

MODULE HANDBOOK

MATHEMATICAL ANALYSIS

**Undergraduate Degree in International
Business and Economics**

University of Alcalá

Academic Year 2018/19

FIRST YEAR – SECOND TERM

MODULE HANDBOOK

Module:	Mathematical Analysis
Code:	360004
Degree Title:	International Business and Economics
Department and Subject Area:	Economics Introduction to Economic Analysis
Nature:	Foundation course
ECTS Credits:	9
Year and term:	First year Term two
Teaching Staff	Omar de la Cruz Vicente
Staff Consultation Hours:	Will be communicated during the introductory lesson. See department website for staff contact details.
Language of Teaching	English

1 MODULE DESCRIPTION

One of the main purposes of mathematical theory is to construct models for describing the real world. In particular, mathematics can be used to design economic models to explain real-world economics.

The student will learn to master the basics of scientific language and will learn to recognise the role mathematics plays in the development of scientific thought; improving logical reasoning; increasing precision and abstraction and in evaluating results. The student must also be able to understand the mathematical world and use mathematical symbols for expression.

This module introduces linear algebra through studying key concepts: vectors, matrices and determinants. These concepts are used to solve linear systems and are key elements of theoretical models. Next, the student will be introduced to mathematical analysis. They will focus on describing and studying real functions of one and two variables, as well as developing mathematical instruments that can be used to predict their behaviour, determine their characteristics and ascertain their principal properties. At the end of this module, integral calculus of real variable functions and their economic applications will be revised.

This module aims to provide a foundation of knowledge for studying, understanding and communicating in the field of mathematical analysis. In particular, it provides a foundation for studying the statistics and macro- and micro-economics modules in this degree course.

Prerequisites and Recommendations

The student is expected to have a sufficient knowledge of mathematics (basic logic; manipulating fractions and exponents; elementary functions; representation of functions; equations and inequations, etc.). Having studied Mathematics at high school leaving diploma level or equivalent is sufficient background knowledge for this module.

2. LEARNING OBJECTIVES

The student is expected to develop the following skills through studying this module. These will be assessed throughout the term. (See below for details of assessment methods).

General skills:

1. Analysing and summarising information.
2. Expressing ideas in writing and verbally.
3. Working independently and as part of a team.
4. Researching and using ICT applications.

Subject-specific skills:

1. Understanding mathematical language and using it to explain various basic concepts.
2. Being familiar with the basics of algebra that are required in economic studies.
3. Being familiar with the basics of mathematical analysis that are required in economic studies.
4. Using these mathematical concepts to describe concrete situations and problems.
5. Being able to resolve a range of practical problems using algebra and calculus.
6. Developing oral, written and technological skills for presenting results and assignments in front of the class.
7. Collaborating and working with others to reach solutions by consensus.
8. Understanding and interpreting information received.
9. Acquiring the foundation knowledge required for studying later modules in this course.
10. Being aware of and using this foundation knowledge of economics and business to defend opinions.

3. MODULE CONTENT

Units	Number of hours
<p>Part I – Linear Algebra</p> <p>Topic 1: VECTORS</p> <p>Introduction. Definition and examples. Dot product. Modulo. Orthogonality. Linear dependence.</p> <p>Topic 2: MATRICES AND DETERMINANTS</p> <p>Introduction. Definition, operations and properties. Determinants. Properties. Matrix rank.</p> <p>Topic 3: LINEAR EQUATION SYSTEMS</p> <p>Introduction. Linear equation systems. Matrix expression. Existence of solutions. Solution and discussion of linear system of equations.</p> <p>Topic 4: DIAGONALIZATION OF MATRICES</p> <p>Introduction. Eigenvalues and eigenvectors: explanation and calculus. Properties. Diagonalizations of a matrix.</p> <p>Quadratic forma. Definition and examples.</p>	<p>21 hours</p>

Part II – Mathematical analysis

Topic 5: FUNCTIONS OF A VARIABLE: DERIVATION

Revising basic concepts of one variable functions.

Revising concept and calculus of derivatives and their applications.

Topic 6. FUNTIONS OF SEVERAL VARIABLES

Introduction. Definitions and examples. Contour lines. Limits and continuity. Directional derivatives. Partial derivatives. Vector gradient. Partial derivatives in economics.

Homogeneous functions.

Topic 7. ADVANCED TOPICS

Introduction to Static Optimization. Indefinite and Definite integrals. Economic applications. Multiple integrals. Definition and examples.

Introduction to numerical sequences and series.

