

From point processes to Hawkes processes

Reading seminar - M2 RI

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The goal of this reading seminar is to give an introduction to the theory of point processes. Point processes are discrete stochastic processes that can be constructed on the real line (for modeling successive occurrences of a specific events) or on a more general space. We will introduce the well known Poisson point process on \mathbb{R} or \mathbb{R}^d , its generalizations to the time inhomogeneous cases and Hawkes processes on the real line.

Hawkes processes initially introduced for modeling the occurrence of earthquakes and their after-shocks, are currently used in a growing number of domains such as neurosciences, finance, insurance. These point processes model the successive arrivals of events and the influence of each events on the probability of future occurrences. In particular, the intensity is a stochastic process depending on the past trajectory.

A large variety of subjects can be then studied :

- Limit theorem for the Poisson point process on \mathbb{R}
- Properties and construction of the Poisson process on \mathbb{R}^d .
- The thinning construction of Hawkes processes,
- The cluster representation of linear Hawkes processes,
- The likelihood-based estimation method for parameters of point processes,

Some references

- An Introduction to the Theory of Point Processes (Volume 1), D.J. Daley and D. Vere-Jones, *Probability and its Applications*, Springer (2005).
- Cours de M2 de G. Miermont, *Theorèmes limites et Processus de Poisson* <http://perso.ens-lyon.fr/gregory.miermont/thlim.pdf>
- The Elements of Hawkes Processes ; P.J. Laub, Y. Lee, T. Taimre Cham *Springer Nature*, 2021
- A Cluster Process Representation of a Self-Exciting Process, A. Hawkes and D. Oakes, *Journal of Applied Probability*, Vol. 11, No. 3 (Sep., 1974), pp. 493-503.