COURSE DATA

DATA SUBJECT

Code: 43772
Name: Advanced mathematics for actuaries
Cycle: Master's Degree
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
2171 - Master's Degree in Actuarial and Financial Sciences	Facultat d'Economia	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2171 - Master's Degree in Actuarial and Financial Sciences	Quantitative methods	COMPULSORY

COORDINATION

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SUMMARY

Advanced Mathematics for Actuaries is a subject of the first semester of the first year. Its location responds to the formative importance of the subject within the curriculum to establish the technical and methodological bases on which much of the subsequent developments are based, which the student will acquire in other subjects.

In accordance with the guidelines established by the **Core Syllabus for Actuarial Training in Europe**, the objective is to provide the mathematical foundations of actuarial and financial science. These fundamentals are essential when dealing with problems of a financial-actuarial nature, emphasizing the application of techniques that allow us to deal with other disciplines such as Financial Mathematics and Statistics for Actuaries with guarantees.

In this line, the topic is also linked to a part of the content developed in other areas, such as portfolio management, non-life insurance, life insurance, health and pensions, solvency, etc., which contributes to a better application of the skills requirements for professional practice.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

Prerequisites have not been established, but to understand the subject, the student must know the typical contents that are generally taught in the introductory courses of mathematics in social studies. Thus, for example, the student must have previous basic knowledge about differential and integral calculus, function representation and optimization.

COMPETENCES / LEARNING OUTCOMES

2171 - Master's Degree in Actuarial and Financial Sciences

Alcanzar sólidos fundamentos en las técnicas matemáticas y estadísticas como base para la comprensión de otras materias y elaboración de modelos del riesgo utilizados en la práctica actuarial.

Comprender y ser capaces de desarrollar las técnicas matemáticas y estadísticas que resultan relevantes para el trabajo actuarial: modelos de supervivencia, siniestralidad, tarificación, previsión y solvencia.

Ser capaces de construir modelos adecuados al entorno económico empresarial a partir de las posibilidades que ofrecen las modernas tecnologías de la información y de la computación.

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should demonstrate self-directed learning skills for continued academic growth.

DESCRIPTION OF CONTENTS

1. The integration process

1.1. The Riemann Integral: Fundamentals (concept, interpretation, properties).

1.2. Integration methods.

1.3. Applications.

1.4. Numerical analysis: Numerical Integration.

2. Riemann-Stieltjes Integral

2.1. Introduction.

2.2. Formalization and Properties.

2.3. Practical approach (calculation).

2.4. Bounded variation functions.

2.5. Applications.

3. Introduction to Measurement Theory

3.1. Introduction.

3.2. Measurement of sets.

3.3. Measurement of functions.

3.4. Lebesgue integral.

4. Improper integration

4.1. Introduction.

4.2. Improper integrals of the first kind.

4.3. Improper integrals of the second kind.

4.4. Mixed improper integrals.

5. The Eulerian functions

5.1. Parametric integrals and functions defined by integrals.

5.2. Differentiation Under the Integral Sign. Leibniz integral rule.

5.3. The Gamma function.

5.4. The Beta function.

5.5. Applications.

6. Multiple Integral

6.1. Measure on product spaces. Volume.

6.2. Iterated integration. Fubini's theorem.

6.3. Change of Variables for Multiple Integrals: affine, polar coordinates.

6.4. Unbounded regions and discontinuous integrands.

6.5. Applications.

7. First order differential equations

7.1. Introduction to dynamic analysis: trajectories and models.

7.2. Basic concepts about differential equations.

7.3. Elementary resolution methods for ordinary first-order differential equations: homogeneous, separable variables, linear, reducible to linear and exact.

