Syllabus

Course Description

Course Title	Mathematics and Applied Statistics
Course Code	40211
Course Title Additional	
Scientific-Disciplinary Sector	NN
Language	English
Degree Course	Bachelor in Sustainable Agriculture and Forestry in Mountain Environments
Other Degree Courses (Loaned)	
Lecturers	Prof. Giovanni Modanese, Giovanni.Modanese@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/494 Prof. Paolo Girardi, Paolo.Girardi2@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/35917
Teaching Assistant	
Semester	First semester
Course Year/s	1
CP	10
Teaching Hours	60
Lab Hours	40
Individual Study Hours	150
Planned Office Hours	30
Contents Summary	Mathematics for Agriculture and Forestry : Properties of functions, Polynomials and applications, Exponentials, logs and applications, Trigonometry, Derivatives and integrals, Differential equations in life sciences. Applied Statistics and Data Analysis: Descriptive statistics and probability, Random variables, Confidence intervals, Hypothesis

	testing, Correlation and linear regression.
Course Topics	MATHEMATICS MODULE 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, sinx, cosx, lnx, e^x. 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 equations: 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. STATISTICS MODULE 1. Introduction to Descriptive Statistics and Probability: this section introduces the role of statistics in applied research, focusing on how data can be summarized and visualized through tables,

	graphs, and summary measures such as mean, median, variance, and standard deviation. Students also learn the basic principles of probability, including conditional probability and Bayes' theorem, as the foundation for statistical inference. 2. Random Variables: Discrete and Continuous. We discuss random variables as models of uncertainty, distinguishing between discrete and continuous types. Key probability distributions such as the Binomial, Poisson, Normal, and Exponential are introduced, with attention to their properties, applications, and the role of the Central Limit Theorem in approximating real-world data. 3. Confidence Intervals: This part explains how sample data can be used to estimate population parameters with an associated level of confidence. Students practice constructing and interpreting confidence intervals for means, proportions, and differences, emphasizing their practical meaning in applied contexts. 4. Hypothesis Testing: Students learn the logic of hypothesis testing, including formulating hypotheses, understanding errors and significance levels, and interpreting p-values. Applications include tests for means, proportions, variances, and categorical data (chi-square tests), as well as an introduction to ANOVA and non-parametric methods. 5. Correlation and Linear Regression: Correlation is used to measure the strength and direction of association, while regression provides a predictive framework. Emphasis is placed on interpreting coefficients, assessing model fit, and diagnosing potential issues in applying regression to real data.
Keywords	Functions, Derivatives and integrals, Statistics and probability, Random variables, Hypothesis testing, Correlation and linear regression
Recommended Prerequisites	
Propaedeutic Courses	no
Teaching Format	Frontal lectures, exercises on the PC with R.
Mandatory Attendance	no
Specific Educational	Knowledge and understanding - Ability to apply knowledge and

Objectives and Learning Outcomes	understanding: The degree course provides advanced knowledge for the training of professionals capable of carrying out management and coordination activities in mountain and forestry agriculture, as well as effectively preparing students for possible further studies. The knowledge and skills acquired provide graduates with planning, management, control, coordination and training skills in agriculture and forestry. All these skills will be transmitted to the graduates by means of face-to-face lecturing, technical and practical laboratory exercises, field exercises and educational-scientific excursions. The elaboration of the experimental thesis may be carried out both in the faculty's laboratories and in companies and local authorities. At the end of their studies, the three-year graduate at Sustainable agriculture and forest management in mountain environment possesses basic knowledge of mathematics, physics, chemistry, statistics, and the biology of plant and animal organisms and microorganisms. The expected learning outcomes can therefore be summarised as: - understanding of the concept of function and the basic principles governing integral calculation by functions; - adequate statistical and data analysis skills - being able to read and understand advanced texts relating to the various aspects characterising the agrarian and agro-forestry environment in mountainous areas - being able to communicate and discuss issues relating to the training course in an appropriate manner in the three languages (Italian, English, German). The knowledge and comprehension skills listed above are achieved through participation in lectures, practical exercises, seminars, and through guided personal and individual study as envisaged by the training activities offered. Some courses in the syllabus may be offered in a dual mode (lectures face-to-face and in video-recorded form and made available on the university intranet platform) The assessment of the achievement of learning outcomes takes place mainly by means of exams and possible in -progress tests. The tests may be written and/or oral, and may also consist of reports and oral presentations of projects or seminars. The ability to apply knowledge is achieved through critical reflection on the texts proposed for individual study stimulated by

