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Normal approximation for subgraph count in graphon-based random graphs

Given a symmetric, measurable function $W : [0,1]^2 \to [0,1]$, vertices in a W-*random graph* are assigned random latent positions $U_i \sim \mathcal{U}[0,1]$ and are connected with location-dependent probabilities $W(U_i, U_j)$. The function W is commonly referred to as a *graphon*. Graphon-based framework covers a wide class of random graphs, including random geometric graphs and stochastic block models.

The analysis of the *subgraph count* – the number N^G of copies of a fixed graph G within a random graph – provides major insight into the structure of random networks. Recently in [1], the asymptotic normality of N_n^G, as $n \to \infty$, has been characterized in the *sparse setting* (where $W_n = p_n W$ for some graphon W and edge density parameters $p_n \ll 1$). Moreover, bounds for the normal approximation in the Kolmogorov distance were established for strongly balanced graphs G, see [2].

In this talk, we present improved normal convergence rates for the subgraph count in the sparse regime with arbitrary graph G. Additionally, we address the normal approximation in the absence of the sparsity condition on W_n, focusing specifically on edge and triangle counts.

This is based on a joint work with Grzegorz Serafin.

Bibliography

[1] S. Chatterjee, A. Chatterjee, A. Chakraborty, and B. B. Bhattacharya, *Asymptotic normality of subgraph counts in sparse inhomogeneous random graphs*, arXiv: 2512.12937.

[2] Q. Liu, and N. Privault, *Gaussian fluctuations of generalized u-statistics and subgraph counting in the binomial random-connection model*, Stochastic Processes and their Applications, 2026.