1. Suppose this preference schedule gives the results of an election among 3 candidates, A, B, and C.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>22</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

a. Who wins using the Plurality method?

b. Does any candidate get a majority of the first place votes? If so, which one?

c. Who wins using Pairwise Comparisons?

d. Does any candidate beat every other candidate one-on-one? If so, which one?

e. Who wins using the Borda Count method?

f. Suppose candidate B drops out but the winner is still chosen using the Borda Count method. Is the winner the same as in ‘e’ above? If not, which candidate does win?

2. Suppose this preference schedule gives the results of an election among 3 candidates, A, B, and C.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>19</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

a. Who wins using Pairwise Comparisons?

b. Does any candidate beat every other candidate one-on-one? If so, which one?

c. Who wins using the Plurality method?

d. Suppose candidate C drops out but the winner is still chosen using the Plurality method. Is the winner the same as in ‘c’ above? If not, which candidate does win?

e. Who wins using the Plurality with Elimination method (Hare system)? (Candidate C is back in now.)

f. Now suppose candidate A drops out but the winner is still chosen using the Plurality with Elimination method. Is the winner the same as in ‘e’ above? If not, which candidate does win?
3. Suppose this preference schedule gives the results of an election among 4 candidates, A, B, C, and D.

<table>
<thead>
<tr>
<th>14</th>
<th>4</th>
<th>10</th>
<th>1</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>B</td>
<td>D</td>
<td>B</td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
<td>D</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>D</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

a. Who wins using the Plurality with Elimination method (Hare system)?

b. Who wins using Pairwise Comparisons?

c. Does any candidate beat every other candidate one-on-one? If so, which one?

4. Suppose this preference schedule gives the results of an election among 3 candidates: A, B, and C.

<table>
<thead>
<tr>
<th>7</th>
<th>8</th>
<th>10</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>B</td>
<td>C</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

a. Who wins using Plurality with Elimination (Hare system)?

b. Suppose the election is invalid for some reason and everyone must revote. As it happens, everyone votes exactly as before except the 4 voters in the last column above. These 4 voters who originally voted A,C,B decide to switch the order of their votes for A & C so that their new preference ballots are C,A,B. Who wins this new election using Plurality with Elimination?

5. Suppose this preference schedule gives the results of an election among 3 candidates.

<table>
<thead>
<tr>
<th>20</th>
<th>19</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>B</td>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

a. Who wins using the Plurality with Elimination method?

b. Suppose candidate A drops out but the winner is still chosen using Plurality with Elimination. Is the winner the same as in ‘a’ above? If not, which candidate does win?
**The Majority Criterion**
Any candidate receiving a majority of first place votes should be the winner.

**The Condorcet Criterion**
A candidate who wins head-to-head matchups with all other candidates should be the winner.

**The Monotonicity Criterion**
If an election is held and a winner is declared, this winning candidate should remain the winner in any revote in which all preference changes are in favor of the winner of the original election.

**The Independence of Irrelevant Alternatives Criterion**
If an election is held and a winner is declared, this winning candidate should remain the winner in any recalculation of votes as a result of one or more of the losing candidates dropping out.

**PART II: Carefully EXPLAIN each of the answers you give below.**

7. One exercise from PART I illustrates a violation of the Majority Criterion. Which one & why?

8. Three exercises from PART I illustrate a violation of the Condorcet Criterion. Which ones & why?

9. One exercise from PART I illustrates a violation of the Monotonicity Criterion. Which one & why?

10. Two exercises from PART I illustrate a violation of the Irrelevant Alternatives Criterion. Which & why?
Answers: Fairness Criteria Exercises

1a. candidate A

1b. Yes, candidate A
1c. candidate A
1d. Yes, candidate A
1e. candidate C
1f. No, candidate A
2a. candidate B
2b. Yes, candidate B
2c. candidate A
2d. No, candidate B
2e. candidate B
2f. Yes

3a. candidate D
3b. candidate C
3c. Yes, candidate C
4a. candidate C
4b. candidate B
5a. candidate B
5b. Yes
6a. candidate A
6b. No, candidate B

7. In ‘1e’ above, candidate C wins the election (under Borda Count) but candidate A has a majority of the first place votes. THIS VIOLATES THE MAJORITY CRITERION.

8. 1st Violation: In ‘1e’ above, candidate C wins the election (under Borda Count) but candidate A wins all the one-on-one matchups with the other candidates. THIS VIOLATES THE CONDORCET CRITERION.
2nd Violation: In ‘2c’ above, candidate A wins the election (under Plurality) but candidate B wins all the one-on-one matchups with the other candidates. THIS VIOLATES THE CONDORCET CRITERION.
3rd Violation: In ‘3a’ above, candidate D wins the election (under Plurality with Elimination) but candidate C wins all the one-on-one matchups with the other candidates. THIS VIOLATES THE CONDORCET CRITERION.

9. In ‘4a’ above, candidate C wins the election (under Plurality with Elimination). After a revote in which all vote changes were favorable to candidate C, candidate C loses the election to candidate B. THIS VIOLATES THE MONOTONICITY CRITERION.

10. 1st Violation: In ‘1e’ above, candidate C wins the election (under Borda Count). However, one of the losers (candidate B) dropping out, causes candidate C to lose to candidate A. THIS VIOLATES THE IRRELEVANT ALTERNATIVES CRITERION.
2nd Violation: In ‘2c’ above, candidate A wins the election (under Plurality). However, one of the losers (candidate C) dropping out, causes candidate A to lose to candidate B. THIS VIOLATES THE IRRELEVANT ALTERNATIVES CRITERION.