# Math 1015: Homework #3

**Question 1.** Give an example demonstrating how the plurality system satisfies the monotonicity criterion. (Make up an example with As, Bs, Cs, etc, and show how boosting the winner makes the outcome stay the same.)

**Question 2.** Explain why the Condorcet method satisfies the Monotonicity criterion.

**Question 3.** Please explain in your own words why the monotonicity property is desirable in a real-world voting system. (You only need to write a few sentences at most.)

**Question 4.** Explain why dictatorship satisfies IIA.

**Question 5.** Please use this example election to show that plurality does not satisfy IIA:

| 4 | 3 | 3 | 2 |
|---|---|---|---|
| A | B | C | D |
| B | A | A | E |
| C | C | B | C |
| D | D | D | A |
| E | E | E | B |

(Show how somebody can change their vote in a certain way that has a certain effect.)

**Question 6.** Consider this election, using plurality:

| 2 | 4 | 3 |
|---|---|---|
| A | B | D |
| C | A | A |
| B | D | C |
| D | C | B |

a) Describe how the DACB voters can manipulate this election.

b) Explain why the ACBD voters cannot manipulate this election.

**Question 7.** Three of our concepts involve people changing their votes and having certain effects: monotonicity, IIA, and manipulability. Say a sentence or two about each one describing the difference between these 3 things.

**Question 8.** Find the results of this approval election:

| | 3 | 2 | 2 | 1 | 1 |
|---|---|---|---|---|---|
| A | X | | | X | X |
| B | X | X | | | X |
| C | | X | X | | |
| D | | X | X | | |

**Question 9.** Consider this election:

| 3 | 5 | 2 |
|---|---|---|
| A | B | D |
| C | A | A |
| B | D | C |
| D | C | B |

a) Let's imagine we run this election instead using approval voting, and assume that each voter will approve of their top two choices, but disapprove of their bottom two choices.

Make a chart (like in the previous question) that summarizes the approval ballots, and find the winner using approval voting.

b) For the same election, if we do the random dictator method, say what the probability is for each candidate to win. You answer should say something like: "A wins with probability ???%, B wins with probability ???%, etc."

**Question 10.** Invent and describe a situation where it might be a good idea to use the random dictator method, and also a situation where it would be a bad idea to use the random dictator method.

**Question 11.** In the weighted system $[12 : 8, 7, 1]$, explain why the 8 & 7 have the same amount of power even though 8 is more than 7.