KÖVETELMÉNYRENDSZER

Semmelweis Egyetem, Általános Orvostudományi Kar
A gesztorintézet (és az esetleges közreműködő intézetek) megnevezése:
Biofizikai és Sugárbiológiai Intézet

A tárgy neve: Orvosi statisztika, informatika és telemedicina

Angol nyelven[1]: Medical statistics, informatics and telemedicine

Német nyelven[1]: Medizinische Statistik, Informatik und Telemedizin

Kreditértéke: 2

Teljes óraszám: 28 **előadás:** 14 **gyakorlat:** 14 **szeminárium:** 0

Tantárgy típusa: **kötelező** **kötelezően választható** **szabadon választható**

Tanév: 2021/2022 I. félév

Tantárgy kódja[2]: AOKFIZ739_1M, AOKFIZ739_1A, AOKFIZ739_1N

Tantárgyfelelős neve: Dr. Kellermayer Miklós Sándor Zoltán

Munkahelye, telefonos elérhetősége: SE Biofizikai és Sugárbiológiai Intézet, 06-1-4591500/60200

Beosztása: egyetemi tanár, igazgató

Habilitációjának kelte és száma: 2004 PTE ÁOK 7/2004/habil

A tantárgy oktatásának célkitűzése, helye az orvosképzés kurrikulumában:
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.

A tárgy oktatásának helye (előadóterem, szemináriumi helyiség, stb. címe):
Lectures: Semmelweis University, Basic Medical Science Center, ground floor: Szent-Györgyi Albert lecture hall
Practices: Semmelweis University, Basic Medical Science Center, Department of Biophysics and Radiation Biology, 1st floor: Biophysics practice rooms
1094 Budapest, Tűzoltó u. 37-47.

A tárgy sikeres elvégzése milyen kompetenciák megszerzését eredményezi:
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

A tantárgy felvételéhez, illetve elsajátításához szükséges előtanulmányi feltétel(ek):
Medical Biophysics II.

A kurzus megindításának hallgatói létszámfeltételei (minimum, maximun), a hallgatók kiválasztásának módja:
There is no maximum or minimum number of students, we select them based on their application.

A kurzusra történő jelentkezés módja:
In the Neptun system.

A tárgy részletes tematikája[3]:

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	Prevalence, incidence, OR, RR. ROC curves. Likelihood ratios.
12	Our own research, diploma work, dialogue with the statistician: How much is enough? How not to make a very bad questionnaire? How to make a good data table?
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. Herényi Levente, Dr. Kaposi András, Dr. Kiss Balázs, Dr. Liliom Károly, Dr. Schay Gusztáv, Dr. Smeller László, Dr. Somkuti Judit, Dr. Veres Dániel Sándor.

Hét	Gyakorlat címe
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. Interpreatation of percentile curves. *Descriptive values.* Determination of descriptive values from a large sample size.
4	*Distributions*. Using binomial distributions. Using normal ditributions.
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	*Student t-tests*. Making t-tests. Interpretation of effect size, confidence interval and p-value. *Multiplicity*. Examples for multiple testing.
8	*Correlation, regression*. Interpretation of corerlation coefficient. Making simple linear regression, interpretation of the slope.
9	*Arguing*. Examples. *Bias*. Examples.

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	*A gyakorlatban*. When and how to ask a statistician. *Questionnaires*. Reflection on a questionnaire - how not to do very badly.

Tutors: Dr. Agócs Gergely, Dr. Bőcskei-Antal Barnabás, Csányi Csilla, Dr. Ferenczy György, Dr. Forgách László, Dr. Galántai Rita, Dr. Gál-Somkuti Judit, Dr. Haluszka Dóra, Dr. Jedlovszky-Hajdú Angéla, Dr. Juriga Dávid, Dr. Herényi Levente, Dr. Kaposi András, Dr. Kellermayer Miklós Sándor Zoltán, Dr. Kiss Balázs, Dr. Kiss Bálint, Dr. Hegedűs Nikolett, Dr. Kis-Petik Katalin, Dr. Kósa Nikoletta, Dr. Liliom Károly, Dr. Mártonfalvi Zsolt, Dr. Orosz Ádám, Dr. Padányi Rita, Dr. Schay Gusztáv, Sipos Evelin, Dr. Smeller László, Dr. Szöllősi Dávid, Dr. Veres Dániel Sándor, Dr. Voszka István, Dr. Zolcsák Ádám.

