

## MCMC methods

# Introducing

## Description

Program (detailed contents):

- Simulation of random variables and vectors: pseudo-random numbers, simulation by the inversion method of the probability distribution function, by the acceptance-rejection method and by specific simulation methods.
- Classical Monte Carlo methods: implementation, variance reduction by different methods (control variate, importance sampling, antithetic variates method).
- Markov chain Monte Carlo methods: reminders on Markov chains, Markovian law of large numbers, Metropolis-Hastings algorithm.
- Application with the Python software

## Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- The fundamental principles of simulating random variables and vectors.
- The classical methods for variance reduction when approximating numerically integrals by means of the Monte Carlo method.
- The approximation of integrals by means of the Monte Carlo method using Markov chains.

The student will be able to:

- Generate a real random variable by the inversion method.
- Simulate a random vector by the acceptance-rejection method.

- Choose appropriate techniques for variance reduction (control variate, importance sampling, antithetic variates method).

- Use the Metropolis-Hastings algorithm generating a reversible ergodic Markov chain with prescribed stationary distribution.

## Necessary prerequisites

Probability and Statistics (2MIC Semester 4).

Probability and Data Analysis (3MIC Semester 5).

Complements of Probability (3MIC MA Semester 5).

## Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

## Practical info

### Location(s)

 Toulouse