Lines of descent in a Moran model with frequency-dependent selection and mutation

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Dealing with the interplay of mutation and selection is one of the important challenges in population genetics. We consider two variants of the two-type Moran model with mutation and frequency-dependent selection, namely a scheme with nonlinear dominance (of the fit type) and another with what we name the *fittest-type-wins* scheme. We show the equivalence of the two variants and pursue the latter for further analysis. In particular, we trace the genealogy of a sample of individuals backward in time, via an appropriate version of the so-called *ancestral selection graph* (ASG), originally introduced by Krone and Neuhauser (1997). We use the information contained in mutation events to reduce the ASG to the parts that are informative with respect to the type distribution of the present population and their ancestors, respectively. This leads to the killed ASG and the pruned lookdown ASG in this setting, which we use to derive representations for the (factorial) moments of the type distribution and the ancestral type distribution; we do so by connecting forward and backward graphical models via duality relationships. Finally, we show how the results carry over to the diffusion limit.

[1] Baake, Ellen, Luigi Esercito, and Sebastian Hummel. "Lines of descent in a Moran model with frequency-dependent selection and mutation." *arXiv preprint arXiv:2011.08888* (2020).