

## Chapter 1 – Test 1

Name: \_\_\_\_\_

Date: \_\_\_\_\_

1. Your college radio station is holding auditions to find the next *Campus Idol*. There are four people competing in the auditions: Beth (B), Frank (F), Helen (H), and Sam (S). After all of the competitors have auditioned, the audience members rank each contestant in order of preference and submit their ballots. The results are given below.

Number of Voters	25	20	10	30	10
1 <sup>st</sup> choice	F	B	H	S	S
2 <sup>nd</sup> choice	S	H	F	F	H
3 <sup>rd</sup> choice	H	F	S	B	B
4 <sup>th</sup> choice	B	S	B	H	F

How many preference ballots were cast in this competition?

Answer: \_\_\_\_\_

2. According to the preference schedule from problem 1, who would be the next *Campus Idol* if the **Borda Count Method** was used to choose the winner?

Answer: \_\_\_\_\_

3. According to the preference schedule from problem 1, who would be the next *Campus Idol* if the **Method of Pairwise Comparisons** was used to choose the winner?

Answer: \_\_\_\_\_

4. According to the preference schedule from problem 1, Sam would be voted the next *Campus Idol* using the **Plurality Method**. Would this result be a violation of the **Condorcet Criterion**? Explain.

Answer: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. There are 280 voting members in your school's faculty union. Resort Alpha (A), Resort Beta (B), Resort Gamma (G) and Resort Delta (D) are the four possible resorts at which the union could hold its annual meeting. Each faculty member ranks the four resorts, and the **Method of Plurality** is being used to determine which resort will be chosen. Suppose that 30% of all members vote for Resort Alpha (A) as their 1<sup>st</sup> choice. Assuming that all 280 members vote, then what is the smallest number of the remaining 1<sup>st</sup> choice votes needed in order to guarantee that Resort Beta (B) is the winner?

Answer: \_\_\_\_\_

# Chapter 1 – Test 1

Name: \_\_\_\_\_

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6. Since 2011, a total of 68 college basketball teams qualify for the NCAA March Madness Tournament. These teams play each other in a series of games in a bracket style competition resulting in a total of 67 games. However, suppose that each team was required to play one game against everyone other participating team in a round-robin style tournament. How many games would this entail?

Answer: \_\_\_\_\_

7. A new president is being chosen by your college's Math Club. The candidates are Alex (A), Betsy (B), Charlie (C), and Dana (D). The 27 members of the Math Club rank each candidate in order of preference and the results are tabulated below. Who would be chosen as the president of the Math Club using the **Plurality with Elimination Method**?

Number of Voters	10	6	5	4	2
1 <sup>st</sup> choice	A	B	C	D	D
2 <sup>nd</sup> choice	C	D	B	C	A
3 <sup>rd</sup> choice	D	C	D	B	B
4 <sup>th</sup> choice	B	A	A	A	C

Answer: \_\_\_\_\_

8. Use the scenario and preference schedule from problem 7. Suppose that Dana is asked to be president of the Latin Club and has to withdraw from the race before the results are made public. Realign the preference table by removing D and shifting all of the votes up one slot. Now who would be chosen as the president of the Math Club using the **Plurality with Elimination Method**?

Answer: \_\_\_\_\_

9. Which **Fairness Criterion** is being violated by the actions shown in problems 7 and 8?

Answer: \_\_\_\_\_

10. Find the smallest value of  $X$  so that a violation of the **Condorcet Criterion** occurs using the **Plurality Method**. **Hint:**  $B$  will be the winner using *Plurality* and  $C$  will be *Condorcet*.

Number of Voters	2	10	6	12	4	$X$
1 <sup>st</sup> choice	A	A	B	B	C	C
2 <sup>nd</sup> choice	B	C	A	C	A	B
3 <sup>rd</sup> choice	C	B	C	A	B	A

Answer: \_\_\_\_\_

# Chapter 1 – Test 2

Name: \_\_\_\_\_

Date: \_\_\_\_\_

1. Five students are taking part in the *Campus Talent Show*. Each of the five students will perform their talent in front of an audience and once all the performers have finished the audience members will rank each participant in order of preference. The candidate who has the highest ranking will move on to the national competition. The final preference schedule is given below.

