COURSE DATA

DATA SUBJECT

Code: 43784
Name: Stochastic processes
Cycle: Master's Degree
ECTS Credits: 3
Academic year: 2026-27

STUDY (S)

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

SUBJECT-MATTER

Degree	Subject-matter	Character
2171 - Master's Degree in Actuarial and Financial Sciences	Non-life insurance	COMPULSORY

COORDINATION

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SUMMARY

The Stochastic Processes subject is located in the second semester of the first year. Its integration responds to the formative importance of the module within the syllabus as it serves to develop the technical and methodological bases on which part of the subsequent processes will be based, which the student will acquire in other subjects. In this line, the contents of the subject are linked to part of the contents taught in some of the subjects of subjects III (Finance and Introduction to Insurance), VI (Risk Control and Solvency) and IX (Optional Itineraries).

The subject is professionally useful as part of the contents and, above all, the skills acquired are directly applicable in professional practice. Thus, for example, the aim is for the student to acquire skills in how to obtain precise results of the modelling of the number of claims, the amount of these, the total claims rate, etc. in order to be able to apply them in pricing processes, claims provision by means of theoretical and simulation techniques. In particular, the contents taught include: association and dependence between risk variables, stochastic processes, Markov chains, stationary processes, Poisson and diffusion processes, Brownian movement, temporal beings; so that they can be applied to particular cases of extreme value theory, risk quantification or pricing.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

In order to make the best use of the subject, the student should know and know how to use the usual contents of introductory mathematics courses (descriptive statistics, representation of functions, differential and integral calculus) and intermediate level statistics (probability models, statistical inference) classically taught in social science studies. In addition, it is desirable that the student possesses basic skills related to the use of software.

COMPETENCES / LEARNING OUTCOMES

2171 - Master's Degree in Actuarial and Financial Sciences

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.

Poseer un amplio conocimiento de los procesos estocásticos y ser capaces de utilizarlos en modelos financieros y actuariales.

Saber tomar decisiones relacionadas con los riesgos evaluables económicamente.

Ser capaces de aplicar los criterios y principios de planificación y control actuarial, necesarios para el correcto funcionamiento de las operaciones que, en cada momento, ofrezcan las entidades de seguros, financieras o cualesquiera otras que impliquen transferencia y cobertura de riesgos.

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. Introduction to Stochastic Processes

1.1 Introduction to probability theory. Notation.

1.2 Examples.

1.3 Marginal Distributions. Kolmogorov's Theorem.

1.4 Typologies of stochastic processes.

1.5 Normal Processes. Continuity.

2. Linear Processes and Stationary Processes

2.1 Definition and examples.

2.2 Moving Average Processes.

2.3 AR and ARMA Processes.

2.4 ARIMA Processes.

2.5 Partial autocorrelation function.

2.6 Ergodicity. Wold's decomposition theorem.

3. Introduction to Applied Simulation with R-software

3.1 Simulation Applications: Plausible reality and realizations.

3.2 Basic Concepts: Variables and data types, Programming structures.

3.3 Pure random numbers and pseudorandom numbers.

3.4 Monte Carlo method and sequential simulation.

3.5 Period and longitudinal simulation.

3.6 Analysis of simulation results: Statistical summaries and direct quantile function.

3.7 Genetic algorithms.

3.8 Matrix diagonalization.

4. Brownian Motion

4.1 Definition.

4.2 Trajectory regularity.

4.3 Quadratic and total variation.

4.4 Brownian Bridge.

4.5 Brownian and geometric Brownian Motion.

4.6 Simulation.

5. Markov Chains

5.1 Stochastic matrix. Markov Chains.

5.2 State Classification.

5.3 Hitting times and absorption probability.

5.4 Recurrence and transience. Asymptotic behavior.

6. Markov Processes

6.1 Introduction.

6.2 Marginal distributions.

6.3 Transition Probabilities.

6.4 Kolmogorov's differential equations.

7. Birth and Death Processes

7.1 Typologies.

7.2 Differential equations.

7.3 Polya process and introduction to Poisson Processes.

8. Poisson Processes

8.1 Definition. Memoryless property.

8.2 Examples.

8.3 Superposition. Decomposition.

8.4 Compound and non-stationary Poisson processes. Examples.

8.5 Construction of Poisson processes.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	15,00
Classroom practices	15,00
Total hours	**30,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	2,00
Individual or group project	15,00
Independent study and work	15,00
Preparation of lessons	3,00
Preparation for assessment activities	5,00
Resolution of case studies	5,00
Total hours	**45,00**

TEACHING METHODOLOGY

During the course, the contents of the programme will be worked on, combining theoretical content with exercises and practical cases and various tasks will be proposed that the student must hand in in in the manner and on the date specified throughout the course.

For this purpose, all available resources (blackboard, transparencies, projector, computer, etc.) will be used

in each case and depending on the needs, and which are considered most appropriate for the correct achievement of the proposed objectives.
In general, the classes of the theoretical part will be reduced as far as possible and will be taught using the lecture-participatory methodology, in which the teacher will highlight the fundamental aspects of each subject and will guide the study through the relevant bibliography. At the same time, and given the theoretical-practical nature of this subject, the student will have a desktop PC or similar to validate the results presented in class, so that he/she will be able to study the subject in depth.

The practical classes will consist of posing questions and exercises of an applied nature in the statistical, economic, financial and actuarial field, which the student will have to solve, proceeding, where appropriate, to the relevant modelling and discussion of the solution.

The practical classes may be carried out with computer support, so that the student can have an updated view of the use of the packages and techniques, which are increasingly used in the field of statistics, economics, finance and actuarial studies.

EVALUATION

For the assessment of competences in this subject, a procedure similar to the rest of the subjects in the Master's programme is used.

This may consist of all or part of the following elements:

A final exam, which may consist of theoretical questions, problems and/or real cases.

An evaluation of the practical activities carried out by the student, based on: the preparation of papers/memorials and/or oral presentations - with defence of the positions developed by the students.

Continuous assessment will be based on face-to-face training activities and on the student's participation and involvement in the teaching-learning process. In particular, an independent assessment will be carried out for each of the elements set out.

The percentage distribution of these will be agreed at the beginning of each course jointly by those responsible for each subject, taking into account the comments and indications of the students.

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