



UNIVERSITÀ DEGLI STUDI
DI TRENTO

Dipartimento di Matematica



SEMINARI

Mathematics for Data Science, Artificial Intelligence and Machine Learning

Monday, December 11, 2023– at 14:30

Seminar Room 1, Povo0, Via Sommarive 14,
and online through the ZOOM platform

<https://unitn.zoom.us/j/81698041878> (Passcode: 028649)

Daniele Durante
(Università Bocconi Milano)

Bayesian Nonparametric Stochastic Block Modeling of Criminal Networks

Abstract:

Europol recently defined criminal networks as a modern version of the Hydra mythological creature, with covert and complex structure. Indeed, relationships data among criminals are subject to measurement errors, structured missingness patterns, and exhibit a sophisticated combination of an unknown number of core-periphery, assortative and disassortative structures that may encode key architectures of the criminal organization. The coexistence of these noisy block patterns limits the reliability of community detection algorithms routinely-used in criminology, thereby leading to overly-simplified and possibly biased reconstructions of organized crime architectures. In this seminar, I will present a number of model-based solutions which aim at covering these gaps via a combination of stochastic block models and priors for random partitions arising from Bayesian nonparametrics. These include Gibbs-type priors, and random partition priors driven by the urn scheme of a hierarchical normalized completely random measure. Product-partition models to incorporate criminals' attributes, and zero-inflated Poisson representations accounting for weighted edges and secrecy strategies, will be also discussed. Collapsed Gibbs samplers for posterior computation are presented, and refined strategies for estimation, prediction, uncertainty quantification and model selection will be outlined. Results are illustrated in an application to an Italian Mafia network, where the proposed models unveil a structure of the criminal organization mostly hidden to state-of-the-art alternatives routinely used in criminology. I will conclude the seminar with ideas on how to learn the evolutionary history of the criminal organization from the relationship data among its criminals via a novel combination of latent space models for network data and phylogenetic trees.

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CONTATTI

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