Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	**Mathematics and Applied Statistics**
Course code	40180
Scientific sector	MAT/07
Degree	Bachelor in Agricultural, Food and Mountain Environmental Sciences
Semester	I
Year	I
Academic year	2024/2025
Credits	9 (6 mathematics + 3 applied statistics)
Modular	No

Total lecturing hours	36 hours Mathematics 18 hours Applied Statistics
Total lab hours	
Total exercise hours	24 hours Mathematics 12 hours Applied Statistics
Attendance	Not required, but strongly suggested
Prerequisites	Basic Math at a Bachelor course level
Course page	See ole.unibz.it

Specific educational objectives	Mathematics: The course aims at reinforcing the mathematical skills acquired by students in the high school, in particular the concepts of function and equation, which are indispensable for any study course in life sciences and for the parallel Statistics module. The contents of the course are also organized in coordination with the Physics course. For this reason, lessons start with the part about elementary differential and integral calculus. Next, a simple introduction to first order differential equations is given, seen as a natural application of calculus to real-world models. Finally, linear and quadratic fits are treated, as well as linear optimization problems in two variables. Applied Statistics: The course is designed for acquiring professional skills and knowledge. The students will be able to: • analyze their own data statistically and to present them graphically • judge critically scientific results and conclusions • use specific functions of the statistical software package R • apply methods of inferential statistics

Lecturer	Giovanni Modanese, Giovanni.Modanese@unibz.it Fabiola Del Greco Miglianico FabiolaCristina.DelGrecoMiglianico@unibz.it

Scientific sector of the lecturer	MAT/07
Teaching language	English
Office hours	See Timetable on unibz web page
Teaching assistant (if any)	
List of topics covered (Applied Statistics)	1. Introduction to descriptive statistics and probability 2. Random variables discrete and continuous 3. Confidence intervals 4. Hypothesis testing 5. Correlation and linear regression
Teaching format (Applied Statistics)	Frontal lectures, exercises on the PC with R
List of topics covered (Mathematics)	Functions 1: Definitions, notation y=f(x). Table and graph of a function. Domain and range, simple examples, recall of integer and fractional equations and inequalities of I, II degree. Injective functions. Polynomial functions of I and II degree. Functions xn, n-th root, sinx, cosx. Range of rational fractional functions. Derivatives and integrals: Derivative of a function, incremental ratio and tangent line. Numerical examples. Derivatives of the elementary functions, of products and ratios. Derivative of function of function. Physical notation "dy/dx", chain rule dy/dx=(dy/du)(du/dx). Maxima, minima and horizontal inflection points. Simplified scheme for studying the graph of a function (without asymptotes and convexity). Examples of functions containing roots and logarithms. Indefinite integrals. Elementary primitives. Integration rules. Applications to kinematics: uniform and accelerated motion. Definite integrals. Geometrical meaning. Application to dynamics: work of an elastic force. Fundamental theorem of the integral calculus. Integration by parts and by substitution. Functions 2: Taylor polynomial of second degree. Convexity, second derivatives. Inverse functions and their graphs. Inverse of the elementary functions. Restrictions of the domain. Relationship between the range of a function and the domain of its inverse. Derivative of the inverse function. Limits at finite and infinite. Limits of the elementary functions. Determinate and indeterminate forms. Elimination of the indetermination. Limits of rational functions. Horizontal and vertical asymptotes. Rule of de l'Hopital. Differential equation, fits, optimization: concept of differential equation of the I order. Direct verification of

	the solutions. Equations with separation of variables. Logistic equation. Linear equations of the I order. Linear and quadratic interpolation. Problems of forecasting.
Teaching format (mathematics)	Frontal lectures and exercises
Learning outcomes	**Mathematics:** **Knowledge and understanding** of concepts, symbolism and techniques of functions, differential and integral calculus. **Applying knowledge and understanding** in solving exercises and problems which require a formalization, tools and methods learned in the course. **Making judgments** in tackling with the right approach and convenient tools problems and questions suitable to be formulated mathematically. **Communication skills** in reporting on the calculations in a clear and effective way. This is also essential for the student to be able to check his/her own results and overcome deadlocks in the resolution procedure. **Learning skills** through the acquisition and assimilation of a symbolism, methods and tools which are necessary to understand the content of a consistent part of the courses in this academic curriculum. **Applied Statistics:** **Knowledge and understanding** Knowledge of the most important statistical tests, understanding their rationale, conditions of usage and their results. **Applying knowledge and understanding** Identification of appropriate statistical method for data analysis; independent application of tests using software package R. **Making judgements** Critical reviewing of own scientific work and of original publications; interpretation of statistical analyses in the context of environmental sciences

	Communication skills Ability to present results of statistical analyses correctly and intelligibly at the level of scientific publications. **Learning skills** Ability to recognize situations in which statistical analysis is necessary. Ability to judge the appropriateness of statistical methods, even if not explicitly treated in this course.
Assessment	Written exam, 180 minutes. No support allowed, except one formula sheet for mathematics and one for statistics, probability tables prepared by the teacher, scientific calculator (not graphic) with statistical functions. For mathematics the exam will consist of exercises. For statistics: written exam and previous Project work. The written exam will include 8-10 questions (that is, exercises and theory questions). The programming language R will not be concretely examined. However, the student may be asked to correctly interpret numerical and graphical outputs generated using R. The Project work will consist of an individual work (exceptions for 2 students will be evaluated) with an applied work to be presented with 4 slides (1. Data and scientific hypothesis to be analyzed; 2. Method used; 3. Results; 4. Conclusions).
Assessment language	English
Evaluation criteria and criteria for awarding marks	The ability to accurately trace the solution will be more important than the final calculation result. In the Project work, the ability to identify a scientific hypothesis and the appropriate statistical method, and the ability to synthesize and present data and results, will be evaluated. Maximum 3 points more will be added for the Project work to the mark of the written statistics exam. The final mark will be determined as the weighted average from the marks in statistics and mathematics.

Required readings	Mathematics: R.A. Adams, *Single variable calculus*, SK 400 A 216 (3) or (6). Also SK 400 A 216 (7) or (8) (library reserve collections). Teacher's slides in the electronic reserve collection. Applied Statistics: Heumann, Christian/ Schomaker, Michael/ Srivastava, Shalabh. Introduction to Statistics and Data Analysis: With Exercises, Solutions and Applications in R, Part I (2016). Web. ISBN 3-319-46162-1, Springer International. Free PDF available from the Unibz Library. Teacher's slides in the electronic reserve collection.
Supplementary readings	*Mathematics with applications for the management, life, and social sciences*, Howard Anton, Bernard Kolman. Academic Press, 1982. Free PDF available from the Unibz Library.