SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş-Bolyai University**
1.2 Faculty	**Faculty of Biology and Geology**
1.3 Department	**Department of Molecular Biology and Biotechnology**
1.4 Field of study	**Biology**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**Bioinformatics applied in life sciences**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			**Applied biostatistics** **Biostatistică aplicată**				
2.2 Course coordinator			**Assist. prof. dr. László Zoltán**				
2.3 Seminar coordinator			**Assist. prof. dr. László Zoltán**				
2.4. Year of study	**1**	2.5 Semester	**2**	2.6. Type of evaluation	**C**	2.7 Type of discipline	**Mandatory**
2.8. Code of the discipline		**BME1123**					

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	**4**	Of which: 3.2 course	**2**	3.3 seminar/laboratory	**2**
3.4 Total hours in the curriculum	**56**	Of which: 3.5 course	**28**	3.6 seminar/laboratory	**28**
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					24
Additional documentation (in libraries, on electronic platforms, field documentation)					16
Preparation for seminars/labs, homework, papers, portfolios and essays					18
Tutorship					8
Evaluations					4
Other activities:					-

3.7 Total individual study hours	70
3.8 Total hours per semester	126
3.9 Number of ECTS credits	5

4. Prerequisites (if necessary)

4.1. curriculum	• Basic knowledge of statistical concepts and R
4.2. competencies	• Average computer skills

5. Conditions (if necessary)

5.1. for the course	• Multimedia projector • Online meeting platform if necessary
5.2. for the seminar /lab activities	• Attendance of a minimum of 90% of practical/ seminar classes, • Computers, specific development environment

6. Specific competencies acquired

Professional competencies	• The ability to use advanced statistical models in data analyses • Advanced skills in data analyses of biologic datasets • Statistical analyses of bioinformatic datasets
Transversal competencies	• Using specific methods to analyse data, interpret results or solve theoretical and experimental assignments in daily work problems.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• To enable students to perform statistical analysis of biological datasets with generalized linear and non-linear models.
7.2 Specific objective of the discipline	• Students will be able to understand and use concepts of generalised and mixture models in their work. They will be able to build generalized linear/non-linear models to solve different types of problems, to perform advanced exploratory data analysis.

8. Content

8.1 Course	Teaching methods	Remarks
Introduction to study design, sampling and descriptive statistics.	• Interactive exposure • Presentation • Explanation • Practical examples	
Probability distributions: continuous and discrete, contingency tables, GOF tests		
Least squares and maximum likelihood estimations		
Regression and ANOVA design: the concept of the general linear model		
Linear and non-linear models for normally distributed outcome data.		
Generalised linear and non-linear models		
Linear Mixed Effect models		
Stochastic processes: random walks		
Stochastic Processes: Markov chains		

Bibliography

1. Sokal, R. R. and Rohlf, F. J. (1995). *Biometry*: The principles and practice of statistics in biological research. Third Edition, WH Freeman and Company. New York. 850 pp.
2. Michael J. Crawley (2014): The R Book, 2nd Edition, https://onlinelibrary.wiley.com/doi/book/10.1002/9781118448908
3. Zuur, A. F., Ieno, E. N., Walker, N. J., Saveliev, A. A., & Smith, G. M. (2009). Mixed effects models and extensions in ecology with R. New York: Springer. DOI: 10.1007/978-0-387-87458-6
4. Jane M Horgan (2020) Probability with R, Second Edition. ISBN:9781119536949. DOI:10.1002/9781119536963
5. Ewens, W. J. and Grant, G. R. (2005) Statistical methods in bioinformatics: an introduction. New York: Springer. DOI: 10.1007/b137845

References (1, 2, 3) are available from the Library of Zoology (Clinicilor str. 5-7). References (4, 5) is an optional resource made available upon request.

8.2 Seminar / laboratory	Teaching methods	Remarks
Random number generators in R (sample, rnorm, rbinom, rpois etc.)	• Practical demonstration	

GOF tests, functions (chisq.test, goodfit, fitdist etc.)	• Case-study discussions	
Loops, iterations (apply functions), numeric optimalisations (optimize, mle2)		
Fitting linear models (lm) and analysis of variance models (aov): regression vs. ANOVA		
Fitting non-linear least squares (nls): logarithmic, exponential, power and polynomial models.		
Fitting generalised linear models and generalized least squares (glm, gls): poisson, binomial, negative binomial and gamma error distributions.		
Fitting linear mixed-effects models and generalized linear mixed-effects models (lme, glmer)		
Random walks in R		
Markov chain forecast example in R		
Presentations for storytelling assignment		

Bibliography

1. Sokal, R. R. and Rohlf, F. J. (1995). *Biometry*: The principles and practice of statistics in biological research. Third Edition, WH Freeman and Company. New York. 850 pp.
2. Michael J. Crawley (2014): The R Book, 2nd Edition, https://onlinelibrary.wiley.com/doi/book/10.1002/9781118448908
3. Zuur, A. F., Ieno, E. N., Walker, N. J., Saveliev, A. A., & Smith, G. M. (2009). Mixed effects models and extensions in ecology with R. New York: Springer. DOI: 10.1007/978-0-387-87458-6
4. Jane M Horgan (2020) Probability with R, Second Edition. ISBN:9781119536949. DOI:10.1002/9781119536963
5. Ewens, W. J. and Grant, G. R. (2005) Statistical methods in bioinformatics: an introduction. New York: Springer. DOI: 10.1007/b137845

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9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The course promotes the gaining of theoretical knowledge and practical skills required for teamwork in the field of research and development in academic entities, but also in R&D units in private companies;
- The course is listed in the curriculum of similar specializations at Romanian and foreign Universities.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.1 Course	Knowledge of concepts and methods from the topics of the course	Written exam	50%
10.2 Seminar/lab activities	Evaluation of a short individual project	Storytelling assignment	50%
10.3 Minimum performance standards			
Each student should obtain minimum 5 at the written exam and oral colloquium. In order to obtain the minimum grade 5, the student must demonstrate the mastery of the basic concepts described during the course and practicum classes.			

Date Signature of course coordinator Signature of seminar coordinator

16.01.2023	**Assist. Prof. dr. László Zoltán**	**Assist. Prof. dr. László Zoltán**

Date of approval	Signature of the head of department
20.01.2023	**Assoc. Prof. Beatrice Kelemen**