#Analysis of the Quantitative Traits of Single Yeast Cells Imaged Through Microscopy

##Citation Ginovart, Marta, Rosa Carbó, Mónica Blanco, and Xavier Portell. "Digital Image Analysis of Yeast Single Cells Growing in Two Different Oxygen Concentrations to Analyze the Population Growth and to Assist Individual-Based Modeling". Frontiers in Microbiology, January 4, 2018, 2628. https://doi.org/10.3389/fmicb.2017.02628

##Introduction The authors of this study aimed to find a method that could combine data about yeast cells from two different levels: the population level and the level of individual cells. They took images of yeast cells growing in two different conditions: aerobic (containing a normal amount of oxygen) and microaerophillic (containing decreased amounts of oxygen) and established a protocol for analyzing the images. The researchers then used the data obtained from these image analyses to determine a number of parameters describing each cell, including area and perimeter. This data was then used to determine what point the cells were at in their life cycle by finding the growth state and budding phase of the cells. These results were then compared to results obtained using the INDISIM model, a method for simulating the growth and behavior of bacterial colonies.

##Figure to Recreate Figure 3 in this paper shows the results obtained from the protocol for measuring individual cells for two different replicates grown in two different conditions, where figure 3A represents the results for a replicate grown in aerobic conditions and figure 3B represents the results for a replicate grown in microaerophillic conditions. The data for this figure came from a series of images similar to the image shown in figure 1. More specifically, the researchers used the image analysis software image J to obtain four direct measurements-area, perimeter, major diameter, and minor diameter-using a series of modules in ImageJ and then used the resulting measurements to calculate the circularity of the cells. I intend to apply the analysis protocol developed by the authors of this study to a series of similar but original photos of yeast cells of the same species, Saccharomyces cerevisiae, in order to generate the data necessary to recreate this figure with original data..

##Materials and Methods -On February 5th, 2025, I performed an eight hour time course experiment in which microscopy images of Saccharomyces cerevisiae cells grown in standard YPD media were photographed at the time points of 0 hours, 2 hours, 4 hours, 6 hours, and 8 hours. 20 images were taken at each time point, for a total of 100 images across 5 time points. I intend on using these images as the data to recreate this figure. -I plan on using ImageJ and the Fiji image processing package within ImageJ to process these images, as this is

the software used by the researchers in the paper cited above. -The researchers began by creating blurred copies of each of their images and subtracting these copies from the original images in order to reduce noise. They converted the resulting images to greyscale and saved the each grayscale image in the 8 B format. The researchers then used the enhance contrast tool to make the borders of the cells more easily detectable. The images were then segmented using the auto threshold tool in imageJ and saved as 1 B binary images. The images were then put through automatic object closing, hole filling, and object separation modules in imageJ. I plan on putting my images through the same process. -The direct morphological parameters studied by the researchers in the paper cited above were area, perimeter, major diameter, and minor diameter. These direct parameters were used to calculate two additional derived morphological parameters. The first of these was circularity, which was calculated using the formula C = 4 x pi x A / P^2, where C is circularty, A is area, and P is perimeter. The second was aspect ratio, a measure of elongation calculated using the formula AR = Dmax/Dmin, where AR is aspect ratio, Dmax is major diameter, and Dmin is minor diameter. I plan on measuring the same morphological parameters for the cells in my images.