

[E1.10]	Statistics and Data Analysis	Compulsory elective module	4 CP (total) = 120 h				3 SWS
			Contact hours 3 SWS / 45 h		Independent study 75 h		
Content							
<p>We introduce the basics of probability theory, classical statistics, and classical error analysis (uncertainty quantification, p-values, confidence intervals), which serve as starting points to explore modern methods of statistics (maximum likelihood, Bayes, machine learning).</p> <p>We use these methods to extract information from noisy data through linear and nonlinear parameter estimation (fitting) and model comparison. We show how to analyze data containing dynamical information by time series analysis (correlation functions, block averaging) and Markov chain Monte Carlo simulations. We introduce and discuss the main concepts of machine learning and discuss supervised and unsupervised learning, including state-of-the art clustering methods and neural networks.</p> <p>In the tutorial, students learn to use these tools by adapting functions and scripts written in a modern programming language. They explore fundamental principles of probability theory, statistics, and machine learning. They learn the principles underlying these tools and how to apply them by analyzing data in practical examples taken from diverse areas of biophysics.</p>							
Learning outcomes and skills							
In the course the students will be familiarized with the statistical tools necessary to extract information from noisy data reliably and with quantified uncertainties. The students will be able to identify the common pitfalls of statistical data analysis in their own work, and to critically assess the quality of published data and statistical analysis.							
Admissions requirements/Conditions for participation in the module/courses							
None							
Recommended prior knowledge							
Basic knowledge of physics and mathematics. Programming experience in any language is desirable. In the practical course, we read, minimally adapt, and run Python code.							
Organizational details							
Import module, the registration and cancellation deadlines of the Bachelor's/Master's Biophysics regulations apply. (The exam requires online registration , no later than seven days before the exam date. You can withdraw up to one working day before the exam date without giving reasons.)							
Module allocation (degree programme/faculty)			Bachelor Biophysics / FB13				
Eligibility of the module for other courses			Master Chemistry / FB14, Master Biochemistry / FB14				
Module offered			summer semester				
Duration			1 semester				
Module coordinator			Dr. Jürgen Köfinger				
Course requirements for credits							
Participation record			Tutorial: Regular and active participation, processing of the tutorials				
Coursework			Oral exam (30 min.) or written exam (120 min.)				
Forms of teaching / learning			lecture, tutorial				
Language teaching and instruction			English				
Module assessment			Form / duration / content, if applicable				
Final module assessment			None				
Cumulative module assessment consisting of							
Composition of the module grade for cumulative module assessment							
		Mode of teaching / study	Semester hours per week	Semester CP			
				1	2	3	4
	Statistics and Data Analysis	L+T	2+1	4			
	TOTAL		3	4			