UNIVERSITÀ DEGLI STUDI DI PALERMO

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| **DEPARTMENT** | Scienze Economiche, Aziendali e Statistiche |
| **ACADEMIC YEAR** | 2019/2020 |
| **BACHELOR'S DEGREE (BSC)** | STATISTICS FOR DATA ANALYSIS |
| **SUBJECT** | LINEAR ALGEBRA |
| **TYPE OF EDUCATIONAL ACTIVITY** | A |
| **AMBIT** | 50245-Matematico |
| **CODE** | 01169 |
| **SCIENTIFIC SECTOR(S)** | SECS-S/06 |
| **HEAD PROFESSOR(S)** | TUMMINELLO MICHELE Professore Ordinario Univ. di PALERMO |
| **OTHER PROFESSOR(S)** | |
| **CREDITS** | 6 |
| **INDIVIDUAL STUDY (Hrs)** | 98 |
| **COURSE ACTIVITY (Hrs)** | 52 |
| **PROPAEDEUTICAL SUBJECTS** | |
| **MUTUALIZATION** | |
| **YEAR** | 2 |
| **TERM (SEMESTER)** | 1° semester |
| **ATTENDANCE** | Not mandatory |
| **EVALUATION** | Out of 30 |
| **TEACHER OFFICE HOURS** | **TUMMINELLO MICHELE**<br>Monday 14:00 16:00 Studio/Laboratorio: primo piano, ex DSSM<br>Tuesday 14:00 16:00 Studio/Laboratorio: primo piano, ex DSSM |

**DOCENTE:** Prof. MICHELE TUMMINELLO

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| **PREREQUISITES** | Basic knowledge of calculus, powers and their properties, logarithms and their properties, trigonometry. |
| **LEARNING OUTCOMES** | Knowledge and ability to understand:<br>Knowledge of definitions and fundamental theorems of linear algebra. Knowledge of linear algebra applications. Ability to understand the logical-deductive structure of a scientific text.<br><br>Ability to apply knowledge and understanding:<br>Ability to use linear algebra concepts in practical applications. Ability to represent real problems using mathematical models.<br><br>Making judgments:<br>The student must be able to evaluate and analyze the logical-deductive process of a mathematical model. The student must recognize the appropriateness of different mathematical models to solve a real problem.<br><br>Communication skills:<br>Ability to expose the consequences of the adoption of specific mathematical tools for the analysis of real problems.<br><br>Learning skills:<br>Ability to activate the logical-deductive process for analyzing and solving real problems. |
| **ASSESSMENT METHODS** | THE FINAL<br>The final consists of a test that includes 6 exercises. Students are required to complete the test in two hours. One intermediate test can also be taken by students, and concerns matrix operations and matrix basic properties, e.g., products, transpose, determinant, rank, inverse matrix, etc. A student passing the intermediate test is exempt from doing the corresponding exercises in the final test. In that case, the student is expected to complete the (reminder of the) final test in a shorter time: 1 hour. Both final and intermediate tests will be followed by a discussion of exercises. In the final test, and in the intermediate test (only for the corresponding topics), students will be required to make use of theorems and rules of matrix algebra to solve systems of linear equations and study the properties of matrices. Furthermore, in some exercises, students will be required to explain and motivate all the fundamental steps of the logic process that allow them to provide a mathematical description of a given problem.<br><br>ASSESSMENT CRITERIA<br>The evaluation of the final test is based on the assessment of the following facets: i) competence; ii) ability to apply studied concepts, methods, and theorems; iii) knowledge of mathematical formalism and notation.<br><br>GRADING<br>A score ranging between 0 (insufficient) and 1 (excellent) is associated with each exercise of the final, or intermediate, test. The grade of a test, either intermediate or final, is obtained by taking the first integer larger than the product of the average score of proposed exercises and 30. The "laude" will be assigned based on the discussion of the test with the student (that also applies to intermediate tests). If a student passed one or both intermediate tests then the final grade is obtained by taking the weighted average (0.4 for the first unit, 0.3 for the second one, and 0.3 for the third one) of the grades received by the student for each unit.<br><br>OFA<br>According to a resolution passed by the academic senate on 13/06/2017 and a resolution passed by the CICS L41 - LM82 on 03/07/2017, passing the Mathematics exam automatically implies fulfilling the corresponding OFA. |
| **EDUCATIONAL OBJECTIVES** | OBJECTIVES OF THE COURSE: Matrix algebra.<br>1) construct a system of linear equations and recognize the structure of the system; 2) represent in a tabular form a linear system, and solve it through reduction methods; 3) interpret the solution of the system; 4) formulate and prove the fundamental theorems of linear algebra; 5) use matrix decomposition methods to investigate the characteristics of the system described through a matrix. |
| **TEACHING METHODS** | Lectures (32 hh) and in-class exercises (20 hh). The course is about matrix algebra, linear equation systems, and provides an introduction to vector spaces and sub-spaces and their properties. |
| **SUGGESTED BIBLIOGRAPHY** | Sistemi lineari ed Elementi di algebra lineare. Strang. Introduction to Linear Algebra. Cambridge Press. Ferrarotti. Appunti di Algebra Lineare. Disponibile on-line. M. Stoka e V. Pipitone, Esercizi e Problemi di Geometria, CEDAM |

# SYLLABUS

| Hrs | Frontal teaching |
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| 1 | Educational objectives of the course, and course organization |
| 4 | Linear systems. Matrix representation of a linear system. Gauss reduction method. Row Echelon Form solution. |
| 4 | Pivot and free variables. The general solution of linear non-homogeneous system. Homogeneous linear systems. |
| 4 | Matrix algebra. Determinant and matrix rank. |
| 2 | Invertible matrices and inverse of a matrix. |
| 4 | Generalized inverse and inverse of block matrix |
| 4 | Vector algebra. Scalar product. Linearly dependent and linearly independent vectors. Spanning vectors and bases of a vector space. |
| 3 | Linear transformations and quadratic forms. |
| 6 | Eigenvalues and eigenvectors of a matrix. |

| Hrs | Practice |
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| 20 | Linear systems. Determinants. Matrix inverse. Matrix rank. Linear dependence and independence of vectors. Eigenvalues and eigenvectors of a matrix: diagonalization and the eigendecomposition. |