

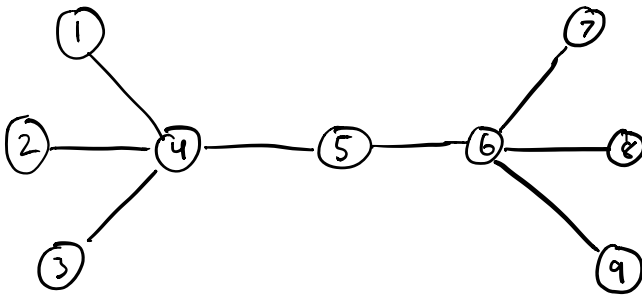
Math 36 — Weekly Homework

Assigned: 10/8

Due: 10/15

1. Show that a degree sequence does not uniquely determine a network by giving two networks with the same degree sequence that are not isomorphic.

2. Give the degree, closeness, betweenness, and eigenvector centralities for the following network.



3. Add one new vertex (with as many neighbors as you want) to the network from 2 to make vertices 4, 5, and 6 as unimportant as possible. Explain your decision.

4. Here we will examine the Prisoner's Dilemma on a grid and determine what payoff values favor cooperation or defection or both.

Use a population on a square lattice. Each round, all pairs of neighbors play the game with their neighbors. Then an individual will be chosen uniformly to die. The neighbors of the deceased individual compete to fill the spot. Select a neighbor proportional to fitness (which is a function of payoff). Repeat this until all individuals are playing one strategy.

The details:

- Use a population of  $N = 400$  individuals on a  $20 \times 20$  square lattice.
- Use weak selection. The fitness of an individual will be  $f = 1 - w + w(\text{payoff})$ , where  $w = 0.01$ .
- The payoff matrix takes the form

		Player 2	
		$A$	$B$
Player 1	$A$	$b - c$	$-c$
	$B$	$b$	$0$

For each of the following sets of values for  $b$  and  $c$ , determine if the probability of invasion by a single mutant (cooperator or defector) is above or below  $1/N$ .

- (a)  $b = 8, c = 1$
- (b)  $b = 4, c = 1$
- (c)  $b = 4, c = 2$