Main course information	
Academic subject	Mathematics and Elements of Statistics
Degree course	Natural Sciences (I level)
Classe di laurea	L/32
ECTS credits (CFU)	9
Compulsory attendance	Yes
Teaching language	Italian
Accademic Year	2019/2020

Docente responsabile	
Name & SURNAME	Annunziata Loiudice
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Tutorial time/day	By appointment to be requested by e-mail

Course details	Pass-fail exam/Exam with mark out of 30	SSD code	Type of class
	Exam with mark out of 30	MAT/05	Lecture/Exercise workshop

Teaching schedule	Year	Semester
	I	I

Modalità erogazione	CFU/ECTS	Lessons (hours)	CFU/ECTS lab	Lab hours	CFU/ECTS tutorial/workshop	Tutorial/workshop hours	CFU/ECTS field trip	Field trip Hours
	6	48	0	0	3	45	0	0

Time management	Total hours	Teaching hours	Self-study hours
	225	93	132

Academic Calendar	First lesson	Final lesson
	October	January

Syllabus	
Course entry requirements	Knowledge of the basic notions of algebra and calculus
Expected learning outcomes (according to Dublin Descriptors) (it is recommended that they are congruent with the learning outcomes contained in A4a, A4b, A4c tables of the SUA-CdS)	
Knowledge and understanding	Students will acquire the basic mathematical tools for the description and the interpretation of natural phenomena. They will learn the basic notions of the differential and integral calculus and the fundamental tools of Statistics. This knowledge will be acquired by participating to the lectures and exercise sessions and by means of a careful self-study.
Applying knowledge and understanding	Students will learn how to use the acquired mathematical tools to collect and treat statistical data; particularly, they will be able to apply the acquired techniques in representing and modeling phenomena, synthesizing and interpreting statistical data. To this aim, it will be useful to participate to the exercise sessions and to carry out the suggested exercises which will be available on the webpage of the course.
Making informed judgements and choices	Students will acquire autonomy in devising the right strategies to solve mathematical problems, they will be able to choose the appropriate mathematical models to describe natural phenomena and they will develop capacity in the analysis and interpretation of scientific data. During the course, specific exercises will be proposed in order to promote the acquisition of such skills.
Communicating knowledge and understanding	Students will acquire mastery of notation and mathematical language to be able to understand and communicate scientific knowledge. These communication skills will be developed by means of an assiduous attendance to the lectures and by a careful reading

	of the course books. Students will be stimulated to use the correct scientific language during the exercise sessions and while preparing the oral examination.
Capacities to continue learning	Students will acquire the capacity to critical reading scientific texts and interpreting scientific results in order to achieve a correct scientific update. To this aim, students will be stimulated to consult and compare texts and various materials which will be made available by the course teacher.

Syllabus	
Course content	**Lectures** Basic notions of set theory Set operations: union, intersection, Cartesian product. The notion of function and related properties. Composition of functions. Injective, surjective, bijective functions; inverse function. Numerical sets The set of rational numbers Q. Existence of non rational numbers. The set R of real numbers. The real line. Intervals, open and closed, limited and unlimited intervals. Scientific notation. Approximation with a fixed number of digits. Approximation errors: absolute, relative, percentage error. Propagation of the error in the operations. Analytic Geometry review The Cartesian plane; distance between two points; equation of the line, equation of the circle, equation of the parabola. Functions with real variable The graph of a function. The algebra of functions. Transformation of graphs. Qualitative properties of real functions: symmetries, monotonicity, local and global extrema, boundedness, convexity. Elementary functions: polynomial functions, rational functions, irrational functions, exponential functions, logarithmic functions. Algebraic properties of logarithms. Principal basis of logarithms. The Gaussian function. Trigonometric functions and their inverses. Equations and inequalities involving elementary functions. Limits and Continuity Definition of limit of functions. Limits of some elementary functions. Algebra of limits. Limit theorems. Limits at infinity and infinite limits. Indeterminate forms. Definition of continuity at a point and on an interval. Algebra of continuous functions. Continuity of elementary functions. Weierstrass Theorem, Bolzano's Theorem, The Intermediate Value Theorem. Differential calculus Notion of derivative. Differentiability implies continuity. Tangent line and the geometric meaning of derivative. Derivatives of elementary functions. Rules of differentiation. Higher order derivatives. Theorems of differential calculus: Rolle's Theorem, Lagrange's Theorem. Monotonicity criterium. Convexity criterium. Finding local maxima and minima. De l'Hopital Theorem. Study of the graph of a function. Integral Calculus The Riemann integrability. The Riemann integral. Integrability of continuous functions. Geometric interpretation of the Riemann integral. Properties of the Riemann integral. The Integral Mean Theorem. Primitives. Fundamental Theorem of Integral Calculus. Fundamental Formula of Integral Calculus. Indefinite integrals. Rules for integration. Integration of rational functions. Integration by substitution. Integration by parts. Introduction to improper integrals. Elements of Combinatorics Dispositions: simple and with repetitions. Permutations. Combinations.

