THE UNIVERSITY OF CHICAGO

Computational and Applied Mathematics & Statistics Student Seminar

---

Jordan Kemp

Department of Physics
University of Chicago

Bayesian Origins of Growth, Cooperation, and Inequality in Populations of Learning Agents

Monday, March 20, 2023
12:30 PM
Jones Laboratory,
Room 303

ABSTRACT

The statistical dynamics of population growth, wealth, and inequality are related through their common description as multiplicative stochastic processes. In these systems, variations in growth rates (and fitness) determine selection, relative wealth, and incentives for cooperation. Despite its relevance for biological and social sciences, we still lack a general theory that explains the dynamics of growth rates in terms of agent adaptation to their environment, heterogeneities of traits, and other consequential behaviors. In this talk, we derive a general population dynamics of learning agents leveraging the knowledge of their environments to grow and reinvest their resources. Growth rates emerge in the long-time limit as the mutual information between agents signals and states of the environment. We show that, with knowledge of past and present conditions only, sequential Bayesian inference is optimal for maximizing growth, thus formally associating growth rates with information. We discuss how this framework can address problems of inequality in heterogeneous populations and lay the foundations for a unified general quantitative theory of social and biological phenomena such as the dynamics of cooperation via Hamilton's rule, and the effects of education on life history choices.

Readings:
Optional - Statistical Dynamics of Wealth Inequality in Stochastic Models of Growth
Important - The Bayesian Origins of Growth Rates in Stochastic Environments