Inferring latent random networks from random interactions

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Most statistical models are defined as a probability measure on some observable outcome. Clearly, this definition is rarely helpful directly to analyze real data. In fact, modern data tend to be rather complex. For example, genomic data comes from large monitoring systems with no prior screening.

However, in most of these systems, these interactions are rather structured and the actual set of relationships, therefore, tends to be sparse. A graph is one possible way to describe complex relationships between many actors, such as for example genes and psychiatric symptoms.

Graphical models present an appealing and insightful way to describe graph-based dependencies between the random variables. Although potentially still interesting, the main aim of inference is not the precise estimation of the parameters in the graphical model, but the underlying structure of the graph. Combining graphical models with exponential random graph models is an interesting new way to model the underlying topology of such non-observed graphs.

We derive Bayesian and frequentist procedures for inferring the parameters of the non-observed network, giving insight in the underlying drivers of the system.

Keywords: sparse covariance selection; graphical model; exponential random graph model.