

## Markov Chains and applications CM

Course title - Intitulé du cours	Markov Chains and applications CM
Level / Semester - Niveau /semestre	M1 / S1
School - Composante	Ecole d'Economie de Toulouse
Teacher - Enseignant responsable	Jean-Paul IBRAHIM
Other teacher(s) - Autre(s) enseignant(s)	
Other teacher(s) - Autre(s) enseignant(s)	
Other teacher(s) - Autre(s) enseignant(s)	
Other teacher(s) - Autre(s) enseignant(s)	
Other teacher(s) - Autre(s) enseignant(s)	
Lecture Hours - Volume Horaire CM	15
TA Hours - Volume horaire TD	0
TP Hours - Volume horaire TP	0
Course Language - Langue du cours	Anglais
TA and/or TP Language - Langue des TD et/ou TP	

### Teaching staff contacts - Coordonnées de l'équipe pédagogique :

E-mail : [jean-paul.ibrahim@ut-capitole.fr](mailto:jean-paul.ibrahim@ut-capitole.fr)

Office : TJ16

If you have questions, you may drop by my office at any time but it is better to make an appointment before. You can also send me e-mails.

### Course's Objectives - Objectifs du cours :

This course is an introduction to the Markov chains on a discrete state space. At the end of the course, students must be able to :

- Understand the notion of a random process.
- Give the definition of a Markov chain on a discrete state space .
- Recognize any experiment or any real-life phenomenon that can be modeled using a Markov chain.
- Give the transition matrix of a given Markov chain.
- Deal with communicating classes and irreducible Markov chains.
- Deal with transient and recurrent states.
- Determine, when it exists, an invariant distribution.
- Compute a hitting probability of state  $j$  starting at state  $i$ .
- Compute an expected hitting time of state  $j$  starting at state  $i$ .

- Understand the link between the long-run proportion of time spent in a given state, the expected return time to this state and the invariant distribution.
- Understand the definition of an aperiodic Markov chain and the convergence to equilibrium.
- Applications : Gambler's ruin, life insurance, Penney's Game.

**Prerequisites - Pré requis :**

Probability basis : Sample space (finite or countably infinite), conditional probability, random variables, convergence in distribution. Linear algebra: basic operations on matrices, diagonalization.

**Grading system - Modalités d'évaluation :**

One final exam.

**Bibliography/references - Bibliographie/références :**

- J.R. Norris, Markov Chains, Cambridge Series in Statistical And Probabilistic Mathematics.

**Distance learning – Enseignement à distance :**

Distance learning would be implemented on a regular basis by implementing :

- Interactive virtual classrooms
- Online exercises and assignments
- Remote tutorials
- Chatrooms/Forum.