Southern California Probability Symposium 2025

April 5, 2025
ISEB 1200, UC Irvine

Speaker: Lutz Warnke (University of California San Diego)

Title: The phase transition in the random d-process

Abstract: One of the most interesting features of Erdös-Rényi random graphs is the `percolation phase transition', where the global structure intuitively changes from only small components to a single giant component plus small ones.

In this talk we discuss the percolation phase transition in the random d-process, which is a time-evolving random graph model with bounded degrees: starting with an empty graph on n vertices, new random edges are added step-by-step so that the maximum degree remains at most d. For fixed d \ge 3, we (i) show that the d-process undergoes a giant component phase transition, and (ii) determine the asymptotic size of the giant component just after the phase transition. For d=2, we also show that the giant component has a non-trivial distribution at the end of the 2-process. These results verify a conjecture of Balinska and Quintas from 1990, and solve a problem of Wormald from 1997.

The proofs are based on an interplay between discrete and continuous methods, with connections to ideas and heuristics arising in percolation theory as well as aggregation and coagulation theory. For example, our arguments track a large system of O(d^4) many random variables via the differential equation method: these variables are used as input to suitable branching process approximation arguments, which in turn require an asymptotic analysis of the associated unusually large system of O(d^4) many differential equations.

Based on joint work with Nick Wormald and Laura Eslava, respectively.

Speaker: Sixian Jin (California State University San Marcos)

Title: **Stationary Behavior of a Diffusion Limit for SRPT Queues with Heavy Tailed Processing Time Distributions**

Abstract: In this talk, we explore the stationary behavior of diffusion limits in shortest remaining processing time (SRPT) queues with heavy-tailed processing times. The SRPT state descriptor is a measure-valued process that at each time has unit masses at the remaining processing time of each job in system. Banerjee, Budhiraja and Puha (2022) have shown that, under proper scaling, this state descriptor converges to a measure-valued stochastic process, characterized by workload processes modeled as reflecting coupled Brownian motions with a specific negative drift function. Motivated by the form of the limit, we study reflecting coupled Brownian motions with a general

nondecreasing negative drift function. We analyze the stationary behaviors of the distributions of the resulting measure-valued process and its moments through the maximum process of the coupled Brownian motions. Additionally, we derive joint distributions and the covariance structure of the maximum process, offering new insights into the stationary distribution of the queue length in SRPT systems.

Speaker: Moritz Voss (University of California Los Angeles)

Title: On the generalized Obizhaeva-Wang model with small instantaneous costs

Abstract: The Obizhaeva and Wang model (2005) is a cornerstone in financial mathematics for modeling price impact — the effect of trades on market prices — central to optimizing order execution and understanding liquidity. In this talk, we present a novel probabilistic approach to solving the associated singular (non-regular) optimal stochastic control problem (for the order execution problem) within a generalized Obizhaeva and Wang framework. We also analyze the asymptotic behavior of a regularized version of the problem.

The talk is based on joint work in progress with Marcel Nutz (Columbia University).

Speaker: Lily Reeves (California Institute of Technology)

Title: Chemical distance in hierarchical percolation

Abstract: Hierarchical percolation is a toy model for percolation on Z^d that, much like the Euclidean model, is expected to exhibit mean-field behavior in high dimensions, non-mean-field behavior in low dimensions, and mean-field behavior with logarithmic corrections at the upper-critical dimension. Building on Hutchcroft's work on cluster volumes in hierarchical percolation, we examine the distribution of the chemical distance in high dimensions and the upper-critical dimension. In this talk, I will explain the renormalization group—style analysis we use to obtain precise estimates on the moments of the chemical distance and discuss our attempt to generalize this approach to long-range percolation on the Euclidean lattice. Joint work with Tom Hutchcroft.

Speaker: Pedro Abdalla (University of California Irvine)

Title: Covariance Estimation through Empirical Process Theory

Abstract: In this talk, we revisit the classical problem of covariance estimation from the perspective of empirical process theory. In particular, we explore the relationship between the sample covariance matrix and the quadratic empirical process. This talk is based on a joint work with Nikita Zhivotovskiy.

Speaker: Jun Yin (University of California Los Angeles)

Title: The delocalization conjecture for random band matrices

Abstract: In this talk, we present a new proof of the delocalization conjecture for random band matrices. The conjecture asserts that for an $N \times N$ random matrix with bandwidth W, the eigenvectors in the bulk of the spectrum are delocalized provided that $W \gg N^{1 / 2}$. Moreover, in this regime, the eigenvalue distribution aligns with that of Gaussian random ensembles (i.e., GOE or GUE). Our proof employs a novel loop hierarchy method and leverages the sum-zero property, a concept that was instrumental in the previous work on high-dimensional random matrices.

This work is a joint collaboration with H.T. Yau.