UAB
Universitat Autònoma de Barcelona

Stochastic Processes

Code: 104859
ECTS Credits: 6

2025/2026

Degree	Type	Year
Applied Statistics	OB	2

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is advisable to have successfully completed the following mandatory courses: Càlcul 1, Àlgebra lineal, Introducció a la probabilitat, Eines informàtiques per a l'estadística, Probabilitat and Distribucions multidimensionals.

Objectives and Contextualisation

We introduce the students into the theory of the stochastic processes, with a special emphasis on how they can be used to mathematically model several examples and real situations. More precisely, the main part of the course is devoted to deal with Markov chains, which provide one of the more important tools in stochastic modeling, with a lot of applications, for example in biology, medicine or queuing theory. We introduce discrete-time and continuous-time Markov chains and, due to its highly level of applicability, we specially treat the Poisson process, as a example of birth and death processes, and branching processes. During the course mathematical proofs will be mostly avoided, although we give a reference for them, and we focus on the applications of the methods and techniques to particular examples. Indeed, one of the principal aims consists that students learn to choose the convenient method in order to model some phenomenon, and also to implement it as well as to extract conclusions.

Another major objective is to introduce the Brownian motion, which represents the paradigmatic example of stochastic process with non-countable state space. Its definition will be motivated, emphasizing all variety of fields where Brownian motion can be applied, and some of its properties will be studied. We also introduce some processes related to Brownian motion, such as the Brownian bridge and the geometric Brownian motion.

Finally, the last aim of the course is that the students learn to use the software R in order to simulate different types of stochastic processes and extract the pertinent conclusions in view of the phenomenon that is being modeled.

Learning Outcomes

1. CM09 (Competence) Assess the suitability of the models with the correct use and interpretation of indicators and graphs.

2. KM12 (Knowledge) Provide the experimental hypotheses of modelling, considering the technical and ethical implications involved.
3. SM12 (Skill) Interpret the results obtained to formulate conclusions about the experimental hypotheses.

Content

1. Introduction to stochastic processes

2. Discrete-time Markov chains

3. Branching processes

4. Poisson process

5. Continuous-time Markov chains

6. Brownian motion

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problem classes	14	0.56	
Theoretical classes	26	1.04	
Type: Supervised			
Computer sessions	12	0.48	
Type: Autonomous			
Personal study, problem solving and computer work	90.5	3.62	

The theoretical and problem sessions will be carried out in a classroom. These sessions will be devoted to the presentation of theoretical aspects and the solution of problems. Problem lists will be supplied along the course.

The computer sessions will be carried out in a computer room. In these sessions, studens will solve some problems related to the methods introduced during the course using R

The gender perspective goes beyond the contents of courses, since it implies also a revision of teaching methodologies and interactions between students and lecturers, both inside and outside the classroom. In this sense, participative teaching methodologies that give rise to an equality environment, less hierarchical in the classroom, avoiding examples stereotyped in gender and sexist vocabulary, are usually more favorable to the full integration and participation of female students in the classroom. Because of this, their effective full integration and participation of female students in the classroom. Because of this, their effective implementation will be attempted in this course.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	50	3	0.12	CM09, KM12, SM12
Midterm exam	30	2	0.08	CM09, KM12, SM12
Practical exam	20	2.5	0.1	CM09, KM12, SM12

See Catalan version

Bibliography

Borovkov, Konstantin. Elements of stochastic modelling. Second edition. World Scientific Publishing Co., 2014.

Dobrow, Robert P. Introduction to stochastic processes with R. John Wiley & Sons, 2016. (*)

Rincón, Luis. Introducción a los procesos estocásticos. Las Prensas de Ciencias, Fac. de Ciencias, UNAM. It can be downloaded from: http://www.matematicas.unam.mx/lars/flip-procesos/flip-en-pdf/procesos2012.pdf

Pinsky, Mark A. and Karlin, Samuel. An introduction to stochastic modeling. Fourth edition. Elsevier/Academic Press, 2011.

(*) Most important

Software

We will use the statistical software R.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn

(PAUL) Classroom practices	1	Catalan	second semester	afternoon
(PLAB) Practical laboratories	1	Catalan	second semester	afternoon
(PLAB) Practical laboratories	2	Catalan	second semester	afternoon
(TE) Theory	1	Catalan	second semester	afternoon