Az adott tantárgy határterületi kérdéseit érintő egyéb tárgyak (kötelező és választható tárgyak egyaránt!). A tematikák lehetséges átfedései:
Some concepts - e.g. The interpretation of average, frequency and scientific publications occurs in each of the subjects, but these are not listed here, considering that the overlap is significant but not relevant.

<u>*Compulsory subjects*</u>:
Medical Biophysics I.: descriptive statistics.
Medical Biophysics II.: descriptive statistics.
Public Health: interpretation of concepts, calculations (prevalence, incidence, parameters of diagnostic tests, etc.), databases, scientific articles that also appear in epidemiology.
Medical Microbiology: epidemiological statistical concepts

<u>*Compulsory subjects*</u>:
Introduction to the Methodology of Clinical Research I – observational studies: descriptive statistical concepts, their calculation, thought process of hypotheses, interpretation of their results, types of clinical trials, biases. Regression models, confoundings.
Introduction to the Methodology of Clinical Research II – experimental studies: descriptive statistical concepts, their calculation, thought process of hypotheses, interpretation of their results, types of clinical trials, biases.
Library informatics: databases
Infectology: epidemiological statistical concepts
TDK munka: no overlap - anything can completely overlap in range

<u>*Elective subjects*</u>:
Introduction to principles of students' scientific research: statistical concepts, database management
The role of artificial intelligence in medicine: concepts related to diagnostic tests, their calculation (eg hit rate, sensitivity, specificity, AUC)
Bioinformatics: concepts related to diagnostic tests, their calculation (eg hit rate, sensitivity, specificity, ROC curve), interpretation of the results of hypothesis tests
Data visualization: making figures

A tantárgy sikeres elvégzéséhez szükséges speciális tanulmányi munka[4]:
None.

A foglalkozásokon való részvétel követelményei és a távolmaradás pótlásának lehetősége:
Attendance at lectures is optional. Attendance is required for at least 75% of the practicals. Make up of missed exercises is possible in the given week, with another group, after consultation with the practice leaders.

A megszerzett ismeretek ellenőrzésének módja a szorgalmi időszakban[5]: Compulsory moodle tests.
A félév aláírásának követelményei: Attend at least 75% of the exercises.
A vizsga típusa: Written exam in moodle,
Vizsgakövetelmények[6]: The material of the exam was introduced during the lectures and exercises. Two "level" exam: 1. The first level covers material of theory (e.g., interpretation of concepts) and practice (e.g., evaluation of charts, result tables) that does not require the use of R Commander. At this level, a maximum of grade 4 can be earned. 2. To write the second level, one needs to complete level 1 at least grade 4. At this level, the use of R Commander is highly recommended (similarly to the tasks performed in practice, calculations and evaluations must be performed on a given dataset). At this level, a grade of 5 can be earned with at least 75% of the points. In case of a worse result, the final grade remains 4.
Az osztályzat kialakításának módja és típusa[7]: There is no practical grade. The grade of the subject is based on the mark of the exam, the equivalent value is taken into account with a weighting factor of 1.
A vizsgára történő jelentkezés módja: Through the Neptun system, students can apply for the exam at the scheduled times.
A vizsga megismétlésének lehetőségei: Based on TVSZ.
A tananyag elsajátításához felhasználható nyomtatott, elektronikus és online jegyzetek, tankönyvek, segédletek és szakirodalom (online anyag esetén html cím): http://biofiz.semmelweis.hu/,
A tárgyat meghirdető habilitált oktató (tantárgyfelelős) aláírása:
A gesztorintézet igazgatójának aláírása:
Beadás dátuma:

OKB véleménye:
Dékáni hivatal megjegyzése:
Dékán aláírása:

[1] Csak abban az esetben kell megadni, ha a tárgy az adott nyelven is meghírdetésre kerül.
[2] Dékáni Hivatal tölti ki, jóváhagyást követően.
[3] Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Mellékletben nem csatolható!
[4] Pl. terepgyakorlat, kórlapelemzés, felmérés készítése, stb.
[5] Pl. házi feladat, beszámoló, zárthelyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.
[6] Elméleti vizsga esetén kérjük a tételsor megadását, gyakorlati vizsga esetén a vizsgáztatás témakörét és módját .
[7] Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkérések eredményeink beszámítási módja.