THE UNIVERSITY OF CHICAGO

Computational and Applied Mathematics & Statistics Student Seminar

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General Moment Closure for the Neutral Two-Locus Wright-Fisher Dynamics

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12:00 PM
Rosenwald 011
1115 E 58th St

ABSTRACT

The Wright-Fisher diffusion and its dual process, the coalescent, are at the core of many results and methods in population genetics. Approaches have been developed to study the dynamics of the moments of the diffusion under genetic drift, mutation, and recombination using ordinary differential equations (ODEs). The dynamics of these moments can be used to study population genetic processes and are key building blocks of efficient methods to infer population genetic parameters, like demographic histories or fine-scale recombination rates. They can also be used to characterize linkage disequilibrium, which is essential for accurate interpretation of genome-wide association studies. However, the system of ODEs does not close under recombination; that is, computing moments of a certain order requires knowledge of moments of higher orders. Thus, the system cannot be solved directly. By applying a coordinate transformation to the diffusion generator, we show that the canonical moments in these alternative coordinates yield a closed system. Compared to previous approaches in the literature, we believe that this approach can be readily extended to more general scenarios. Through simulations, we verify that the derived closed system accurately captures the dynamics of the moments and can be used to efficiently compute expected diversity and linkage statistics in population genetic samples.

Link to corresponding paper: https://www.biorxiv.org/content/10.64898/2026.01.16.700021v1