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Evolutionary dynamics in finite populations

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Traditionally, evolutionary dynamics has been studied based on infinite populations and deterministic frameworks such as the replicator equation. Only more recently the focus has shifted to the stochastic dynamics arising in finite populations. Over the past years new concepts have been developed to describe such dynamics and has lead to interesting results that arise from the stochastic, microscopic updates, which drive the evolutionary process. Here we discuss a transparent link between the dynamics in finite and infinite populations. The focus on microscopic processes reveals interesting insights into (sometimes implicit) assumptions in terms of biological interactions that provide the basis for deterministic frameworks and the replicator equation in particular. More specifically, we demonstrate that stochastic differential equations can provide an efficient approach to model evolutionary dynamics in finite populations and we use the rock-scissors-paper game with mutations as an example. For sufficiently large populations the agreement with individual based simulations is excellent, with the interesting caveat that mutation events may not be too rare. In the absence of mutations, the excellent agreement extends to small population sizes.