**Advanced calculus and stochastic processes**

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***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims to provide students with sophisticated mathematical tools necessary for understanding banking, financial and insurance models, whose phenomena under consideration are expressed in quantitative terms.

The expected learning outcomes are the ability to read, interpret and manipulate the quantitative aspects of banking, financial and insurance phenomena and to choose the correct tool to model and analyse some problems in these areas.

***COURSE CONTENT***

*Detailed learning objectives*

By the end of the course, students will have obtained technical skills accompanied by an understanding of their specific applications. In particular, students will be able to:

* solve linear differential equations and systems
* recognize a martingale in discrete or continuous time
* analyze a Markov chain in discrete time
* recognize which tool to use to model concrete situation

*Detailed course content*

Linear differential equations and systems with constant coefficients: solutions by means of characteristic equation or by means of Laplace transform.

Differential equation with separation of variables.

Conditional expectation.

Stochastic processes in discrete times: marttingales, submartingales and supermartingales; stopping times and optional sampling theorem.

Time-homogenoeus Markov chains in discrete times: graph representation, transition matrix, classification of states, absorbing and stationary probabilities.

Stochastic processes in discrete times: marttingales, submartingales and supermartingales; Wiener process (brownian motion) and Poisson process.

***READING LIST***

Selected materials (lecture notes, exercises, past exams, etc.) will be made available on the course Blackboard site.

***TEACHING METHOD***

Classroom lectures.

***ASSESSMENT METHOD AND CRITERIA***

The final grade is based on a written exam at the conclusion of the course consisting of open response questions and/or multiple choice questions which may be theoretical or applied, worth a maximum total of 32 points. The point value of each question will be indicated in the exam text. The points obtained on the written exam, rounded to the nearest integer (rounded up if the decimal part is greater than or equal to 0.5), will constitute the final mark obtained in the course. Honors marks will be awarded in the event the student obtains a final rounded score of at least 31 and has demonstrated an excellent command of the material.

Several mock exams will be published to Blackboard.

***NOTES AND PREREQUISITES***

Students are expected to have basic knowledge of Calculus I and II and probability theory.

*In the event that the health situation relating to the COVID-19 pandemic does not allow for lessons to be held in presence, remote teaching will be guaranteed in a manner that will be communicated to students.*

*Office hours and location*

The time and location for office hours will be published on the instructors’ personal pages.