

Continuous approximations of Discrete Processes

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Abstract

We consider frequency dependent birth-death processes in evolutionary dynamics in a population with N individuals of two given types. Let $p(x,t)$ be the probability to find x individuals of a given type at time t in the population. We first show that the evolution of $p(x,t)$ can be uniformly in time approximated by the solution of a degenerated Fokker-Planck equation. This equation generalized the celebrated Kimura equation for the fitness dependent case. In the sequel, we use asymptotic analysis to find solutions of this equation that provide explicit formulas approximating the fixation probability of any given type. This formulas depend on the functional form of the difference of fitness between both types (in the language of theory of games: dominance, coexistence, coordination).

Finally, we show many generalization of this techniques: multi-type models, more general processes, large population limits with and without weak selection, equations for the time to fixation etc.