Number of Voters	8	5	3	2	7	9
1 <sup>st</sup> choice	Joe	Sam	Peg	Lea	Lea	Peg
2 <sup>nd</sup> choice	Lea	Joe	Joe	Peg	Sam	Lea
3 <sup>rd</sup> choice	Sam	Val	Val	Sam	Val	Sam
4 <sup>th</sup> choice	Val	Lea	Sam	Val	Peg	Val
5 <sup>th</sup> choice	Peg	Peg	Lea	Joe	Joe	Joe

Rank the five students using the **Borda Count Method**.

Answer: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

2. According to the preference schedule from problem 1, rank the five students using the **Plurality Method**.

Answer: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

3. According to the preference schedule from problem 1, rank the five students using the **Method of Pairwise Comparisons**.

Answer: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

4. According to the preference schedule from problem 1, rank the five students using the **Plurality with Elimination Method**.

Answer: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

5. According to the preference schedule from problem 1, which candidate, if any, will receive a **majority** of 5<sup>th</sup> choice votes?

Answer: \_\_\_\_\_

6. The Student Government at your college consists of 184 voting members. A motion regarding funding for a new club activity is brought to the floor. The four possible activities for which a member could vote are the Karaoke Club (K), Hiking Club (H), Jousting Club (J) and Dog-Lovers Club (D). If the Karaoke Club (K) receives a total of 48 votes, then what is the **minimum number** of votes needed by one of the remaining clubs to ensure that **no club** can receive a majority of all votes?

Answer: \_\_\_\_\_

# Chapter 1 – Test 2

Name: \_\_\_\_\_

Date: \_\_\_\_\_

7. The Board of Trustees at your college is holding elections to determine which candidate from the faculty will be chosen to head up the new *Committee on Voting Standards*. The choices are Dr. Abel, Dr. Barnes, Dr. Corza, and Dr. Davis or A, B, C, and D, respectively. The trustees have ranked the candidates from their first choice to their fourth choice, and the results are given below in the preference table.

Number of Voters	10	6	5	4	2
1 <sup>st</sup> choice	A	B	C	D	D
2 <sup>nd</sup> choice	C	D	B	C	A
3 <sup>rd</sup> choice	D	C	D	B	B
4 <sup>th</sup> choice	B	A	A	A	C

Who will be chosen as the candidate to head up the *Committee on Voting Standards* if the trustees use the **Plurality with Elimination Method**?

Answer: \_\_\_\_\_

8. Use the scenario and preference schedule from problem 7. Suppose that Dr. Davis (D) has to withdraw her name from consideration. Remove D from the preference table and shift all votes up one slot. Who will be chosen as the candidate to head up the *Committee on Voting Standards*, if the trustees use the **Plurality with Elimination Method** with the new preference table?

Answer: \_\_\_\_\_

9. Which **Fairness Criterion** is being violated by the actions shown in problems 7 and 8?

Answer: \_\_\_\_\_

10. Which of the four Voting Methods (**Plurality**, **Borda Count**, **Plurality with Elimination** or **Pairwise Comparison**) will **never** violate the Majority Criterion **and** the Condorcet Criterion?

Answer: \_\_\_\_\_

# Chapter 1 – Test 3

Name: \_\_\_\_\_

Date: \_\_\_\_\_

1. An election consists of four candidates A, B, C, and D. The candidates are ranked in order of preference by each of the voters. The preference schedule for this election is given below.

Number of Voters	27	19	8	15	2
1 <sup>st</sup> choice	B	A	D	C	A
2 <sup>nd</sup> choice	D	D	C	A	C
3 <sup>rd</sup> choice	A	C	A	D	D
4 <sup>th</sup> choice	C	B	B	B	B

- How many votes are required in order to obtain a **majority** of votes?
- (a) 18  
(b) 27  
(c) 36  
(d) 71  
(e) None of the above.
2. According to the preference schedule from problem 1, who is the winner of the election using the **Plurality Method**?
- (a) A  
(b) B  
(c) C  
(d) D  
(e) There is a tie.
3. According to the preference schedule from problem 1, who is the winner of the election using the **Borda Count Method**?
- (a) A  
(b) B  
(c) C  
(d) D  
(e) There is a tie.
4. Using the preference schedule from problem 1, who is the winner of the election using the **Plurality with Elimination Method**?
- (a) A  
(b) B  
(c) C  
(d) D  
(e) There is a tie.
5. Using the preference schedule from problem 1, who is the winner of the election using the **Method of Pairwise Comparisons**?
- (a) A  
(b) B  
(c) C  
(d) D  
(e) There is a tie.

# Chapter 1 – Test 3

Name: \_\_\_\_\_

Date: \_\_\_\_\_

6. An election with four candidates (A, B, C, and D) and 150 voters will use the **Plurality Method** to choose a winner. After 120 ballots have been recorded A has 26 1<sup>st</sup> choice votes, B has 18 1<sup>st</sup> choice votes, C has 42 1<sup>st</sup> choice votes, and D has 34 1<sup>st</sup> choice votes. What is the smallest number of the remaining 30 1<sup>st</sup> choice votes that A must receive in order to guarantee a win?
- (a) 17  
 (b) 24  
 (c) 27  
 (d) 30  
 (e) None of the above.
7. The **Plurality with Elimination** method can possibly violate which of the **Fairness Criteria**?
- (a) Condorcet Criterion  
 (b) Monotonicity Criterion  
 (c) Independence of Irrelevant Alternatives Criterion  
 (d) Majority Criterion  
 (e) (a), (b) and (c)
8. As of 2012, there are 435 voting members in the US House of Representatives. At the opening session of the House, it is customary to have each Representative shake hands once with every other Representative. How many handshakes would this account for in 2012?
- (a) 870  
 (b) 94395  
 (c) 94830  
 (d) 189225  
 (e) None of the above.
9. Using the **Plurality with Elimination Method**, rank the contestants from the following election.

Number of Voters	15	11	9	6	2
1 <sup>st</sup> choice	Ali	Cat	Deb	Ali	Cat
2 <sup>nd</sup> choice	Bob	Bob	Ali	Cat	Deb
3 <sup>rd</sup> choice	Cat	Deb	Bob	Deb	Bob
4 <sup>th</sup> choice	Deb	Ali	Cat	Bob	Ali

- (a) Ali 1<sup>st</sup>, Cat 2<sup>nd</sup>, Bob 3<sup>rd</sup>, Deb 4<sup>th</sup>  
 (b) Ali 1<sup>st</sup>, Bob 2<sup>nd</sup>, Cat 3<sup>rd</sup>, Deb 4<sup>th</sup>  
 (c) Ali 1<sup>st</sup>, Cat 2<sup>nd</sup>, Deb 3<sup>rd</sup>, Bob 4<sup>th</sup>  
 (d) Ali 1<sup>st</sup>, Deb 2<sup>nd</sup>, Cat 3<sup>rd</sup>, Bob 4<sup>th</sup>  
 (e) None of the above.
10. According to the preference schedule from problem 9, who is ranked second using the **Borda Count Method**?
- (a) Ali  
 (b) Bob  
 (c) Cat  
 (d) Deb  
 (e) None of the above.

# Chapter 1 – Test 4

Name: \_\_\_\_\_

Date: \_\_\_\_\_

1. An election consists of four candidates A, B, C, and D. The candidates are ranked in order of preference by each of the voters. The preference schedule for this election is given below.

Number of Voters	12	13	17	16	21
1 <sup>st</sup> choice	B	A	D	C	A
2 <sup>nd</sup> choice	D	B	C	D	C
3 <sup>rd</sup> choice	A	C	B	B	D
4 <sup>th</sup> choice	C	D	A	A	B

Which candidate, if any, received a *majority* of 1<sup>st</sup> choice votes?

- (a) A
  - (b) B
  - (c) C
  - (d) D
  - (e) None of the above.
2. According to the preference schedule from problem 1, who is the winner of the election using the **Plurality Method**?
- (a) A
  - (b) B
  - (c) C
  - (d) D
  - (e) There is a tie.
3. According to the preference schedule from problem 1, who is the winner of the election using the **Borda Count Method**?
- (a) A
  - (b) B
  - (c) C
  - (d) D
  - (e) There is a tie.
4. According to the preference schedule from problem 1, who is the winner of the election using the **Plurality with Elimination Method**?
- (a) A
  - (b) B
  - (c) C
  - (d) D
  - (e) There is a tie.
5. According to the preference schedule from problem 1, who is the winner of the election using the **Method of Pairwise Comparisons**?
- (a) A
  - (b) B
  - (c) C
  - (d) D
  - (e) There is a tie.

# Chapter 1 – Test 4

Name: \_\_\_\_\_

Date: \_\_\_\_\_

6. An election is held among five candidates (A, B, C, D, and E). There are 37 voters. Using the **Method of Pairwise Comparisons** it is found that A, B, and C each win two pairwise comparison while D wins three. If E wins the remaining comparisons in this election, then which statement is true?

