

## Martingales Theory and applications CM

Course title - Intitulé du cours	Martingales Theory and applications CM
Level / Semester - Niveau /semestre	M1 / S2
School - Composante	Ecole d'Economie de Toulouse
Teacher - Enseignant responsable	Miclo Laurent - Villeneuve Stephane
Other teacher(s) - Autre(s) enseignant(s)	
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Other teacher(s) - Autre(s) enseignant(s)	
Lecture Hours - Volume Horaire CM	15
TA Hours - Volume horaire TD	12
TP Hours - Volume horaire TP	0
Course Language - Langue du cours	Anglais
TA and/or TP Language - Langue des TD et/ou TP	Anglais

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

stephane.villeneuve@tse-fr.eu laurent.miclo@math.cnrs.fr Office hours scheduled the first lecture

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

Martingales are an important theoretical tool of probability theory that is used to model fluctuations in time series, such as stock market prices or noisy signals in telecommunication. The main motivation of these lectures is to give the students the basics of the martingale theory in discrete time. The martingale theory requires considering random processes with values in  $\mathbb{R}$ . This implies generalizing the notion of conditioning to continuous variables and a preliminary chapter will therefore be necessary to define the conditional expectation before introducing the main martingales features and results. To go further in the convergence results, the notion of uniform integrability will be introduced and characterized. The lecture will end up with many applications such as gambling, reinforcement process in social network and arbitrage pricing in Finance. These lectures are adapted from the book of Walsh [1]. For alternative presentations, the chapters about martingales in the other books listed below can also be consulted:

### Prerequisites - Pré requis :

We assume some familiarity with the notions of probability spaces, sigma fields, measures, random variables and their distributions, expectation and variance, the sigma field generated by a random variable and independence

### Practical information about the sessions - Modalités pratiques de gestion du cours :

Laptops are accepted

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

One final Exam

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

[1] John B. Walsh. Knowing the odds, volume 139 of Graduate Studies in Mathematics. American Mathematical Society, Providence, RI, Septembre 2012. An introduction to probability. [2] Zdzisław Brzeźniak and Tomasz Zastawniak. Basic stochastic processes. Springer Undergraduate Mathematics Series. Springer-Verlag London, Ltd., London, 1999. A course through exercises. [3] Richard Durrett. Probability: theory and examples. Duxbury Press, Belmont, CA, second edition, 1996. [4] Stewart N. Ethier. The doctrine of chances. Probability and its Applications (New York). Springer- Verlag, Berlin, 2010. Probabilistic aspects of gambling. [5] David Williams. Probability with martingales. Cambridge Mathematical Textbooks. Cambridge University Press, Cambridge, 1991.

**Distance learning – Enseignement à distance :**

Remote (online) tutorials (classes)