

Seminario de Probabilidades

Miércoles 9 de Diciembre a las 16:15 horas.

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Título: Asymptotic analysis of a population dynamics with competition and horizontal transfer.

Resumen: We present a model for the dynamics of a population of bacteria with trait structure, who compete for resources and exchange genetic material by horizontal transfer. Phenotypic traits characterizing individuals may then be vertically inherited through mutations, and horizontally transmitted through transfer. Competition and horizontal transfer influence individual demographics and population size, which in turn feeds back on the dynamics of competitions and transfers. We consider a stochastic individual-based pure jump process taking values in the space of point measures. The jumps describe the individuals' reproductions (possibly with mutation), transfers and deaths. In this model there is a trade-off between the transfer and the effect of advantageous mutation: individuals with costly traits and hence smaller growth rates can transfer their traits to fitter individuals. Depending on the parameters of the model, different behaviors can be observed on simulations, including evolutionary suicides and cyclic phenomena. If the trait describes the resistance charge to some antibiotics carried by plasmids in a bacterium, this cyclic effect can for instance be associated to the appearance of resistant strains. In the limit of large populations and rare mutations, we explore mathematically these phenomena developing an approach introduced in a different context by Durrett, Mayberry and by Bovier, Coquille, Smadi. The idea is to consider population sizes in a log scale to keep track of the smaller subpopulations that have negligible sizes compared with the size of the dominant (so-called resident) population. The population dynamics observed in simulation can then be compared with the asymptotic behavior of the model in this log scale, relying in particular on coupling arguments with inhomogeneous branching processes with immigration. We also present the first steps of a work in progress relying this approach with a class of Hamilton-Jacobi equations introduced by Barles, Mirrahimi and Perthame.