Course ADVANCED BIOSTATISTICS

Basic Information

This is a course, which contributes to MSc award in Biology

Course period	From October 1st till February 1st, 1 semester (16 weeks)
Study credits	3 ECTS credits
Duration	108 hours
Language of instruction	English
Academic requirements	– BSc degree in Biology, Physics, Biophysics, Chemistry , Biochemistry, Environmental Sciences or equivalent (transcript of records), – good command of English (certificate or other official document)

Course Description

«Advanced Biostatistics» provides students with statistical foundation of the various problems of Biology. Students will learn to recognize the main features of the processes under investigation that could be analyzed in terms of survival analysis, meta-analysis, Bayesian statistics or general analysis of the paired data. Grading this course will help the future specialist to analyze the observed phenomena in advanced statistical level.

Course Aims

- To help students to systematize their knowledge of general statistics, and repeat the basics.
- To assist students to plan an experiment in the field of their interest.
- To provide students with understanding of several experimental sets comparison.
- To introduce the basic principles of Bayesian statistical processing of experimental data.
- To introduce basics of survival analysis and its application in biological experiments.

Course Objectives

- To ensure that students are familiar with basic statistical methods.
- To give students randomization methods for experimental design.
- To give students an appreciation of the analyses of the paired data and estimation criteria for hypothesis testing.
- To provide students with the basic principles of the Bayesian statistics and its application in Biology.
- To ensure students understanding of the principles of survival analysis.

Learning Outcomes of the Course

By the end of the course, students will be able to:

- compare and analyze prior and posterior expectations of the process under the investigation,
- to perform the analysis of variance,
- make the non-trivial regression for the experimental data,
- apply the randomization to simulate the biological process together with randomization-based analysis.

Course Outline

Week	Lectures	Practice session / Assignments	Hours[1]
1-2	Analysis of the paired data	– Paired, repeated and matched variables – Normality – Paired t-test	2
	Analysis of variance (ANOVA)	– The F-criterion and comparison of variances – 1-way ANOVA – Generalizations of ANOVA	2
3-5	Randomization and randomization-based analysis	– Randomized experiment – Survey sampling and resampling	6
6-10	Survival Analysis	– Common terms – Cox regression analysis – Tree-structure models	10
11-17	The basic Bayesian statistics	– Bayesian probability – Likelihood – Prior and posterior – Empirical Bayes models – Bayesian information criterion – Maximum a posteriori estimation	7 7
18	Final exam		4

[1] Hours designed for Classroom sessions, Web-sessions, Home Assignments etc.

Lecturer and Contact Information

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Assessment

- Problems can be solved with any suitable package: SciLab, Matlab, SAS, R etc.
- Grade policy for both home assignments and the final exam is:
- A (excellent work) 91–100 %
- B (above average work) 81–90 %
- C (average work) 71–80 %
- D (below average work) 50–70 %
- F (failed work) < 50 %
- The final exam is an individual problem in the form of a simulated experimental dataset.

Core reading

1. 1. Westfall, P., & Henning, K. S. (2013). *Understanding advanced statistical methods*. CRC Press.
2. Triola, M. M., & Triola, M. F. (2006). *Biostatistics for the biological and health sciences* (pp. 47-48). Boston: Pearson Addison-Wesley.
3. Whitlock, M. C., & Schluter, D. (2009). *The analysis of biological data* (p. 700). Greenwood Village, CO: Roberts and Company Publishers..