able to interpret the normal range, in the case of a normally distributed variable, calculate from a large number of samples - be able to interpret the confidence interval of the mean
- be able to formulate a question suitable for hypothesis testing and a null hypothesis - be able to interpret the result of a simple hypothesis test - be able to distinguish between relevant and significant result
- be able to perform a t-test in a simple situation, - be able to interpret the results of a simple hypothesis test - be able to recognize multiple comparisons
- be able to calculate the correlation of two variables (if applicable), to interpret the correlation coefficient - be able to make a simple linear regression: to estimate a slope - be able to evaluate the result of a hypothesis test related to a simple linear regression - be able to estimate based on the fitted slope and intercept
- be able to distinguish between "right and wrong" arguments
- be able to give examples of basic bias (selection and information bias), confounding, recognize them - be able to give examples of basic clinical study types and recognize them - be able to basically interpret the outcome of multiple linear regression and logistic regression (estimate, confidence interval, p-value) - be able to interpret the odds ratio
- be able to calculate basic diagnostic test parameters on the basis of a confusion matrix - be able to interpret each test parameter; recognize their significance, advantages and disadvantages
- be able to compare ROC curves - be able to correctly recognize the use of incidence and prevalence - be able to estimate the likelihood ratios
- be able to organize his data into an appropriate structure which can be processed by statistical programs
- be able to prepare a not terribly bad questionnaire - be able to recognize what data and information to share with a statistician

---

Course outcome (names and NEPTUN ID of related subjects):

Prerequisites for course registration and completion: (NEPTUN ID):

Medical Biophysics II

In the case of multi-semester courses, position on the possibility of and conditions for concurrent registration:

The number of students required to start the course (minimum, maximum), method of selecting participants:

There is no maximum or minimum number of students, we select them based on their application

Detailed course syllabus (if the course can be divided into modules, please indicate): (Theoretical and practical instruction must be broken down into hours (weeks), numbered separately; names of instructors and lecturers must be listed, indicating guest lecturers/instructors. It cannot be attached separately! For guest lecturers, attachment of CV is required in all cases!)

Planned schedule of lectures:

Week	Title
1	Principles of quantitative medicine.
2	Summary of data: descriptive statistics.
3	Event, probability, distribution.
4	Estimations.
5	Principles of hypothesis testing in medical practice.
6	T-tests; chi-square tests. Multiplicity.
7	Correlation. Simple linear regression.
8	Arguing.
9	Confounding, biases. Linear regression as a tool against confounding,
10	Evaluation of diagnostic tests.
11	Statistical concepts in epidemiology. Prevalence, incidence, risk, odds. ROC curves. Likelihood ratios.
12	Communication with a statistician. Sample size. Data tables. Survey tips.
13	Introduction to medical decision theory, Bayesian theory: a priori and a posteriori distributions, learning model.
14	Databases, expert systems, AI supported diagnostics, BigData.

Lecturers: Dr. KELLERMAYER Miklós Sándor Zoltán, Dr. AGÓCS Gergely, Dr. KISS Balázs, Dr. MÁRTONFALVI Zsolt, Dr. SCHAY Gusztáv, Dr. VERES Dániel Sándor.

Planned schedule of practices:

Week	Title
1	Introduction. *Data types.* Introduction to data types.
2	*Graphical representation of data and interpretation of plots I.* Ploting frequencies: visualization of samples with a large number of elements on a histogram, bar plot.
3	*Graphical representation of data and interpretation of plots II*. Box plots, scatter plot, mosaic plot. Outliers. Interpretatation of percentile curves. *Descriptive values.* Determination of descriptive values from a large sample size.
4	*Distributions*. Using binomial distributions. Using normal distributions.
5	*Reference interval.* Approximate calculation for normal distribution. Interpretation. *Confidence intervals.* Simple calculation of the confidence interval of mean. Interpratation.
6	*Hypothesis tests*. Logic of hypothesis tests.
7	*Hypothesis test and confidence interval calculation on difference between two ratios.* Chi-square tests, Fisher exact test. Confidence interval of difference between two ratios.
8	*Hypothesis test and confidence interval on difference of means. Student t-tests*. Making t-tests. Interpretation of effect size, confidence interval and p-value. *Multiplicity*. Examples for multiple testing.
9	*Correlation, regression*. Interpretation of correlation coefficient. Making simple linear regression, interpretation of the slope.
10	*Regression models*. Interpreting the results of multiple regression models.
11	*Diagnostic tests I.* Diagnostic tests.
12	*Diagnostic tests II.* Odds, OR, RR. Likelihood ratios.
13	*Preparing data*. Organizing data tables.
14	Possibility to write an exam test.

