1128-60-185 **hong qian***, University of Washington, Department of Applied Mathematics, Seattle, WA 98195.

A mathematical theory of biological population dynamics: From cells to ecology, small and large systems with and without stochasticity.

Complex dynamics of interacting populations of intrinsically stochastic individuals can be mathematically represented by a discrete-state, continuous-time Markov jump process. T. G. Kurtz's theorem establishes a relation between this stochastic process, in the limit of a system's size tending infinity, and the traditional dynamical systems based on ODEs. We apply this theory to several problems in current cell biology in terms of the biochemical constituents, and illustrate the emergent notions of epigenetic phenotypes and their switching, and relation to the classical idea of phase transition. We show the existence of an emergent nonequilibrium landscape, as a generalization of J. W. Gibbs' energy function, for nearly any complex dynamics. We discover a rather surprising underlying mathematical structure, with geometric and thermodynamic implications. (Received February 25, 2017)