	classroom activities, the study of research and application cases shown by the lecturers, the performance of practical laboratory and field exercises, bibliographical research, individual and/or group projects as part of the fundamental and optional courses included in the teaching plan, as well as during the internship and preparation for the final examination. The tests carried out by means of written and/or oral examinations, reports and exercises include the performance of specific tasks in which the student demonstrates mastery of tools, methodologies and critical autonomy. In the internship activities, the verification takes place through the presentation of a report by the student to the teacher of reference. Making judgements: Autonomy of judgement is developed and verified through the exercise activities, the organised seminars, the preparation of papers as part of the teaching, as well as during the internship activity and the activity assigned by the lecturer for the preparation of the final examination. Communication skills: The graduate has the ability to use the most modern and effective means of communication to disseminate the research carried out and the analyses relating to the problems of agro-forestry and forest management; he/she is able to deal with the production realities in the agro-forestry sector and to interact with figures from the sector and related sectors. Communication skills are particularly developed during exercises, the organised seminars, as well as during training activities that also involve the preparation of reports and written documents and the oral presentation of the same. Since the course is trilingual, graduates are able to communicate correctly, in written and oral form, in Italian and in two other languages (German and English). In tutorial activities and seminars, students are encouraged to speak publicly in order to improve their ability to describe clearly and comprehensibly any doubts and/or requests for clarification on specific topics. The acquisition and evaluation/verification of the achievement of communication skills are also provided for during the internship and the final report, as well as when writing and discussing the final paper.

	Learning skills: The degree course provides the basic cognitive tools indispensable for the continuous updating of knowledge, also with tools that make use of new communication and information technologies. The graduate is able to apply the developed learning methods and tools to update and deepen the studied contents, also in professional contexts and to undertake further studies.
Specific Educational Objectives and Learning Outcomes (additional info.)	
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 be asked by correctly interpret numerical and graphical outputs generated using R. The project work will consist of an individual report, prepared using R, based on the analysis of a dataset. The report, with a maximum length of 6 pages, should be structured into four sections: - Data and research hypothesis: a clear description of the dataset and the scientific question under investigation; - Methodology: the statistical techniques applied and their justification; - Results: presentation and interpretation of the main findings; - Conclusions: a concise summary of the outcomes and their implications.
Evaluation Criteria	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. Students will pass the exam if they achieve a mark of 18 or higher in both parts.

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	
Further Information	
Sustainable Development Goals (SDGs)	Quality education

Course Module

Course Constituent Title	Mathematics for Agriculture and Forestry
Course Code	40211A
Scientific-Disciplinary Sector	MATH-04/A
Language	English
Lecturers	Prof. Giovanni Modanese, Giovanni.Modanese@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/494
Teaching Assistant	
Semester	First semester
CP	5
Responsible Lecturer	
Teaching Hours	30
Lab Hours	20
Individual Study Hours	75
Planned Office Hours	
Contents Summary	Properties of functions, Polynomials and applications, Exponentials, logs and applications, Trigonometry, Derivatives and integrals, Differential equations in life sciences.

Course Topics	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, sinx, cosx, lnx, e^x. 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 equations: 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.
Teaching Format	Frontal lectures and exercises
Required Readings	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.
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.

Course Module

Course Constituent Title	Applied Statistics and Data Analysis
Course Code	40211B
Scientific-Disciplinary Sector	STAT-01/A
Language	English
Lecturers	Prof. Paolo Girardi, Paolo.Girardi2@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food-sciences/academic-staff/person/35917
Teaching Assistant	
Semester	First semester
CP	5
Responsible Lecturer	
Teaching Hours	30
Lab Hours	20
Individual Study Hours	75
Planned Office Hours	15
Contents Summary	Descriptive statistics and probability, Random variables, Confidence intervals, Hypothesis testing, Correlation and linear regression.
Course Topics	
Teaching Format	Frontal lectures, exercises on the PC with R.
Required Readings	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	