Editorial of the Special Issue "Networks and Statistics".

Title: Editorial du numéro spécial "Méthodes statistiques pour les réseaux".

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Statisticians show a growing interest in networks, with a rapidly increasing number of papers. This special number is a drop in this stream. It contains two review papers and also new contributions, specially about dynamic networks.

Antoine Channarond wrote the article *An overview of random graph models* that is a rewriting of the first chapters of his PhD. This is an introductory paper to the domain. In the first part basic definitions and theorems are presented, such as degree, transitivity, clustering coefficient, definition and properties of the Erdos-Renyi, Kleinberg-Watts-Strogatz (also called *small world*) and Albert and Barabasi (aslo called *preferential attachment*) models. In the second part more realistic statistical models are presented, such as exponential and latent variables models. This paper is a nice personal journey that does not pretend to be exhaustive. The focus is on models more than statistical inference. The reader interested in the topics of the second part may also see Kolaczyk and Csárdi (2014), Vu et al. (2013), Matias and Robin (2014), Daudin (2011) et Leger et al. (2014).

A highway of the domain is the clustering of nodes with the same topological behaviour. This set of methods that have already be presented in the second part of the Channarond's paper is the topic of the two following ones.

In the article *Using SOMbrero for clustering and visualizing graphs*, Madalina Olteanu and Nathalie Villa-Vialaneix propose to use SOM algorithm to cluster the nodes. A network of chemical reactions with several thousands of nodes is analyzed and a package R is presented.

Let us divide the node set of a graph in two groups A and B. In a bipartite graph the only possible edges are between A and B. Co-clustering of a bipartite graph consists in building at the same time a partition of A and a partition of B. The article *Co-clustering through Latent Bloc Model : a Review* by Vincent Brault and Mahendra Mariadassou contains a review of co-clustering methods with a focus on the Latent Bloc (LBM) model.

Most of the studies are about static networks (only one network). There is a need for new statistical models suited to dynamic networks (several networks indexed by time) that are now available. This is the subject of two articles of this special issue.

In the article *Estimation of Stochastic actor-oriented models for the evolution of networks by generalized method of moments,* Viviana Amati, Felix Schvnenberger and Tom Snijders define the

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Stochastic actor-oriented model and a generalized moments method to estimate the parameters. This model may include covariates and allows to study the evolution of the network.

In the article *Un Modhle dynamique de sous-graphes aliatoires. Étude du scandale Enron,* Rawyia Zreik, Pierre Latouche and Charles Bouveyron propose an extension of the Random subgraph model (RSM) to the dynamic case. For this model it is assumed that the network is divided in known sub-networks. Each sub-network is clusterized. The same clusters are present in each sub-network but their proportions may be different. The evolution of the network of the relations between employees of the firm Enron (that became bankrupt in 2001) are studied with this model.

Social and genomics networks have been investigated for a long time. Ecological networks have received less attention from statisticians. A paper on this topic has been planned for this special issue but the project did not complete. Readers interested by the domain may see Gauzens et al. (2015), Daudin et al. (2010), Miele et al. (2014) or Leger et al. (2015).

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Références

Daudin, J.-J. (2011). A review of statistical models for clustering networks with an application to a ppi network. *Journal de la Société Française de Statistique*, 152(2) :111–125.

Daudin, J.-J., Pierre, L., and Vacher, C. (2010). Model for heterogeneous random networks using continuous latent variables and an application to a tree-fungus network. *Biometrics*, 66(4) :1043–1051.

Gauzens, B., Thébault, E., Lacroix, G., and Legendre, S. (2015). Trophic groups and modules : two levels of group detection in food webs. *Journal of The Royal Society Interface*, 12(106).

Kolaczyk, E. and Csárdi, G. (2014). *Statistical Models for Network Graphs*, volume 65 of *Use R !* Springer New York.

Leger, J.-B., Daudin, J.-J., and Vacher, C. (2015). Clustering methods differ in their ability to detect patterns in ecological networks. *Methods in Ecology and Evolution*, 6(4) :474–481.

Leger, J.-B., Vacher, C., and Daudin, J.-J. (2014). Detection of structurally homogeneous subsets in graphs. *Statistics and Computing*, 24(5) :675–692.

Matias, C. and Robin, S. (2014). Modeling heterogeneity in random graphs through latent space models : a selective review. *ESAIM : Proc.*, 47 :55–74.

Miele, V., Picard, F., and Dray, S. (2014). Spatially constrained clustering of ecological networks. *Methods in Ecology and Evolution*, 5(8) :771–779.

Vu, D. Q., Hunter, D. R., and Schweinberger, M. (2013). Model-based clustering of large networks. *Ann. Appl. Stat.*, 7(2) :1010–1039.