2020 Transfer Bridge Program

Math Bootcamp Project 1

Modeling Mangroves

Mangroves are trees and shrubs that can grow in salt water and form forests along tropical and subtropical coasts. They provide habitat for many marine organisms, including commercially important species of fish, shrimp and crabs, stabilize the shore and protect coastal communities against hurricanes. Clarke (1995) used a matrix model to study the regeneration of the Australian mangrove *Avicennia marina* after disturbances. In this project, you will investigate these models.

Figure 1. A mature *Avicennia marina* tree

Instruction for project report: Make a single pdf file report with the brief answers/analysis of each question and python code (copy paste your code or insert a snapshot)

Problem 1. (10 pts)

Read the “Introduction” and “Demographic Synthesis” sections of the paper (you don’t have to understand everything) and write a brief description of the mangrove life cycle. NOTE: *Propagules* are stages of an organism’s life cycle that can disperse – in this case, seeds. *Cotyledons* are the first leaves that form when a seed sprouts.

Problem 2. (10 pts)

Use Table 1 to create a matrix model of regeneration after a ‘type a’ disturbance. NOTE: Recruitment refers to new individuals joining the population.

Problem 3. (15 pts)

Simulate your model for at least three different initial conditions, plotting whatever life stage or combination of life stages you want to focus on. Your simulation should run for at least 10 time units.

Problem 4. (10 pts)

Will the mangrove population grow or decline in the long run?

Problem 5. (10 pts)

If we had 1000 older trees, how many individuals would we have in the other stages?

Problem 6. (25 pts)

If we want to promote mangrove regeneration after a type a disturbance, what parameter should we focus on changing? Test the effectiveness of each parameter value. When changing the parameter value, think of a way to make all changes comparable, even when the parameter values are very different. (Hint: %)

Problem 7. (10 pts)

Use Table 1 to create a matrix model of regeneration after a ‘type b’ disturbance and redo the problems 2 and 4 only.

Problem 8. (10 pts)

Come up with a question of your own and use the model to answer it.