INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

# 4th YEAR MA – OPTIONAL COURSES_SEMESTER 7

# Practical info

## Location(s)

Toulouse

# Partial Derivative Equations & Monte Carlo methods

ECTS
4 crédits

Hourly volume
53h

# Introducing

## Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
PDE
- The four fundamentals PDE models, with their solution behaviors
- The Finite Difference discretization method

Monte-Carlo
- The fundamental principles of simulating random variables and Monte-Carlo methods.

The student will be able to:
PDE
- To model basic fundamental phenomena by employing PDE
- To derive a Finite Difference scheme (consistent, stable, convergent).

Monte-Carlo
- Simulate a random variable by different methods, use probabilistic, choose appropriate techniques for variance reduction and error estimation.

## Necessary prerequisites

EDP
Differential calculus, analysis, ODE

Basic numerical methods

Monte-Carlo
A basic course on probabilities.

# Practical info

## Location(s)

Toulouse

# Advanced probability and Monte Carlo methods

ECTS
4 crédits

Hourly volume
53h

# Introducing

## Objectives

Objectives:
At the end of this module, the student will have understood and be able to explain (main concepts):
- The notion of conditional expectation, the main properties of martingales and their classical use in modelling,
- Stochastic algorithms of Robbins-Monro type.
- The fundamental principles of simulating random variables and Monte-Carlo methods.

The student will be able to:
- To compute a conditional expectation, to show that a random process is a martingale, to use the various theorems (Doob, optional stopping and convergences), in particular for the maximum likelihood estimation.

- Build and study the convergence of stochastic optimization algorithms, apply these methods to different problems (quantile, quantization,¿)

Simulate a random variable by different methods, use probabilistic, choose appropriate techniques for variance reduction and error estimation

## Necessary prerequisites

Necessary knowledge:

A basic course on probabilities.

# Practical info

## Location(s)

Toulouse