Seminar talk
"U-statistics of row-column exchangeable matrices: application to ecological network analysis"

Tâm Le Minh*

*Univ. Grenoble Alpes, Inria, CNRS, Grenoble INP, LJK, 38000 Grenoble, France

This is the abstract of a talk given at the Statistics seminars of Inria Grenoble, Université d'Évry Paris-Saclay, Université Toulouse III and Université Grenoble Alpes, and the Mathematical Biology seminar of Université Sorbonne Paris-Nord, in 2023 and 2024. It is based on my doctoral thesis [2].

Ecological interaction networks represent the functioning of an ecosystem. Studying the variability of interaction networks helps to understand how ecosystems are affected by external factors. I propose a methodology for analyzing bipartite networks, applicable to mutualistic ecological networks [1]. This methodology is based on U-statistics of row-column exchangeable matrices. In network analysis, these matrices correspond to the adjacency matrices of bipartite networks with exchangeable nodes, and U-statistics can be used as estimators of quantities of interest. My goal is to identify the asymptotic behavior of these U-statistics [3]. To achieve this, a Hoeffding-type decomposition is established [5, 4]. Inspired by this decomposition, an estimator for the asymptotic variance is also suggested, enabling the development of a general method for conducting statistical inference on exchangeable network models. This methodology is applied to the analysis of bipartite networks. Simulation studies are conducted to validate the use of this methodology.

References

[1] M. Dubart, P. Alonso, D. Barroso-Bergada, N. Becker, K. Bethune, D. A. Bohan, C. Boury, M. Cambon, E. Canard, E. Chancerel, J. Chiquet, P. David, N. de Manincor, S. Donnet, A. Duputié, B. Facon, E. Guichoux, T. Le Minh, S. Ortiz-Martínez, L. Piouceau, A. Sacco-Martret de Préville, M. Plantegenest, C. Poux, V. Ravigné, S. Robin, M. Trillat, C. Vacher, C. Vernière, and F. Massol. Coupling ecological network analysis with high-throughput sequencing-based surveys: Lessons from the next-generation biomonitoring project. In *The Future of Agricultural Landscapes, Part III*, volume 65 of *Advances in Ecological Research*, pages 367–430. Academic Press, 2021.

[2] T. Le Minh. *U-statistics of row-column exchangeable matrices: application to ecological network analysis.* PhD thesis, Université Paris-Saclay, 2023.

[3] T. Le Minh. U-statistics on bipartite exchangeable networks. *ESAIM: Probability and Statistics*, 27:576–620, 2023.

[4] T. Le Minh. Characterization of the asymptotic behavior of U-statistics on row-column exchangeable matrices. *arXiv preprint arXiv:2401.07876*, 2024.

[5] T. Le Minh, S. Donnet, F. Massol, and S. Robin. Hoeffding-type decomposition for U-statistics on bipartite networks. *arXiv preprint arXiv:2308.14518*, 2023.