

Syllabus

Course description

Course title	Mathematics and Applied Statistics
Course code	40180
Scientific sector	MATH/07 (Module 1, Mathematics) SECS/01 (Module 2, Applied Statistics)
Degree	Bachelor in Agricultural and Agro-Environmental Sciences/ Bachelor in Agricultural, Food and Mountain Environmental Sciences (L-25)
Semester	1
Year	1
Academic year	2020/2021
Credits	6 (mathematics), 3 (statistics)
Modular	No
Total lecturing hours	36 (mathematics), 18 (statistics)
Total lab hours	
Total exercise hours	24 (mathematics), 12 (statistics)
Attendance	Recommended
Prerequisites	Solid basic knowledge of mathematics
Course page	

Specific educational objectives	<ul style="list-style-type: none"> ○ type of course: basic ○ scientific area: mathematics and statistics ○ the course is part of a curriculum within the study programme <p>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.</p> <p>The aim of Module 2 (Applied Statistics) is to allow attendances to be able to</p> <ul style="list-style-type: none"> - Gather and describe data - Plot and analyse data - Use basic commands of R software
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Scientific sector of the lecturers	MAT07 (Mathematics) SECS01 (Statistics)
Lecturer (mathematics)	Giovanni Modanese, Giovanni.Modanese@unibz.it , room K1.13, tel. 0471-017134, webpage https://www.unibz.it/it/faculties/sciencetechnology/academic-staff/person/494-giovanni-modanese
Lecturer (statistics)	Fabiola Del Greco M. Fabiola.DelGreco@unibz.it
Teaching language	English
Office hours	According to individual arrangement
Teaching assistant (if any)	
List of topics covered (statistics)	Descriptive statistics (measures of location and dispersion). Assessment of data quality; identification of outliers. Distributions. Graphical presentation of data. Contingency tables. Association. Correlation. Linear Regression.
Teaching format (statistics)	Frontal lectures, exercises on the PC

List of topics covered (mathematics)	<p>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 x^n, n-th root, $\sin x$, $\cos x$. Range of rational fractional functions.</p> <p>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.</p> <p>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.</p>
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	<p>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.</p>
<p>Teaching format (mathematics)</p>	<p>Frontal lectures and exercises</p>

<p>Learning outcomes</p>	<p>Mathematics module:</p> <p>Knowledge and understanding of concepts, symbolism and techniques of functions, differential and integral calculus.</p> <p>Applying knowledge and understanding in solving exercises and problems which require a formalization, tools and methods learned in the course.</p> <p>Making judgments in tackling with the right approach and convenient tools problems and questions suitable to be formulated mathematically.</p> <p>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.</p> <p>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.</p> <p>Statistics module:</p> <p>Knowledge and understanding of the basic concepts of Descriptive and Inferential Statistics.</p> <p>Applying knowledge and understanding Starting from those basic concepts, the student will be able to carry on his/her own experimental study; to evaluate data quality and reliability; to identify the correct statistical method for the data; to perform those analyses with the software R.</p> <p>Making judgments Analysis and interpretation of the data in their own research and work field.</p>
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	<p>Communication skills Ability of presenting results of statistical analyses clearly and in the correct way.</p> <p>Learning skills Abstraction and formalization ability of phenomena under study in their field, and application of the statistical methods studied.</p>
<p>Assessment</p>	<p>Partial exam mathematics: Written exam, 120 minutes, solving exercises. No support allowed, except one formula sheet.</p> <p>Partial exam statistics: Written exam and Project work. The length of the written exam will be 90 minutes. This will include 8/10 questions (that is exercises and theory questions) which will allow to reach a maximum of 30 points. The student will be allowed to consult only a sheet of formulas and use a calculator to perform simple calculations. The ability to accurately trace the solution will be more important than the final calculation result. 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 a team work (2/3 students) 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).</p>
<p>Assessment language</p>	<p>English</p>
<p>Evaluation criteria and criteria for awarding marks</p>	<p>The final mark will be determined only in the final exam. A partial exam consists of about 8 to 10 questions. A total of 30 points can be obtained for all correct answers. Only one final mark will be determined as the weighted average from the marks in statistics and mathematics.</p> <p>Special hint for statistics: The written exam will be the 80% of the final grade; the Project work will be the 20% of it. The written exam will be pass if the student reach at least 18 points over 30. 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.</p>
<p>Required readings</p>	<p>Mathematics:</p>

	<p>R.A. Adams, Single variable calculus, SK 400 A 216 (3) or (6). Also SK 400 A 216 (7) or (8) (library reserve collections).</p> <p>Exercises in the electronic reserve collection.</p> <p>Statistics: Slides and lab materials will be available online on the Reserve Collections electronic platform.</p>
<p>Supplementary readings</p>	<p>Mathematics: G. Naldi, L. Pareschi, G. Aletti, Calcolo differenziale e algebra lineare, McGraw-Hill, ISBN 9788838663024</p> <p>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</p>