How Quorum Sensing Interactions Affect Microbial Population Structures

02-712 Final Project

Siddharth Reed*[1], Neel[1], Evan[1], Sarah[1], and Deepika[1]

[1]Computational Biology Department, Carnegie Mellon University

November 18, 2021

Abstract

example abstract

*[OTU]: Operational Taxonomic Unit

Background

Methods

Results

Comparing QS interaction matrices

How Sparsity affects model dynamics

Examining well-known adjacency matrices

Simulations with OTU data

The data we use is an OTU table O_I, an $m \times n$ matrix representing the abundance of m OTUs across n samples. For each sample we use the abundance vector as our initial state and run the simulation with a given set of parameters. So after all simulations we get an OTU table O_T representing the terminal state of the model (abundance vector) for each initial state. Given the tables O_I, O_T we can calculate the difference in α-diversity and β-diversity between O_I and O_T. We can also calculate the mean and variance of the Bray-Curtis distance between the initial and terminal states for each sample.

Simulation with an empirically derived QS interaction matrix

Discussion

Bibliography

Aggarwal, Surya D., Hasan Yesilkaya, Suzanne Dawid, and N. Luisa Hiller. 2020. "The Pneumococcal Social Network." *PLOS Pathogens* 16 (10). https://doi.org/10.1371/journal.ppat.1008931.

Calle, M. Luz. 2019. "Statistical Analysis of Metagenomics Data." *Genomics &Amp; Informatics* 17 (1). https://doi.org/10.5808/gi.2019.17.1.e6.

Dimitriu, Tatiana, Frances Medaney, Elli Amanatidou, Jessica Forsyth, Richard J. Ellis, and Ben Raymond. 2019. "Negative Frequency Dependent Selection on Plasmid Carriage and Low Fitness Costs Maintain Extended Spectrum Beta-Lactamases

*slreed@andrew.cmu.edu

in Escherichia Coli." *Scientific Reports* 9 (1). https://doi.org/10.1038/s41598-019-53575-7.

Eldar, A. 2011. "Social Conflict Drives the Evolutionary Divergence of Quorum Sensing." *Proceedings of the National Academy of Sciences* 108 (33): 13635–40. https://doi.org/10.1073/pnas.1102923108.

Pérez-Escudero, Alfonso, and Jeff Gore. 2016. "Selection Favors Incompatible Signaling in Bacteria." *Proceedings of the National Academy of Sciences* 113 (8): 1968–70. https://doi.org/10.1073/pnas.1600174113.

Pollak, Shaul, Shira Omer-Bendori, Eran Even-Tov, Valeria Lipsman, Tasneem Bareia, Ishay Ben-Zion, and Avigdor Eldar. 2016. "Facultative Cheating Supports the Coexistence of Diverse Quorum-Sensing Alleles." *Proceedings of the National Academy of Sciences* 113 (8): 2152–57. https://doi.org/10.1073/pnas.1520615113.