Journal of the Royal Society Interface, vol.19, no.196, pp.20220629-1-20220629-18, November, 2022.

Why are cell populations maintained via multiple compartments?

F. Feliciangeli; H. Dreiwi; M. López García; M. Castro Ponce; C. Molina París; G. Lythe

Abstract-

We consider the maintenance of ‘product’ cell populations from ‘progenitor’ cells via a sequence of one or more cell types, or compartments, where each cell’s fate is chosen stochastically. If there is only one compartment then large amplification, that is, a large ratio of product cells to progenitors comes with disadvantages. The product cell population is dominated by large families (cells descended from the same progenitor) and many generations separate, on average, product cells from progenitors. These disadvantages are avoided using suitably constructed sequences of compartments: the amplification factor of a sequence is the product of the amplification factors of each compartment, while the average number of generations is a sum over contributions from each compartment. Passing through multiple compartments is, in fact, an efficient way to maintain a product cell population from a small flux of progenitors, avoiding excessive clonality and minimizing the number of rounds of division en route. We use division, exit and death rates, estimated from measurements of single-positive thymocytes, to choose illustrative parameter values in the single-compartment case. We also consider a five-compartment model of thymocyte differentiation, from double-negative precursors to single-positive product cells.

Index Terms- branching process, probability generatingfunction, progenitor cell, cell fate, generation, clonality

Citation:
Feliciangeli, F.; Dreiwi, H.; López-García, M.; Castro, M.; Molina-Paris, C.; Lythe, G. "Why are cell populations maintained via multiple compartments?", Journal of the Royal Society Interface, vol.19, no.196, pp.20220629-1-20220629-18, November,

2022.