CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
James Gui

Project Number
S1406

Project Title
Simulating Tumor Progression Using Spatial Evolutionary Games

Abstract

Objectives/Goals
My goal was to improve upon the model of tumor progression described in "Evolutionary game theory elucidates the role of glycolysis in glioma progression and invasion" by D. Basanta by incorporating a spatial component.

Methods/Materials
A. I first replicated results gathered in the original Basanta model by using an ordinary differential equation coded in Matlab. Then, by using the Laplacian matrix of a 10 by 10 grid, I attempted to turn the original model into a two-dimensional model.
B. I changed the parameters c, k, and n was well as the initial values and ran simulations to find out what changes in microenvironment could affect final cell populations.
C. The model was changed twice after creating replicating the original; once to add the spatial component, and once to improve visualization
D. I recorded the population fractions at the end of each simulation under different parameter values. For example, at c=.5, n=.4, and k=.2, the values of AG, INV, and GLY were 18.58%, 50.09%, and 31.33% respectively.

Results
The model returned similar results to the original model, but in a more clearly visualized manner. The microenvironments that were conducive to GLY cells were also conducive to INV cells, and GLY cell takeover always preceded INV takeover.

Conclusions/Discussion
The model was an improvement on the original model in that it provided a more solid visualization and accounted for space as a factor in tumor progression. However, the assumptions surrounding the simulation could be adjusted in accordance with more specific biological background.

Summary Statement
I use MatLab to improve upon an existing model of glioma progression by including space as a factor in analysis.

Help Received
Graduate student helped with MatLab syntax and initial background information