COURSE DATA

DATA SUBJECT

Code: 43773
Name: Advanced statistics 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

MARTINEZ DE LEJARZA ESPARDUCER JUAN

SUMMARY

The course **Advanced Statistics for Actuaries (EAA)** is included within the Quantitative Methods subject area and is scheduled for the first semester of the first year. This placement underscores the formative importance of the module within the curriculum, as it establishes the technical and methodological foundations of statistics that will underpin subsequent developments encountered in other subjects.

Beyond its foundational role for later coursework, this subject is also highly relevant for professional practice, as many of the concepts and skills acquired are directly applicable in actuarial work. The course initially focuses on developing and consolidating key concepts from probability theory, probability models, and statistical inference. Emphasis is placed on ensuring that students become familiar with, and are able to appropriately use, the statistical software R.

Throughout the course, students will also acquire skills in handling and estimating mortality tables and in calculating risk premiums associated with various life insurance products. Specifically, the course covers classical and Bayesian statistical analysis, mortality tables, principal mortality models, the discrete and continuous probability distributions most commonly used by actuaries, linear models, and techniques for constructing mortality tables.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

There are no formal enrollment prerequisites, but in order to successfully complete the course, students should be familiar with the typical content covered in introductory mathematics and statistics courses in social science programs. For example, students should have prior basic knowledge of descriptive statistics, probability models, and elementary concepts of parametric estimation.

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. Review of Probability Theory and Statistical Inference

Probability function, probability density, and distribution function
Probability distributions: Binomial, Poisson, Normal
Statistic, estimator, estimation

Confidence intervals
Formulation and testing of hypotheses (parametric and non-parametric)
Introduction to and basic use of the R program

2. Actuarial Statistics

Purpose of actuarial statistics
Actuarial terminology
Life and non-life insurance
Historical evolution
Relationship between actuarial statistics and financial operations

3. The Mortality Table: Mortality as a Discrete Phenomenon

Independence, homogeneity, stationarity
The mortality table and its elements
Relationship between the elements of a mortality table
Types of insurance: Calculation of probabilities
Probabilities for one life
Probabilities for more than one life
Actuaries

4. Variability and Mortality: Mortality as a Random Phenomenon

Introduction
The elements of the mortality table as random variables
Construction of the mortality table with safety loadings
Calculation of probabilistic risk associated with a portfolio

5. Mortality as a Continuous Phenomenon

Age-at-death as a random variable. Distribution and density functions
Relationship between basic probabilities for one life and the age-at-death random variable
Instantaneous force of mortality
Annual and central force of mortality
Life expectancy and probable lifetime
Generalization of survival and mortality probabilities for more than two lives. Joint distributions

6. Probability Distributions in Actuarial Science

Discrete distributions
Continuous distributions
Modeling and fitting main distributions in R

7. Linear Models

The linear regression model
The simple linear model
Model estimation
Inference about parameters. Model validity
General validity of the model
The general linear model
Modeling and fitting in R

8. Introduction to Bayesian Statistics

Classical and Bayesian inference
Conjugate distributions
Introduction to Markov Chain Monte Carlo (MCMC)

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	3,00
Individual or group project	18,00
Independent study and work	40,00
Preparation of lessons	16,00
Preparation for assessment activities	0,00
Resolution of case studies	13,00
Total hours	**90,00**

TEACHING METHODOLOGY

During the course, the program content will be covered by alternating theoretical material with exercises and practical case studies. Various assignments will be proposed, which students must submit in the manner and by the deadlines specified throughout the course. To this end, all available resources (whiteboard, transparencies, projector, computer, etc.) will be used as needed and as deemed most appropriate to achieve the course objectives.

In general, theoretical classes will be delivered using the lecture method, in which the instructor will highlight the key aspects of each topic and guide students' study through the relevant bibliography, which

must be consulted to complete and deepen understanding of the subject.

Practical classes will involve presenting questions and exercises applied to the economic, financial, and actuarial fields, which students must solve, including, where appropriate, the necessary modeling and discussion of the solution.

Practical classes will be supported by computer tools, so that students can gain up-to-date experience with software packages and techniques that are increasingly used in all the aforementioned areas.

In practical classes, questions and problems previously introduced in the theoretical sessions will be addressed, except in certain cases where, due to the practical nature of the topic, the material will be taught only in the practical session.

EVALUATION

In general, the course uses a competency-based assessment procedure similar to that of other subjects in the master's program:

A written exam, which may include both theoretical questions and problems or real cases.

An evaluation of the practical activities carried out by the student, based on the preparation of reports/papers and/or oral presentations, including the defense of the positions developed.

Continuous assessment based on class attendance and participation in other in-person training activities, as well as engagement in the teaching-learning process.

Specifically,

Assessment will be based on:

A) A written exam that will include both theoretical questions and problems or exercises.

B) Continuous assessment based on:

Attendance and participation in classroom activities

Periodic progress tests

Activities carried out during the course: exercises, problems, case studies, and individual and/or group assignments

The written exam will account for 70% of the final grade, and continuous assessment will make up the remaining 30%.

In any case, a minimum grade of 5 out of 10 is required to pass the course, and a minimum of 5 out of 10 must also be obtained in the written exam.

To be assessed, activities and assignments must be submitted on the date and in the manner specified for each.

In the second exam session, the same assessment criteria as in the first session will be applied, except for continuous assessment activities, which cannot be retaken.

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