COURSE CONTENT

(1) GENERAL INFO

SCHOOL	ENGINEERING			
DEPARTMENT	BIOMEDICAL ENGINEERING			
MSc PROGRAM	BIOMEDICAL ENGINEERING AND TECHNOLOGY			
STUDY LEVEL	POSTGRADUATE, MSc			
COURSE CODE	**BMET105**	**SEMESTER**	**A**	
COURSE TITLE	**Biostatistics**			
TEACHING			**HOURS**	**ECTS**
	LECTURES AND WORKSHOPS		26	5
COURSE TYPE	SPECIALIZATION			
COURSE REUIREMENTS:	-			
TEACHING AND EXAMINATION LANGUAGE:	ENGLISH			
IS THIS COURSE OFFER TO ERASMUS STUDENTS	YES (IN ENGLISH)			
COURSE WEBPAGE (URL)	https://eclass.uniwa.gr/courses/302/			

(2) LEARNING OUTCOMES

Learning outcomes

Course Objectives:
The aim of the course is to understand the basic concepts of statistical science and their application in health sciences research. The goal is to enable students to assimilate the material taught and to use their knowledge both in their professional field and in broader applications of biostatistics and probability, which are essential in the context of the study of biomedical engineering problems. Students will apply their knowledge to real biostatistics problems, analyzing data with modern biostatistics tools and evaluating the findings.

Learning Outcomes:
The course outcomes aim to provide students with a foundational understanding of statistical concepts and methods. These outcomes are designed to equip students with the necessary skills to analyze and interpret data, make informed decisions, and apply statistical techniques.

1. Develop a solid understanding of fundamental statistical concepts, including probability, hypothesis testing, confidence intervals, and basic descriptive statistics.
2. Learn to summarize and present data effectively using descriptive statistics, such as measures of central tendency, variability, and graphical representations.
3. Understand the principles of inferential statistics, including hypothesis testing, p-values, and the interpretation of statistical significance.
4. Explore common probability distributions, including the normal distribution, binomial distribution, and Poisson distribution.
5. Gain hands-on experience with statistical software tools commonly used in the field, such as R.
6. Develop critical thinking skills to analyze real-world problems and apply appropriate statistical methods to solve them.
7. Learn to create effective data visualizations to communicate statistical findings, using charts, graphs, and other graphical representations.
8. Develop the ability to communicate statistical results clearly and concisely, both in written reports and oral presentations.
9. Familiarity with common statistical tests, such as t-tests, chi-square tests, and ANOVA, and an understanding of when to apply them.
10. Gain experience in conducting small independent research projects, applying statistical methods to analyze data and draw conclusions.

Achievement of Course Objectives and Learning Outcomes:
Achieving the aforementioned objectives involves a combination of active engagement, effective study strategies, and practical application of statistical concepts.

- Students will actively engage in class discussions, ask questions, and seek clarification when needed. Active participation helps reinforce understanding and retention of statistical concepts.
- Students should attend classes consistently to stay on track with the course material. Missing classes can result in gaps in understanding, especially as the concepts build on one another.
- Since mathematics and statistics are skills that improve with practice, regularly work through problems and exercises provided in the course materials will reinforce theoretical concepts.
- Students will take advantage of additional resources and supplementary readings
- Students will gain hands-on experience with statistical software tool and will practice using tools like R to analyze data and run statistical tests. From the hand-on experience they will have to make an assignment providing a report in the form of scientific paper, and they have to prepare a corresponding presentation in front of classmates, where they have to explain statistical concepts to others, a process that can enhance their own understanding.

General abilities

- Search, analysis and synthesis of data and information, using the necessary technologies
- Decision-making
- Autonomous work
- Group work
- Working in an interdisciplinary environment
- Promotion of free, creative and deductive thinking

(3) COURSE CONTENT

"Introduction to Biostatistics"
Definitions, basic concepts, data, qualitative variables, quantitative variables.

"Descriptive statistics"
Descriptive statistics - Applications, statistical tables, graphs, measures of location, measures of dispersion, measures of asymmetry

"Diagnostic Tests"
Diagnostic tests, truth table, sensitivity, specificity, prevalence, likelihood ratio, odd ratio, relative risk

"Probability distributions of random variables"
Random variable, distribution function, probability mass function, probability density function, basic discrete distributions, basic continuous distributions, standard normal distribution

"Parameter Estimation - Confidence Intervals"
Point estimation, interval estimation, basic sample distributions, Central Limit Theorem, confidence intervals for the mean, sample size determination

"Hypothesis testing"
Type I error, Type II error, null hypothesis, alternative hypothesis, p- value, Student's test, ANOVA test. Non-parametric hypothesis tests, Mann-Whitney U test, Wilcoxon test, Kruskal-Wallis test, chi-squared test.

"Hands-on laboratory in R language"
Basic command learning, variables, creating and saving files, data visualization and analysis.

(4) TEACHING AND LEARNING METHODS - EXAMINATIONS

<table>
<tr><td>COURSE DELIVERY</td><td>Physical presence, face to face at the auditorium</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES</td><td>The theoretical part of the course is conducted with a projector (for the presentation of basic theory) and on the blackboard. The laboratory part of the course is carried out in the laboratory and includes the implementation of computer program.</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Teaching / lectures</td><td>26</td></tr>
<tr><td>Lecture material study</td><td>30</td></tr>
<tr><td>Unsupervised literature review and preparation of the final project</td><td>69</td></tr>
<tr><td>Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUNDET EVALUATION</td><td>20-40% final exam with multiple choice, short answer, and problem-solving questions and/or
40-60% by individual written work and classroom presentation and/or
40-60% code implementation for data analysis</td></tr>
</table>

(5) SUGGESTED LITERATURE

Books, scientific articles and related scientific resources:

[1] Bernard, R., Fundamentals of Biostatistics. 7th ed., Cengage Learning, 2011.
[2] Pagano M., Gauvreau K., Mattie H., Principles of Biostatistics, 3rd ed., Chapman & Hall, 2022.
[3] Galarnyk, M. Understanding Boxplots. 2023. [cited 2023; Available from: https://www.kdnuggets.com/2019/11/understanding-boxplots.html].
[4] Kanchanaraksa, S. Evaluation of Diagnostic and Screening Tests: Validity and Reliability, Johns Hopkins University. 2009.
[5] Hanley, J.A. and B.J. McNeil, The meaning and use of the area under a receiver operating characteristic (ROC) curve. Radiology, 143(1): p. 29-36, 1982.
[6] Hajian-Tilaki, K., Receiver Operating Characteristic (ROC) Curve Analysis for Medical Diagnostic Test Evaluation. Caspian J Intern Med, 4(2): p. 627-35, 2013
[7] Devore, J.L., Probability and Statistics for Engineering and the Sciences. 4th ed., Brooks/Cole Publishing Company, 1995.