Scaling limits for allelic subfamilies in a mother-dependent multitype branching process

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Abstract

The mother-dependent neutral mutations model describes the evolution of a population across discrete generations with a finite set of alleles, where each mutant child acquires a type different from that of their mother, chosen uniformly at random. We introduce a Markov chain that tracks the sizes of allelic subfamilies together with their mutant descendants, and give a d-dimensional random walk representation that we use to obtain its scaling limit, a discrete-time continuous-state Markov process whose transition probabilities depend explicitly on the sizes of the initial allelic populations and their first-generation mutant offspring. As a consequence, we define a suitable multitype tree of alleles and show that, in the scaling limit, it converges to a tree-indexed multitype Jirina process. Our results therefore extend the framework of Bertoin (2010) from the infinite-allele setting to the case of finitely many alleles.

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