7.4. Graphic-qualitative analysis and stability.

7.5. Applications.

7.6. Numerical analysis: numerical calculation of differential equations.

8. Differential equations of order n and systems

8.1. General approach.

8.2. Homogeneous linear differential equations of order n with constant coefficients.

8.3. Nonhomogeneous linear differential equations of order n with constant coefficients. Qualitative analysis.

8.4. Applications.

9. First Order Differential Equations

9.1. Discrete functions, discrete operators and differential equations.

9.2. First Order Differential Equations: general concepts and resolution.

9.3. Balance and stability of the solutions.

9.4. Applications.

10. Differential Equations of Higher Order

10.1. Differential Equations of order n: general concepts and resolution.

10.2. Equilibrium and stability of the solutions.

10.3. Approach to systems of differential equations.

10.4. Applications.

11. Theory of Optimal Control

11.1. Problem Statement.

11.2. The problem of optimal control in continuous time.

11.3. The problem of optimal control in discrete time.

11.4. Economic, financial and actuarial applications.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Classroom practices	30,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	4,00
Individual or group project	18,00
Independent study and work	46,00
Preparation of lessons	18,00
Preparation for assessment activities	4,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

During the course, the contents of the program will be worked on, simulating theoretical contents with exercises and practical assumptions, and various tasks will be proposed that the student will have to deliver in the form and date that will detailed throughout the development of the course. To do this, they will use, in each case and according to the needs, all available resources (blackboard, audiovisual presentations, computer, etc.) that are considered most appropriate to achieve the correct achievement of the proposed objectives.

In general, the theoretical classes will be taught through the master class methodology, in which the teacher will highlight the fundamental aspects of each topic and guide the study through the relevant bibliography, which must be used inexcusably to complete and delve into the subject.

The practical classes will consist in proposing questions and exercises, some of character applied to the economic, financial and actuarial field, that the student will have to solve proceeding, in his case, to the pertinent modeling and discussion of the solution.

In the practical classes will be computer support, so that the student can have an updated view of the use of packages and techniques.

In the practical classes questions and problems previously presented in the theoretical classes will be taught, except in some cases, in which, given the practical nature of the subject, the teaching of the subject is taught only in the practical session.

The available teaching material can be accessed from the virtual classroom, http://aulavirtual.uv.es.

EVALUATION

This subject uses an evaluation procedure similar to the rest of the subjects of the master:

1. A written exam or synthesis test, which may consist of theoretical questions as well as problems and real cases.

2. Continuous evaluation based on class attendance and other face-to-face training activities and participation and involvement in the teaching-learning process. This section will consist of an evaluation of the practical activities developed by the student, from the elaboration of problems in class and/or at home, manually and/or by computer; and the questionnaires/proof of the type of evidence presented.

In particular, a synthesis test will be carried out, which will represent 70% of the final grade and different activities and tasks will be proposed, which will be evaluated together with the continuous evaluation and which will have a joint weight of 30% of the final note. For the evaluation of the proposed activities and tasks, they must be delivered on the date and in the form stipulated for each one of them.

The tasks of continuous assessment can be done in class and / or at home.

All the tests of continuous evaluation will be recoverable in the second call in the terms that inform the teaching team, but not in the first call.

To pass the subject it will be necessary to obtain, between the two parties, a minimum grade of 5. In addition, to pass the subject it will be necessary to obtain at least a 5 in the synthesis test. If the synthesis test is not passed, the final grade cannot exceed 4.5.

Students who do not pass the course in the first examination session will have the opportunity to be assessed in a second session. The grades obtained through continuous assessment during the course may be retained for the second session or retaken under the conditions established by the teaching staff. The same evaluation criteria used in the first session will apply to the second session.

NOTE: The use of illicit or fraudulent methods (cheating, plagiarism, impersonation, etc.) to obtain undeserved results in evaluable assessments will result in a failing grade for the test for all parties involved. This is without prejudice to any additional sanctions that may be imposed by the Master's Program Management or the Academic Coordination Committee.

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- Material elaborado por equipo docente del Departamento de Economía Financiera y Actuarial