44,5 hours

4. TEACHING AND LEARNING METHODS

4.1. Number of hours

Total attending hours:	Theory-practical classes: 65,5 Tests: 4
Total hours of private study:	153 hours
Total: 222,5 hours	

4.2. Methods, materials and resources

Attending classes	<ul style="list-style-type: none"> • Theory classes: The fundamental concepts will be explained.
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	<ul style="list-style-type: none"> • Solving exercises and case studies: These theoretical concepts will be applied in order to solve problems and exercises. The student and tutor must discuss the methods that were used and the solutions found to the set problems. • Presenting exercises and assignments: The student must present their work to their classmates and tutor. • Mid-term tests: Throughout the module, the tutor will set a number of tests at their own discretion. These tests will assess the student's continuous knowledge acquisition and application of knowledge. Tests may be set without prior notice. The results of these tests will contribute to the final grade.
<p>Autonomous study</p>	<p>The student should study independently to consolidate their understanding of the material covered in class. Readings and research. Completing activities: exercises, assignments, ... Participating in forums, blogs, etc.</p>
<p>Tutorials</p>	<p>Individual or group tutorials. During tutorials, the tutor will assess whether the student has acquired the skills listed on page 3. The student must hand in assignments to the tutor and will receive feedback on how to improve if necessary.</p>
<p>Exams</p>	<p>The student will sit several mid-term exams. In these exams, the student must link together all the material covered. This ensures that they can make connections between various concepts and apply them to real-world situations.</p>

MATERIALS AND RESOURCES:

- All recommended books are available in the school library.
- The student can make use of the online learning platform (Blackboard).
- Computers are available for use.
- Reading material will be given before each new topic.
- Exercises and problems will be set regularly.

5. EVALUATION: methods and evaluation criteria

Evaluation criteria

The student will be evaluated on the following:

- Identifying the key ideas of each topic.
- Linking together and applying new material with material already covered.
- Understanding the basic concepts.
- Applying the material covered to various situations.
- Comprehensively solving problems.
- Competently defending findings.
- Analysing and solving problems critically.
- Linking concepts together.
- Accurately, clearly and carefully completing assignments and handing them in on time.
- Developing models using the material covered.

The following areas will be assessed in assignments and practical contributions:

- Originality and contributing in class.
- Presenting work accurately.
- Integrating theory and practice coherently.
- Summarising information.

Evaluation methods

Regarding the **ordinary examination session**, students who attend this course will follow the system of continuous evaluation, as stated in Article 9 of the rules governing Evaluation Processes of Learning UAH (approved in Governing Council 24 March 2011 and modified 5 May 2016), being able to accommodate the system Final evaluation ever and when the requirements of Article 10 of the regulation are met.

1. Continuous Evaluation

Continuous Evaluation will vary according to the teaching staff and the number of students per group. Further information will be given at the beginning of term.

The following evaluation criteria will be used to assess the skills listed on page 3 of this handbook:

- Passing mid-term exams.
- Participating in class: carrying out and passing the exercises and assignments set throughout the module.

In order to pass the module by this continuous evaluation method, the student must obtain a final mark of at least 5, calculated as the weighted average of each of the evaluation activities.

2. Final Evaluation Method

The student may choose this system if the conditions set out in Article 10 of the rules governing Evaluation Processes of Learning UAH are met. If extenuating circumstances prevent the student from following the continuous evaluation process and they wish to be evaluated by a final exam instead, they must submit a written request to the Dean of the School during the first two weeks of term explaining why continuous evaluation is unsuitable. Acceptable reasons for this that do not require further investigation include doing an internship, work obligations, family obligations, health reasons and disabilities, among others. This is in accordance with article 3.2 of the University of Alcalá's "Regulations of Evaluation" published on the 24th March 2011.

The final exam consists of questions and theory-practical questions. The aim of these questions is to demonstrate that the student has acquired the skills listed on page 3 of this handbook.

The student must obtain at least 5 points to pass this exam.

NB: If the student fails the evaluation (either continuous evaluation or final exam), they must sit a further exam in the summer examination resit period (*convocatoria extraordinaria*). This will consist of a similar exam to that mentioned above. This exam is worth 100% of the final grade.

Grading scale

The student will receive a numeric decimal grade which corresponds to a qualitative classification. This conforms to the European Credit Transfer System Royal Decree 1125/2003 which stipulates that the student must receive a numeric decimal grade and a qualitative classification. The scale is as follows:

0.0 - 4.9 FAIL (*SUSPENSO*)

5.0 - 6.9 PASS (*APROBADO*)

7.0- 8.9 VERY GOOD (*NOTABLE*)

9.0 - 10 EXCELLENT (*SOBRESALIENTE*)

9.0 – 10 OUTSTANDING (*MATRICULA DE HONOR, limited to a maximum of 5% of students*)

6. BIBLIOGRAPHY

Basic reading

- SYDSAETER, K., HAMMOND, P. & STROM, A. (2012), *Essential Mathematics for Economic Analysis* (4th Edition). Ed. Prentice Hall.

Further reading

- CHIANG, A. & WAINWRIGHT, K. (2004) *Fundamental Methods of Mathematical Economics* (4th Edition). McGraw-Hill.
- HOY, M., LIVERNOIS, J., McKENNA, C., REES, R. & STENGOS, T. (2011) *Mathematics for Economics* (3th Edition). The MIT Press.
- PEMBERTON, M. & RAU, N. (2011) *Mathematics for Economists: An Introductory Textbook* (3th Edition). University of Toronto Press, Scholarly Publishing Division.
- SIMON C.P. & BLUME, L. (2012) *Mathematics for Economists*. Viva Books.