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"GIUSEPPE PARENTI"

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PhD Seminar Series

“Seminari di Statistica del Dottorato”

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London School of Economics and Political Science

September 12, 10:00 am

Viale Morgagni 59, Room 205

PAIRWISE COMPARISONS WITHOUT STOCHASTIC TRANSITIVITY: MODEL, THEORY AND APPLICATIONS TRANSCRIPTOMICS

Most statistical models for pairwise comparisons, including the Bradley-Terry (BT) and Thurstone models and many extensions, make a relatively strong assumption of stochastic transitivity. This assumption imposes the existence of an unobserved global ranking among all the players/teams/items and monotone constraints on the comparison probabilities implied by the global ranking. However, the stochastic transitivity assumption does not hold in many real-world scenarios of pairwise comparisons, especially games involving multiple skills or strategies. As a result, models relying on this assumption can have suboptimal predictive performance. In this paper, we propose a general family of statistical models for pairwise comparison data without a stochastic transitivity assumption, substantially extending the BT and Thurstone models. In this model, the pairwise probabilities are determined by a (approximately) low-dimensional skew-symmetric matrix. Likelihood-based estimation methods and computational algorithms are developed, which allow for sparse data with only a small proportion of observed pairs. Theoretical analysis shows that the proposed estimator achieves minimax-rate optimality, which adapts effectively to the sparsity level of the data. The spectral theory for skew-symmetric matrices plays a crucial role in the implementation and theoretical analysis. The proposed method's superiority against the BT model, along with its broad applicability across diverse scenarios, is further supported by simulations and real data analysis. This is a joint work with Sze Ming Lee (phd student at LSE).