- (a) D is the *Condorcet candidate*.
- (b) E is the *Condorcet candidate*.
- (c) D has a Majority of 1<sup>st</sup> Choice Votes.
- (d) E has a Majority of 1<sup>st</sup> Choice Votes.
- (e) None of the above is true.

7. An election with four candidates (A, B, C, and D) and 180 voters will use the **Plurality Method** to choose a winner. After 120 ballots have been recorded, A has 26 1<sup>st</sup> choice votes, B has 18 1<sup>st</sup> choice votes, C has 42 1<sup>st</sup> choice votes, and D has 34 1<sup>st</sup> choice votes. What is the **minimum number** of the remaining 60 1<sup>st</sup> choice votes that A must receive in order to guarantee that **no candidate will receive** a majority of 1<sup>st</sup> choice votes?

- (a) 12
- (b) 15
- (c) 16
- (d) 24
- (e) None of the above.

8. Using the **Borda Count Method**, rank the contestants from the following election.

Number of Voters	13	11	9	7	8
1 <sup>st</sup> choice	Ali	Cat	Deb	Ali	Cat
2 <sup>nd</sup> choice	Bob	Bob	Ali	Deb	Deb
3 <sup>rd</sup> choice	Cat	Deb	Bob	Cat	Bob
4 <sup>th</sup> choice	Deb	Ali	Cat	Bob	Ali

- (a) Ali 1<sup>st</sup>, Deb 2<sup>nd</sup>, Cat 3<sup>rd</sup>, Bob 4<sup>th</sup>
- (b) Cat 1<sup>st</sup>, Ali 2<sup>nd</sup>, Deb 3<sup>rd</sup>, Bob 4<sup>th</sup>
- (c) Ali 1<sup>st</sup>, Cat 2<sup>nd</sup>, Deb 3<sup>rd</sup>, Bob 4<sup>th</sup>
- (d) Deb 1<sup>st</sup>, Bob 2<sup>nd</sup>, Ali 3<sup>rd</sup>, Cat 4<sup>th</sup>
- (e) None of the above.

9. According to the preference schedule from problem 9, if Cat drops out of the race and all votes shift up one slot, then who will win the race using the **Borda Count Method**?

- (a) Ali
- (b) Bob
- (c) Cat
- (d) Deb
- (e) None of the above.

10. The situations from problems (9) and (10) show an example of which of the Fairness Criterion being violated?

- (a) Majority Criterion
- (b) Condorcet Criterion
- (c) Monotonicity Criterion
- (d) Independence of Irrelevant Alternatives Criterion
- (e) There is no criterion being violated.



## CHAPTER 1

### Test 4

#### Test 1

- |   |       |
|---|-------|
| 1. 95   | 1. E  |
| 2. Sam or S   | 2. A  |
| 3. Frank or F   | 3. C  |
| 4. Yes, because Frank is the Condorcet candidate and thus should be the winner. | 4. D  |
| 5. 99   | 5. E  |
| 6. 2278   | 6. B  |
| 7. Betsey or B  | 7. A  |
| 8. Charlie or C   | 8. C  |
| 9. Independence of Alternatives Criterion Irrelevant                            | 9. D  |
| 10. 7   | 10. D |

#### Test 2

1. Lea 1<sup>st</sup>, Sam 2<sup>nd</sup>, Peg 3<sup>rd</sup>, Joe 4<sup>th</sup>, Val 5<sup>th</sup>
2. Peg 1<sup>st</sup>, Lea 2<sup>nd</sup>, Joe 3<sup>rd</sup>, Sam 4<sup>th</sup>, Val 5<sup>th</sup>
3. Lea 1<sup>st</sup>, Sam 2<sup>nd</sup>, Val 3<sup>rd</sup>, Peg 4<sup>th</sup>, Joe 5<sup>th</sup>
4. Peg 1<sup>st</sup>, Joe 2<sup>nd</sup>, Lea 3<sup>rd</sup>, Sam 4<sup>th</sup>, Val 5<sup>th</sup>
5. Joe
6. 92
7. 45
8. Dr. Corza or C
9. Independence of Alternatives Criterion Irrelevant
10. Pairwise Comparison

#### Test 3

1. C
2. B
3. D
4. C
5. A
6. B
7. E
8. B
9. C
10. C