Tutors: Dr. AGÓCS Gergely, Dr. GALÁNTAI Rita, Dr. GÁL-SOMKUTI Judit, HALMÓCZKI Sarolta, Dr. KELLERMAYER Miklós Sándor Zoltán, Dr. KISS Balázs, Dr. KISS Bálint, Dr. HEGEDŰS Nikolett, Dr. MÁRTONFALVI Zsolt, Dr. PADÁNYI Rita, Dr. SCHAY Gusztáv, Dr. S. NAGY Krisztina, Dr. SZIKLAI Dominik, Dr. VERES Dániel Sándor, Dr. ZOLCSÁK Ádám.

Other courses with overlapping topics (obligatory, optional, or elective courses) in interdisciplinary areas. To minimalize overlaps, topics should be coordinated. NEPTUN ID(s) of courses (to be provided):

Requirements for attendance, options for making up missed sessions, and method of absence justification:

Students may be absent a maximum of 3 practice in their own group (as registered in Neptun) during the semester. A report must be prepared on the content of each practical session, and uploading it to the designated platform is a condition for confirming attendance. Missed practicals can be made up during the same week (even in advance) in another group after prior consultation with the instructors. Completing a practical in another group does not count as attendance and therefore does not reduce the number of absences. Absences do not need to be justified. Any deviation from these rules is only possible with the permission of the head of the institute or by higher university instruction.

Assessment methods during semester (number, topics, and dates of midterms and reports, method of inclusion in the course grade, opportunities for make-up and improvement of marks):
(number, topics, and dates of midterms and reports, method of inclusion in the course grade, opportunities for make-up and improvement of marks)

Continuous partial assessments (learning-supporting assignments)

After completing major topics, a short test is administered the following week in each student's own group, during the first ~15 minutes of class. Planned weeks: week 5 (basic concepts, descriptive statistics, distributions), week 9 (estimation and simple hypothesis testing), week 11 (regression and confounding). In week 13, one make-up opportunity is provided for one topic, at a pre-scheduled time with prior registration.

Tests cover both theoretical and practical material in Moodle format (single choice, multiple choice, fill-in, diagrams, calculations). Incorrect answers in multiple-choice questions result in point deductions; calculation tasks do not penalize incorrect answers. Questions are available on Moodle for practice. Numerical values in calculation tasks are randomly generated, so results may vary, but correct solution methods remain consistent.

Bonus points: average >80% → +12 percentage points; >70% → +8; >50% → +4.

Summary assessment

In the final week, a comprehensive test is available (weeks 1–12). Bonus points may be included. Grading:
<50% (bonus points should not be used): fail (1)
50–62%: 2
62–72% (bonus points could be used): 3
72–80% (bonus points could be used): 4
80% (bonus points could be used): 5

Number and type of individual assignments to be completed, submission deadlines:

A report must be prepared on the material covered in practical sessions, and uploading it is a condition for confirming attendance. There are no other individual assignments.

Requirements for the successful completion of the course:

Maximum of 3 absences (see point 24).

Type of assessment:
terminal examination

Exam requirements (list of topics, topics of the test exam, and the optional project topics accepted as an exam)

Written exam corresponds to the final summary test but covers the full semester. Same grading scale, without bonus points.
Oral exam topics correspond to lecture titles.

Clear, specific minimum requirements for assessment. (The list of mandatory concepts, parameters, diagrams, calculations, and practical skills required to obtain a passing grade, as well as the criteria for the completion and evaluation of project assignments accepted as an exam.) A link published on the department's website referring to the minimum requirements of the course.

Minimum requirement: the weighted average of the test exam (see point 29) must reach 50%. *If below 50%, there is an opportunity for oral clarification and assisted answering of exam questions, which may modify the original result based on the examiner's judgment.* The minimum requirement for the oral part is a grade of 2 (pass). Standardized examination is supported by the institute's "Teaching the Teachers" project. Students may consult examiners during both the study and exam periods regarding the expected theoretical weight of concepts and calculations through concrete examples.

Method and type of grading (Share of theoretical and practical examinations in the overall evaluation. Inclusion of the results in the end-of-term assessment. Possibilities of and conditions for offered grades.): (Share of theoretical and practical examinations in the overall evaluation, Inclusion of the results in the end-of-term assessment, Possibilities of and conditions for offered grades)

Students may request that their written exam or final test result counts as 100% of the final grade. Otherwise, the final grade is the weighted average of written and oral exam (2:3).

Same rule: either 100% written/test, or weighted average (2:3).

Students may request the final test to count as 100%.

None.

Artificial intelligence systems used in the teaching of the subject and the manner of their application

AI systems may be used cautiously by both instructors and students. During exams, only pre-approved AI systems may be used; others are not allowed.

Signature of habilitated instructor (course coordinator) announcing the course:

Signature of the director of the host institution:

Date of submission:
