

Chapter 1

An election at school is being held to determine the next senior class president. The preference schedule is provided below.

Number of Voters	18	20	10	3
1 st Choice	C	D	A	B
2 nd Choice	E	A	B	C
3 rd Choice	A	B	D	D
4 th Choice	B	E	C	E
5 th Choice	D	C	E	A

Total = 51
majority = 26

- Determine the winner using the Plurality Method.
 (A) (B) (C) (D) (E)
- Totals are given for candidates A, B, D, and E. Complete the Borda Method for B. Determine the winner. {A = 187, C = 142, D = 157, E = 128}

(A) (B) (C) (D) (E)

- Determine the winner using the Plurality with Elimination Method.

(A) (B) (C) (D) (E)

- Complete the table. Determine the winner using the Pairwise Comparison Method.

	A	B	C	D	E	Points
A	X	W	W	W	W	4
B	L	X	W	W	W	3
C	L	L	X	L	W	1
D	L	L	W	X	L	1
E	L	L	L	L	X	0

A vs. B: 48-3 (A)
 A vs. C: 30-21 (A)
 A vs. D: 28-23 (A)
 A vs. E: 30-21 (A)
 B vs. C: 33-18 (B)
 B vs. D: 31-20 (B)
 B vs. E: 33-18 (B)
 C vs. D: 21-20 (C) C vs. E: 31-20 (C)

(A) (B) (C) (D) (E)

- If E is eliminated, what is the new preference schedule?

Number of Voters	18	20	10	3
1 st Choice	C	D	A	B
2 nd Choice	A	A	B	C
3 rd Choice	B	B	D	D
4 th Choice	D	C	C	A

- If candidate X wins the initial election, but does not win the re-election even though they receive more votes, which method is violated?

(A) Majority (B) Condorcet (C) Monotonicity (D) Independent of Irrelevant Alternatives

7. If candidate C receives 84 of the 100 votes, but does not win the election, which method is violated?
 Majority Condorcet Monotonicity Independent of Irrelevant Alternatives
8. If candidate B is ranked higher than candidate A, C, and D, but does not win the election, which method is violated?
 Majority Condorcet Monotonicity Independent of Irrelevant Alternatives
9. If candidate X wins the initial election, but does not win the re-election when candidate Y drops out, which method is violated?
 Majority Condorcet Monotonicity Independent of Irrelevant Alternatives

Chapter 2

Weighted Voting System: [11: 18, 10, 2]

10. Listed are all the Banzhaf coalitions. Circle the winning coalitions.

{18} {10} {2} {18, 10} {18, 2} {10, 2} {18, 10, 2}

11. Determine the Banzhaf power distribution in percent.

Quota = 11	$P_1 = 18$	$P_2 = 10$	$P_3 = 2$	
{18}	✓			
{18, 10}	✓			
{18, 2}	✓			
{10, 2}		✓	✓	
{18, 10, 2}				
Critical #:	3	1	1	= 5
Power Distribution	60%	20%	20%	

12. Determine the Shapley-Shubik power distribution in percent.

Quota = 11	$P_1 = 18$	$P_2 = 10$	$P_3 = 2$
{18, 10, 2}	✓		
{18, 2, 10}	✓		
{10, 18, 2}	✓		
{10, 2, 18}			✓
{2, 18, 10}	✓		
{2, 10, 18}		✓	
Power Distribution	66.7%	16.7%	16.7%

13. Which weighted voting system will produce a dictator? Select all that apply.
 [15: 23, 18, 9] [23: 23, 18, 9] [39: 23, 18, 9] [44: 23, 18, 9] None

14. Which weighted voting system will produce a dummy? Select all that apply.
 [15: 23, 18, 9] [23: 23, 18, 9] [39: 23, 18, 9] [44: 23, 18, 9] None
15. Which weighted voting system will give any player veto power? Select all that apply.
 [15: 23, 18, 9] [23: 23, 18, 9] [39: 23, 18, 9] [44: 23, 18, 9] None

Chapter 3

Abraham, Benjamin, and Caleb are sharing a round half vanilla-half chocolate cake. The following table gives the value of each slice in the eyes of each of the players.

	Abraham	Benjamin	Caleb
Vanilla	21	23	30
Chocolate	16	26	25

16. Determine the fair share of each player.

- | | Abraham | Benjamin | Caleb |
|--------------------------------------|-------------------|-------------------|-------------------|
| <input type="radio"/> (A) | $33\frac{1}{3}\%$ | $33\frac{1}{3}\%$ | $33\frac{1}{3}\%$ |
| <input type="radio"/> (B) | \$37 | \$49 | \$55 |
| <input type="radio"/> (C) | \$18.50 | \$24.50 | \$27.50 |
| <input checked="" type="radio"/> (D) | \$12.33 | \$16.33 | \$18.33 |

17. Using the lone-divider method, Abraham cuts up the cake into three equal fair shares. What are the shares?

- | | s_1 | s_2 | s_3 |
|--------------------------------------|----------------|--------------------------------|-------------------------------|
| <input type="radio"/> (A) | 120° vanilla | 120° chocolate | 60° vanilla and 60° chocolate |
| <input type="radio"/> (B) | 139° chocolate | 106° vanilla | 41° vanilla and 74° chocolate |
| <input checked="" type="radio"/> (C) | 106° vanilla | 139° chocolate | 74° vanilla and 41° chocolate |
| <input type="radio"/> (D) | 159° vanilla | 21° vanilla and 180° chocolate | |

18. Following problem #17, what would be each person's bid given their values of the shares?

Share	Abraham	Benjamin	Caleb
s_1	12.33	13.54	17.67
s_2	12.33	20.08	19.31
s_3	12.33	15.38	18.02

	Abraham	Benjamin	Caleb
(A)	s_1, s_2, s_3	s_1, s_2	s_2
(B)	s_1, s_2, s_3	s_2	s_2, s_3
(C)	s_3	s_2	s_1, s_2, s_3
<input checked="" type="radio"/>	s_1, s_2, s_3	s_2	s_2

19. If Abraham, Benjamin, and Caleb bid as shown in the table, what is one possible fair division?

	Abraham	Benjamin	Caleb
Bids	s_2, s_3	s_1, s_2, s_3	s_1, s_3

	Abraham	Benjamin	Caleb
(A)	s_1	s_2	s_3
<input checked="" type="radio"/>	s_2	s_1	s_3
(C)	s_3	s_1	s_2
(D)	s_3	s_2	s_3

20. Using the lone-chooser method, if Abraham divides first, how would he divide the cake?

<input checked="" type="radio"/>	$s_1 = 159^\circ$ vanilla	$s_2 = 21^\circ$ vanilla and 180° chocolate	$s_3 = 74^\circ$ vanilla and 41° chocolate
(B)	$s_1 = 106^\circ$ vanilla	$s_2 = 139^\circ$ chocolate	$s_3 = 60^\circ$ vanilla and 60° chocolate
(C)	$s_1 = 120^\circ$ vanilla	$s_2 = 120^\circ$ chocolate	
(D)	$s_1 = 180^\circ$ vanilla	$s_2 = 180^\circ$ chocolate	

21. Following problem #20, if Benjamin were to divide next, which share would he choose?

21° vanilla + 180° chocolate

22. Using the last diminisher method, where the order of play is Abraham, Benjamin, and Caleb, and Abraham starts with 180° of vanilla; who would diminish at the end of Round 1 and what is their share?

- | | Abraham | Benjamin | Caleb |
|----------------------------------|--------------|--------------|--------------|
| (A) | | 128° vanilla | |
| (B) | 106° vanilla | | |
| <input checked="" type="radio"/> | | | 110° vanilla |
| (D) | | 88° vanilla | |

23. Following problem #22, what would the fair shares be for the two remaining players?

- | | Abraham | Benjamin | Caleb |
|----------------------------------|---------|----------|---------|
| (A) | \$11.03 | | \$16.83 |
| (B) | | \$17.73 | \$18.67 |
| <input checked="" type="radio"/> | \$12.08 | \$17.47 | |
| (D) | \$13.37 | | \$20.17 |

24. Using the method of sealed bids, what is the first settlement (without surplus) given the table below?

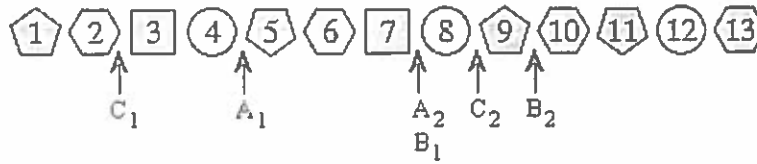
	Abraham	Benjamin	Caleb
Blue Ray player	<u>100</u>	90	75
MP3 player	55	75	<u>80</u>
Cell Phone	45	55	<u>65</u>
Fair Share	\$66.67	\$73.33	\$73.33

- | | Abraham | Benjamin | Caleb |
|----------------------------------|-------------------------------|-------------------------------|--------------------------------------|
| (A) | Gets \$66.67 | Blue Ray player, Pays \$16.67 | MP3 player, Pays \$6.67 |
| (B) | Pays \$61.67 | Blue Ray player Gets \$16.67 | MP3 player, Gets \$6.67 |
| <input checked="" type="radio"/> | Blue Ray player, Pays \$33.33 | Gets \$73.33 | MP3 player, Cell Phone, Pays \$71.67 |
| (D) | Blue Ray player, Pays \$33.33 | MP3 player, Pays \$1.67 | Cell Phone, Gets \$8.33 |

25. Following problem #24, what is the total surplus (before each person receives part)?

- (A) -43.33 (B) 38.33 31.67 (D) 26.67

26. Using the method of markers, what is the initial allocation (without surplus) given the information below?



	A	B	C
Ⓐ	3, 4, 5, 6, 7	8, 9, 10, 11, 12, 13	1, 2
●	5, 6, 7	10, 11, 12, 13	1, 2
Ⓒ	1, 2, 3, 4	5, 6, 7, 8, 9	10, 11, 12, 13
Ⓓ	8, 9, 10, 11, 12, 13	5, 6, 7	1, 2

Chapter 4

The convenience store down the street is under new management. The manager is making the work schedule for the 20 employees.

Shift	Morning	Afternoon	Night	Total:
Number of Customers	280	360	245	885

SD: 44.25

27. Apportion the shifts using the Webster Method.

	Morning	Afternoon	Night
Ⓐ	6	8	5
●	6	8	6
Ⓒ	7	9	6
Ⓓ	7	8	5

28. If the initial standard quota for the afternoon shift is approximately 10.12. What does this represent?

- Ⓐ The number of seats needed for the standard divisor.
- The number of employees needed during a shift.
- Ⓒ The number of customers during a shift needed to have one employee.
- Ⓓ The total number of employees divided by the number of seats.

29. Using the Hamilton Method, we get the following standard quotas in the table. What is the apportionment?

Shift	Morning	Afternoon	Night
Standard Quota	6.33	8.14	5.54

- $\frac{6}{6}$
 $\frac{8}{8}$
 $\frac{5}{6}$
 $\frac{8}{6}$
 $\frac{19}{6}$
- | | Morning | Afternoon | Night |
|----------------------------------|---------|-----------|-------|
| (A) | 6 | 8 | 5 |
| <input checked="" type="radio"/> | 6 | 8 | 6 |
| (C) | 7 | 9 | 6 |
| (D) | 7 | 8 | 5 |

30. Using the Jefferson's Method, what are the initial modified quotas? What should be adjusted?

Shift	Morning	Afternoon	Night
Quota	$\frac{6}{6}$	$\frac{8}{8}$	$\frac{6}{6}$

$D: 40.5$

- (A) Raise the divisor
- Lower the divisor
- (C) Round quotas conventionally

31. Using the Adam's Method, what are the initial modified quotas? What should be adjusted?

Shift	Morning	Afternoon	Night
Quota	$\frac{280}{6}$	$\frac{300}{8}$	$\frac{245}{6}$

$D: 48$

- Raise the divisor
- (B) Lower the divisor
- (C) Round quotas conventionally

32. Given the following table, what is the total number of customers if there are 30 employees? Round to the nearest whole number.

Shift	Morning	Afternoon	Night
Standard Quota	10.31	15.98	13.65

- (A) 40
- (B) 30
- 1198
- (D) 1200

