Professor name	Prof. Lorenza M. Diomeda
Bachelor in	Business Administration
Academic year	2013/14
I or II semester	I
Number of ECTS credits	10
Scientific Sector Code	MAT-05

Course unit title: Mathematics for Business and Economics (a.a. 2013/2014)

(Prof. Diomeda Lorenza M.)

University of Bari Aldo Moro

Bachelor in Business Administration

Pre-requisites

Algebraic elementary calculus and basics of analytic geometry (equation of a straight line and related topics)

Objectives

Providing the main mathematical tools frequently occurring in problems related to business administration, economics and finance; developing suitable techniques of quantitative analysis to face up problems of evaluation and choice in the same areas.

Course content

Basics on set theory: logical symbols, sets, elements and related properties. Set operations: union, intersection, difference, complement, simmetric difference. Cartesian product. The numerical sets **N**, **Z,** **Q** and related properties.
The set **R** of real numbers: algebraic and order properties. Upper and lower bound of a subset of **R**. Bounded and unbounded sets. Maximun and minimum, supremum and infimum of a subset of **R**. The completeness property and equivalent versions. Some applications: n-roots, exponentials and logarithms. Absolute value of a real number. Intervals of **R.** The density of **Q** in **R**. The estended real line: neighborhoods, cluster points and isolated points.

Functions: domain, range and graph. Injective, surjective, bijective and invertible functions. Composition of two or more functions. Inverse function. Restrictions of a function. Real functions of one real variable: upper and lower bound, supremum and infimum, maximun and minimum. Local and global extrema. Bounded, monotone, convex and periodic functions. Sequences of real numbers. Sequences defined by recurrence. Aritmetic and geometric progressions with applications: simple and continuous compounding in finance. The factorial of a natural number. Some elementary functions: constant function, identity function, affine function, absolute value function, power function, n-root function, exponential function, logarithmic function, power function with real exponent, trigonometric functions and the corresponding inverse functions. Equations and inequations. Calculating the domain of a function.

Limits: basic definitions and corresponding interpretation. Limit of sequences. **Uniqueness theorem for the limits**. Local character of the limit. Limit of a restriction of a function. Non –

regularity test. Right-hand and left-hand limit and related theorem. Comparison theorems. **Squeeze theorem.** Divergence criterion. Operations with the limits. Indeterminate forms. Limit of the composition of functions. Theorem of the limit of monotone functions/sequences. Limits of some elementary functions. Worthy limits. Neper number and its financial meaning. Asimptotic analysis for the calculus of indeterminate forms. An estimate of the growth of n! and DeMoivre-Stirling's formula.

Continuity: definition of a continuous function and basic properties. Points of discontinuity and the corresponding classification. Sum, product, quotient and composition of continuous functions. Continuity criterion for monotone functions. Continuity of the elementary functions. Intermediate value property and Bolzano's theorem. **Existence of zeros theorem, fixed point theorem and** Weierstrass's theorem.

Differentiation: the concept of derivative. Differentiable functions Left and right derivative. Geometric interpretation: tangent line and rate of approximation. Angular and cusp points. **Continuity of the differentiable functions**. Differentiation rules. Higher order derivatives and Lagrange's spaces. The chain rule and the differentiability of the inverse function Calculus of the derivatives of the elementary functions. Elasticity, semielasticity and applications in Economics.

Applications of the differential calculus: functions which are strictly monotone at a point: necessary condition and sufficient condition. Local extrema. Stationary points. **Fermat's theorem**. **Main theorems in differentiation: Rolle's theorem** Cauchy's theorem and Lagrange's theorem. Darboux's theorem. **Consequences of Lagrange's theorem.** Monotonicity test for differentiable functions. Some sufficient conditions for local extrema. Convexity/concavity test through the sign of the second derivative. Inflection points: a necessary condition and some sufficient conditions. De L'Hospital's rule and applications. Discontinuity of the first derivative. Second order Taylor expansion and some applications. Asymptotes and graph-sketching.

Basics of integration theory: antiderivatives, **indefinite integral and main properties.** The standard rules of integration. Integration by parts and by substitution. The Riemann integral and related properties. Definite integrals and computing areas. Some classes of integrable functions. **Mean value theorem.** Torricelli-Barrow's theorem. **Newton-Leibnitz theorem (or Fundamental theorem of integral calculus)**.

Some elements of linear algebra: vectors in $\mathbf{R}^n$ and basic operations. Linearly independent vectors and basis in Euclidean spaces. Matrices, determinants and related properties. The rank of a matrix. Kronecker's theorem. Solving systems of linear equations: Cramer's formula and Rouchè-Capelli'theorem.

Functions of two variables: graph, coordinate lines and level curves. Cobb-Douglas functions in Economics. Limits and continuity. Partial derivatives and gradient vector. Differentiability and tangent plane. The chain rule. Directional derivatives and the gradient formula. Some properties of the vector gradient. Second-order partial derivatives and Schwarz's theorem. Hessian matrix. Unconstrained optimisation. Something about constrained optimization and Lagrange multipliers.

The students have to know all the definitions and statements of the theorems indicated above; the proof is required in addition if the theorem is marked in boldface.

Compulsory reading – study material

Slides available on line at www.uniba.it/ricerca/dipartimenti/disag

Recommended reading - study material

1) M. Bramanti, C. D. Pagani, S. Salsa, *Matematica: calcolo infinitesimale e algebra lineare*, Zanichelli, Bologna.
2) S. Salsa, A. Squellati, *Esercizi di Matematica: calcolo infinitesimale e algebra lineare, Volume 1*, Zanichelli, Bologna.
3) P. Marcellini, C. Sbordone, *Esercitazioni di Matematica, Volume I, Parte prima e seconda*, Liguori Editore, Napoli.
4) A. Attalienti, S. Ragni, *Esercitazioni di Matematica*, Giappichelli, Torino.

Teaching methods

- Direct contact
  Lectures: Yes
  Tutorials: Yes
  Personal work
  Case studies – in group: No

Assessment methods

- Assignment: No
- Written without oral presentation: No
- Oral presentation: Yes
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This course is in e-learning Web Site area: No