

Dynamical Biological Processes on Evolutionary Networks - Dynamic Networks and Conjugation Processes in Microbiology

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Abstract

In this paper, we develop a mathematical model to analyse a dynamical system of a stochastic process of a certain type of bacterial conjugation in microbiology and give a general solution. We consider three types of bacteria which are called F- recipients, F+ donors with free plasmid and F+ donors with integrated plasmid, with arbitrary initial conditions. We prove that the final proportions of F- recipients, F+ donors with free plasmid, F+ donors with integrated plasmid converge to 0, 0 and 1, respectively when the conjugation process terminates. Our stochastic-numerical results show that the proportion of the total transitions to the total population approximates to 0.466. We contribute to Operations Research in computational biology and medicine, supported by dynamical system analysis with some convexity properties and stochastic-numerical simulations.

Keywords: Operational research, applied probability, microbiology, experimental genetics, gene networks, bacterial conjugation process

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