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Population dynamics of cancer stem cell

Evolutionary modelling of biological systems - in a Darwinian sense - as a discrete or continuous time dynamical systems has been an important part of mathematical biology particularly in genetics and cancer biology. In cancer biology. an analysis of the dynamics of an invasive mutant stem cell introduced in a tissue compartment through a gain/loss-of-function mutation can be critical to determine the initiation and progression of cancer. We construct a stochastic dynamical system of two populations of stem cells (normal and mutant) and their progenitors (differentiated cells). By finding the fixed points of such a stochastic dynamical system and analyzing the stability of its fixed points, we find the conditions required for a mutant stem cell to take over the whole tissue or conversely to become extinct. An important observation of this model is the fact that for a large set of parameter values there is a chance of the two stem cell phenotypes co-existing. This is important as population co-existence is normally a feature of evolutionary game theoretical models. We discuss the extension of the above model in the presence of spatial structure and the resultant effect on the population dynamics. We also briefly discuss the similarities of stem cell dynamics to evolutionary game theoretical models.