

Math 2270-Last Homework Assignment

This homework is due on May 4. Additional homework for Chapter 8 includes:

- **5.5:** 1,3,6,10,15,16
- **8.1:** 2,5,9,10,14,42
- **9.1:** 24,26,27,31,52
- **9.3:** 1,7

1 Applications of Linear Algebra Homework

1.1 Genetics

1. Suppose that Farmer John has a crop of blueberries. Doing research in his lab, he has discovered a dominant gene that will make the blueberries plump and juicy (call this J for juicy). However this trait is not expressed in all his plants due to a recessive gene j. Blueberry plants inherit one gene each from their parents. Farmer John wants to breed his crop so that all his blueberries will be plump and juicy. He decides to utilize a breeding program that will fertilize a plant with its own genotype. Find the distribution of the three possible genotypes in the population after any number of generations. Will this breeding plan be successful?

1.2 Game Theory

1. In class you simulated a two person game with the following payoff matrix:

$$A = \begin{bmatrix} 1 & 4 \\ 0 & 2 \end{bmatrix}$$

- Remember that you choose somebody to be player “R” and player “C”. In the first scenario your strategy vector is the proportion of cards in your hand. If you have 4 cards, 2 of which are higher than the other, then your strategy vector is $[1/2 \ 1/2]^T$. Play the game many times, keeping track of how many points you receive on each play. After this is done, find the average payoff per play. Then recording your opponents strategy vector, calculate the expected payoff per play from the payoff matrix ($q^T Ap$). Does the expected payoff match that of your average payoff?
2. For the second scenario, reshuffle all the cards. In addition to keeping track of how many points you accumulate, now you have the choice to play or not to play. (Both of you play simultaneously, so you do not have any prior knowledge about your opponent’s choice.) If you decide to play but your opponent does not, you will receive 5 points and your opponent will receive none (and vice versa). If *both* of you decide not to play, then no one receives any points. How does adding the decision to play or not play affect the number of points you accumulate? Repeat and reshuffle a few different times. How do the cards you have in your hand affect your decision to play or not to play? What are the connections of this simple game to the hawk-dove game presented in class?
 3. The federal government decides to vaccinate all of its citizens against anthrax. Anthrax comes in two strains, and the proportions of which the two strains occur in nature is not known. As a result, two vaccines have been developed. The first vaccine is 85% effective against the first anthrax strain and 70% effective against the second. On the other hand, the second vaccine is only 60% effective against the first strain and 90% effective against the second strain. What proportion of the population should be inoculated with vaccine 1 and what proportion should be inoculated with vaccine 2 to make the fraction of citizens resistant to the virus as large as possible?