The Role of Kinetic Parameters in Phenotypic Switches

Banik, Sreya (School: Lincoln Park Academy)

The purpose of this in-silico experiment was to explore a way to model the transition of bacterial populations (persister and normal). The hypothesis theorizes that by studying the role of rate parameters in chemical kinetics, a general computational model will produce results that explain the dynamics of bacteria. The approach for this study was to use kinetic rate equations. The rate equations represent the growth rates of bacteria over a span of 6 hours. Mathematica was used in application to come up with the dependence of rate constants. A total of 1000 different simulations were carried out to check the dependency of the cellular population of the rate parameters. In each of the simulation, the rates were perturbed randomly. There were two groups that were tested: Persister and Normal. Along with that, there were 4 parameter values that affected the CFU (Colony Forming Units). After computing the CFU, next correlation coefficient was calculated. Correlation Coefficient (CC) is used to generate the scatter plots to help determine the strength of the variables (parameter and population). For normal cells, the CC values were .037, -.024, .917, & -.037; for persister, the values were .046, -.1, .912, & -.037. These suggest that the parameters a and μn shows a positive correlation with cellular population. While parameters b and μp show a negative correlation. These results provide support that the hypothesis, there will be a way to graphically showcase the dynamics of persister and normal bacteria using rate parameters.