	Elements of Probability Sample space and random events. Definitions of probability. Axioms of probability. Conditional probability. Independent events. Discrete and continuous random variables. Probability density function. Distribution function. Mean value, variance and standard deviation of a random variable. Bernoulli's random variable. The Normal distribution. The Central Limit Theorem. Elements of Statistics Qualitative and quantitative variables. Graphic representation of statistical data. Measures of location: mean, median, mode. Quantiles, percentiles. Indices of dispersion: variance, standard deviation, range, interquartile range. Approximately normal data. Bivariate data. Dispersion diagram. Least square method. Linear regression. Coefficient of linear correlation. Statistical inference. Pointwise estimate of parameters. Confidence interval for the mean. Introduction to the hypothesis statistical tests. **Workshop hours** The workshop hours will be devoted to carry out exercises on the different arguments of the course. Precisely, the exercise sessions will concern the following topics: - The basic tools of mathematical language - Equations and inequalities - Determination of the domain, zeroes and sign of a function; qualitative properties of functions; transformation of graphs - Limits - Calculus and applications of the derivative - The complete study of functions - The integral calculus and its applications - Descriptive Statistics and linear regression - Elementary probability, normal distribution and the use of tables of standard normal distribution
Course books/Bibliography	**Theory books** • Marcellini-Sbordone, "Elementi di Calcolo", Liguori Editore. • D. Benedetto- M. Degli Esposti- C. Maffei, Matematica per le Scienze della Vita, Casa Editrice Ambrosiana. • S. Ross, Introduzione alla Statistica, Apogeo Education, Maggioli Editore. **Exercise books** • Marcellini-Sbordone, Esercitazioni di Matematica, Vol 1, part I and II, Liguori Editore. • Exercise sheets available on the course website. The suggested books can be consulted in the library of the Department of Mathematics.
Notes	In addition to recommended books, a set of exercise sheets and some review slides on Statistics will be made available by the course teacher on the webpage of the course at the following link: https://www.dm.uniba.it/Members/loiudice/didattica
Teaching methods	Lectures and exercise workshops During the course, at the end of each chapter, a set of exercises will be proposed to the students in order to clarify and consolidate the course contents. The solution to such exercises will be checked during appropriate workshops where the active participation of students will be stimulated. Moreover, the diary of lessons will be published and regularly updated on the course webpage as a support to self- study.

Assessment methods (indicate at least the type written, oral, other)	Written and Oral exam. Also some intermediate tests are planned during the course which exempt (totally or partially) from the written exam. The written exam consists in carrying out a set of exercises. A score is assigned to each exercise and the final mark is given by the sum of the partial scores. The oral exam consists in discussing theorems, definitions and applications. As a guide to the preparation of the oral exam, a list of the possible questions that will be proposed to the students will be made available at the end of the course. It will be required to the students to be able to illustrate the theoretical definitions by means of applications and to know the geometric meaning of theorems and definitions.
Evaluation criteria (Explain for each expected learning outcome what a student has to know, or is able to do, and how many levels of achievement there are**)**	**Knowledge and understanding** Students have to know the main course contents, i.e. the main tools related to elementary functions, differential and integral calculus, and the basic tools of Probability and Statistics. Knowledge and understanding of the basic concepts proposed during the course is a necessary condition in order to pass the exam. The level of completeness and deepness of such knowledge, which will be tested during the written and oral exam, will contribute to a positive evaluation. **Applying knowledge and understanding** Students must demonstrate to be able to apply the acquired theoretical knowledge to solve simple applied problems, to construct or get information from graphs of functions, to understand and apply the fundamental concepts of derivative and integral, to apply the basic notions of probability in the statistical framework. The achievement of these skills will be verified by means of the exercises proposed during the written exam and the oral colloquium and they are necessary for passing the exam. **Making informed judgments and choices** The autonomy achieved by the students in selecting appropriate strategies in problem solving, the capacity of motivating the chosen procedures in carrying out exercises, the ability of correct reasoning and critical thinking will be assessed and they will contribute to a positive evaluation. **Communicating knowledge and understanding** By means of the written and oral exams, the correct use of notation and scientific language, the clarity in the exposition, the ability to communicate the acquired mathematical concepts and their applications will be evaluated. The mastery of the mathematical language and the rigor in the exposition of contents, together with the completeness of knowledge and understanding, will contribute to a positive evaluation up to the maximum grade. **Capacities to continue learning** The students must demonstrate to have acquired capacities to autonomous learning, ability in reading and correctly interpreting mathematical and statistical contents related to natural science. The acquisition of such skills will be shown through the capacity of providing examples and applications of the learned theoretical contents and the ability to establish links and comparisons between different scientific frameworks. These skills will contribute to increment the evaluation up to the maximum grade.
Further information	