

General Information	BACELOR DEGREE IN BIOTECHONOLOGIES
Title of the subject	Mathematics with Elements of Statistics
Degree Course (class)	Industrial and Agri-food Biotechnologies (L-2)
ECTS credits	8
Compulsory attendance	Yes
Language	Italian
Academic year	2020/21

Subject Teacher		
Name and Surname	Mirella Cappelletti Montano	
email address	Mirella.cappellettimontano@uniba.it	
Place and time of reception	Department of Mathemartics, III floor, Room 12 Every Monday, 15:00-17:30; please contact Dr. Cappelletti Montano by e-mail to schedule an appointment.	
ECTS credits details	Discipline sector (SSD)	Area
	MAT05	---

Study plan schedule	Year of study plan		Semester	
	1°		1°	
Time management	Lessons	Laboratory	Exercises	Total
CFU	6		2	8
Total hours	100		100	200
In-class study hours	48		24	72
Out-of-class study hours	52		76	128

Syllabus	
Prerequisites / Requirements	Rules concerning the operations and the ordering on \mathbb{R} (elements of Algebra). Powers and their properties. Analytic Geometry. Basic properties and terminology in set theory and functions. Real-valued functions. Polynomials and their roots. Absolute value function, power function, n-th root function, exponential function and logarithm function.
Expected learning outcomes (according to Dublin descriptors)	
Knowledge and understanding	To get the basic logical-mathematical and statistical tools (correct use of language and understanding of the main theoretical results) useful to tackle biotechnological problems.
Applying knowledge	To get the main techniques of differential and integral calculus useful for solving basic mathematical problems. To be able to apply the

	acquired knowledge to describe/interpret statistically significant data.
Making informed judgments and choices	To be able to identify the most appropriate techniques for the solution of particular mathematical problems.
Communicating knowledge	Ability to use the appropriate terminology in order to prove or disprove a statement, by means of appropriate examples and counterexamples.
Capacities to continue learning	Ability to examine different sources of information, besides books and possible notes. Ability to deepen and acquire new knowledge, consulting Mathematics and Statistics textbooks.

Study Program

Content	<p>Basic Set theory. Cartesian product of two or more sets. Equivalence relations. Partial and total orders. Functional relations. Functions. Injective, surjective and bijective functions. Inverse function. Restriction of a function. Composition of functions. Image and preimage of a set under a function. The sets \mathbb{R}, \mathbb{N}, \mathbb{Z}, \mathbb{Q} and their algebraic properties. Completeness of the real numbers. The oriented line. There's no rational number q such that $q^2 = 2$. Real intervals. The extended real line and indeterminate forms. Absolute value and its properties. Upper and lower bound, maximum and minimum of a set. Uniqueness of the maximum and the minimum. Completeness theorem. Infimum and supremum, maximum and minimum of a function. Upper and lower bounded functions. Even, odd and periodic functions. Graph of a function. Decreasing and increasing functions. Constant functions. Linear functions. Piecewise defined functions. Heaviside function. Sign function. Power function with natural exponent. n-th root function. Exponential functions. Logarithmic functions. Trigonometric functions: \sin, \cos, \tan. Inverse trigonometric functions: \arcsin, \arccos, \arctan. Topology on \mathbb{R}: interior, exterior and boundary of a real set. Cluster points. Neighborhoods. Limits for real-valued functions. Uniqueness of the limit. Right-end and left-end limit. Limits of the elementary functions. Limit of the composite function. Operations with limits. Theorem of the permanence of the sign. Squeeze theorems. Asymptotic analysis. Vertical, horizontal and oblique asymptotes. Sequences and their properties. Limit of a sequence. Subsequences. Monotone sequences and their properties. Continuity at a given point. Continuity of a function. Weierstrass and Bolzano Theorems. Derivative of a function. Every differentiable function is continuous. Tangent line. Derivative of elementary functions. Derivation rules. Local maxima and minima. Fermat, Rolle and Lagrange Theorems. Consequences of the Lagrange theorem. de l'Hospital theorems. Higher order derivatives. Convex and concave functions. Second derivatives test. Inflection points. Graph of a function. Taylor polynomials and related results. Antiderivatives and indefinite integrals. List of integrals. Calculation of integrals by decomposition, substitution, by parts. Integral of rational functions. Riemann integral and its geometric interpretation. Definite integrals. All monotone functions and all continuous functions are Riemann integrable. Properties of the definite integrals. Mean value theorem. Fundamental theorem and fundamental formula of calculus. Improper integrals. Evaluation of the</p>
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	<p>integral of the function $1/x^\alpha$ in $]0,1[$ and in $[1,+\infty[$. Series and their properties. Geometric and telescoping series. Elements of Statistics. Populations and samples: descriptive and inferential statistics. Variables. Scales. Closed series and frequencies. Continuous variables and bins. Data representation: bar chart and histograms. Central tendency: mode, median, quantiles, five number summary; mean, other kinds of mean. Spread indices: range, interquartile range, outlier, box-plot; variance, standard deviation and coefficient of variation; standard score. Chebyshev inequality; Empirical rule. Bivariate Statistics. Contingency table. Scatter plots. Covariance and linear correlation. Linear regression; nonlinear models. Introduction to Inferential Statistics: confidence intervals and hypothesis testing.</p>
Bibliography and textbooks	<ol style="list-style-type: none"> 1) S. Invernizzi, M. Rinaldi, F. Comoglio, <i>Moduli di Matematica e Statistica</i>, Zanichelli, 2018 2) P. Marcellini, C. Sbordone, <i>Calcolo</i>, Liguori editrice. 3) P. Marcellini, C. Sbordone, <i>Esercitazioni di Matematica I</i>, Liguori editrice. 4) N. Cufaro Petroni, <i>Statistica con Elementi di Probabilità</i>, disponibile online.
Notes to textbooks	<p>The first textbook is suggested for Statistics because it is application-oriented and it is a primer on R. The second textbook can be used to study the subjects of Mathematical Analysis included in the above Contents list. The third textbook is suggested because the students can find many exercises in it. The fourth textbook (and in particular Chapters I and II) is suggested for the part of the Contents related to Statistics. For the part concerning Mathematical Analysis, notes by Dr. Cappelletti Montano are also available.</p>
Teaching methods	<p>The lessons include many exercises made by the subject teachers.</p>
Assessment methods (oral, written, ongoing assessment)	<p>Written exam with theoretical questions as well as exercises.</p> <p>Mid-term written exam for the Statistics contents.</p>
Evaluation criteria (describe criteria for each of the above expected outcomes)	<p>For the exercises the correctness of the procedures and the ability in calculations are valued.</p> <p>By means of the theoretical questions we evaluate (in order of importance):</p> <ul style="list-style-type: none"> -the knowledge of the main definitions and of the statement of the theorems; -the knowledge of examples and counterexamples; -the correct use of the mathematic language; -the knowledge of the proofs.
Further information	<p>The prerequisites of the course are part of all high schools programs and, in any event, are recalled during the one-week preparatory course that precedes the beginning of the lessons of this course.</p>

