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The Forward Kimura Equation

Chalub, Fabio[1] and Souza, Max[2]

[1] *Universidade Nova de Lisboa, Portugal*
chalub@fct.unl.pt
[2] *Universidade Federal Fluminense, RJ, Brazil*
msouza@mat.uff.br

ABSTRACT

We consider the Forward Generalized Kimura Equation:

$$\partial_t p = \frac{\kappa}{2}\partial_x^2 \left(x(1-x)p\right) - \partial_x \left(x(1-x)\psi(x)p\right) \ ,$$

where $p(x,t)$ is the probability to find x mutants at time t in a population consisting of two different genotypes: the wild-type and the mutant. The fitness difference between the mutant and the wild type is given by $\psi : [0,1] \to \mathbb{R}$ and κ is the "intensity of selection".
We will show that this equation, when supplemented by two appropriate conservation laws, approximates the evolution given by certain Markov processes (e.g, the Moran process or the Wright-Fisher process). These conservation laws can be obtained from the discrete processes.
We will obtain expressions for the fixation probability of the mutant and also for the expected time for fixation of any type. These equations are of no practical use and will be simplified using asymptotic expansions, given different expressions depending on the sign of the function ψ on the interval $[0,1]$.

References

[1] Chalub, Fabio A.C.C. and Souza, Max O. (2014) *The frequency-dependent WrightFisher model: diffusive and non-diffusive approximations*, Journal of Mathematical Biology, *in press.*

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