

Abstract: Point process modeling has been widely used as a powerful statistical tool in describing, investigating, and forecasting social, economic, and natural phenomena. Especially, the Hawkes-type models describe the interaction between discrete events: each event, no matter whether it is a background event or an excited event, influences the occurrence of the future events, through triggering (“encouraging” of) events, according to some probability rules. Since the Hawkes models can be used to investigate the interaction between discrete events, they became more and more popular in many fields, such as crime data analysis, economics, and seismology.

In this talk, using the ETAS model for earthquake and a nonparametric Hawkes model for crime data as the illustrative examples, I will explain the methods of stochastic declustering and stochastic reconstruction. Stochastic declustering helps us to realize the family-tree structure among the earthquake events in a stochastic manner. Stochastic reconstruction is a technique for model diagnostics and later is generalized to a nonparametric method for estimating the branching characteristics for more general branch process models, by incorporating other smoothing techniques. The stochastic reconstruction method can be validated through the viewpoints of martingale theory. I will show its powers by the examples of extending two existing Hawkes-type models in earthquakes and crimes data analysis.