

MA 111
Fall 2021
Exam 1A
9/17/2021

Full name: _____

Student ID number: _____

I want you to do your best on this exam, so I can see how much you've learned. Be sure to read each question carefully and write clearly. Show your work, and explain it where necessary, so you can earn partial credit even on questions where you make a mistake.

This exam contains 6 pages (including this cover page) and 19 questions. Please keep the pages stapled together. The total number of points is 80 and there are 8 bonus points available. You may use a calculator.

Good luck!

Consider the following election to answer questions 1 through 6.

12	18	16	6
Grease	Wicked	Grease	Hamilton
Cats	Hamilton	Hamilton	Cats
Hamilton	Cats	Cats	Wicked
Wicked	Grease	Wicked	Grease

1. (3 points) If we use the **Plurality Method** in this election, who is the winner?
2. (3 points) How many first-place votes does a candidate in this election need in order to be a **majority candidate**?
3. (3 points) Is there a majority candidate in this election? If so, who?
4. (8 points) Determine the number of Borda points each candidate would receive in a **Borda Count** election. Show your work to receive partial credit if you make a mistake.
 - (a) (2 points) Grease: _____
 - (b) (2 points) Cats: _____
 - (c) (2 points) Hamilton: _____
 - (d) (2 points) Wicked: _____
5. (3 points) Using your results from above, which candidate would win a **Borda Count** election?

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6. (5 points) Based on your results from the previous page, does this **Borda Count** election show a violation of the **Majority Criterion**? Explain why or why not.

 7. (5 points) In an election for best team mascot, Wildcats is the **majority candidate**. Which voting method(s) could we use to guarantee that Wildcats would win the election? List all that apply.

 8. (5 points) In an election for best ice cream flavor, **Borda count** method is used, and Salted Licorice wins. Avocado Tea then drops out of the election and is removed from all the ballots. If the results are re-calculated without Avocado Tea, can we guarantee that Salted Licorice will still be the winner of the new election? Explain your answer.

 9. (5 points) In an election for favorite coffee drink, Pumpkin Spice Latte wins all of its one-vs-one matchups, but Caramel Mocha wins the overall election. Based on the information here, does the voting method used in this election pass or fail the **Condorcet criterion**? Or is there not enough information to tell?

10. (5 points) In the election for King of Gondor, Aragorn wins. After the election, it's discovered that one of the losing candidates, Denethor, was ineligible to run, so he is removed from all ballots, and the results are re-calculated. Aragorn wins the election again. Based on the information here, does the voting method used in this election pass or fail the **IIA criterion**? Or is there not enough information to tell?

Consider the following election to answer questions 11 through 17.

23	16	11	8	8	4
Sue	Mary	Paul	Mel	Paul	Mel
Mary	Paul	Mary	Sue	Sue	Mary
Paul	Mel	Mel	Mary	Mel	Sue
Mel	Sue	Sue	Paul	Mary	Paul

11. (12 points) For each of the possible one-vs-one matchups in the above election, determine how many voters prefer each candidate. Then for each matchup, circle the name of the winner or write "tie" if the candidates tie.

Sue vs Mel

Sue vs Paul

Sue vs Mary

Mel vs Paul

Mel vs Mary

Paul vs Mary

12. (3 points) Which candidate(s) will win a **Pairwise Comparisons** election?
13. (3 points) Is there a **Condorcet candidate** in this election? If so, who?

23	16	11	8	8	4
Sue	Mary	Paul	Mel	Paul	Mel
Mary	Paul	Mary	Sue	Sue	Mary
Paul	Mel	Mel	Mary	Mel	Sue
Mel	Sue	Sue	Paul	Mary	Paul

14. (3 points) How many first-place votes does a **majority candidate** need in this election?
15. (6 points) If we use **Instant-Runoff Voting** in this election, how many candidates will need to be eliminated before a winner is determined? List the candidates in the order they're eliminated, and explain why each is eliminated. (Be careful not to eliminate more candidates than you need to.)
16. (3 points) If we use **Instant-Runoff Voting** in this election, who is the winner?
17. (5 points) Using your results from above and the previous page, does this **Instant-Runoff Voting** election show a violation of the **Condorcet Criterion**? Explain why or why not.

18. (5 points (bonus)) Reflect on your learning experiences for this unit. Your answer to this question should be several complete sentences. Some ideas to get you started: *What ideas challenged you the most and why? Where did you improve the most? What was the most interesting idea we talked about? Why are these ideas important or useful? Are there any of these ideas you would like to explore further?* You should answer at least one but not all of these questions.
19. (3 points (bonus)) Attach your 'cheat sheet' for the exam.