

Midterm I
Math 116
Summer 2004
July 9, 2004

Show all your work. Correct answers without adequate supporting work will receive little or no credit.

- 1.) Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$ be the universal set and define $A = \{1, 4, 7, 10, 11\}$, $B = \{2, 3, 4, 8, 9, 10\}$, and $C = \{3, 6, 7, 8, 11, 12\}$. Find the following sets:

a.) $A \cap B$

b.) $B^c \cap C$

c.) $(A \cap B) \cup (A^c \cap C)$

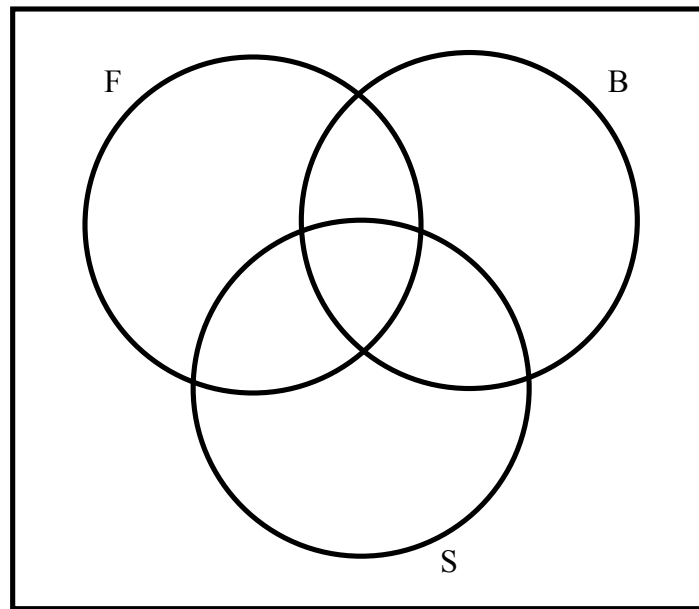
2.) A certain school has three sports teams: Football, Baseball, and Soccer.

Tim, Mike, Seth, and Chris are on the Football team.

Chris, Liz, Matt, and Seth are on the Baseball team.

Lastly, Anthony, Matt, Mike, Liz and Chris are on the Soccer team.

a.) Fill in the Venn Diagram below, where F, B, and S stand for Football, Baseball, and Soccer, respectively.



b.) If Jake wants to join a team but hates Matt, which team should Jake join?

c.) If the entire baseball team has a tournament in another town this weekend, which players from the football team will have to miss practice?

BONUS (3 points): Using set notation (i.e. $A \cap D$), which set represents the answer to part c.)?

3.) Below is a preference schedule for an election with four candidates A, B, C, and D.

	10	7	5	1
1st	A	D	B	D
2nd	B	C	D	B
3rd	C	B	A	C
4th	D	A	C	A

a.) Determine the winning candidate using the Plurality Method.

b.) Determine the winning candidate using the Borda Count Method.

4.) Below is a preference schedule for an election with four candidates A, B, C, and D.

	6	7	2	5	4
1 st	C	A	B	C	D
2 nd	D	B	A	B	B
3 rd	B	D	C	D	A
4 th	A	C	D	A	C

- a.) How many people voted in the election?
- b.) Determine the winning candidate using the Plurality with Elimination (Instant Runoff) Method.
- c.) Determine the winning candidate using the Pairwise Comparison Method.
- d.) What criterion (or criteria) is (or are) violated in part b.)? (Circle one).

Majority Criterion *Condorcet Criterion*

Neither of the Above *Both of the Above*

5.)

a.) Which Apportionment Method(s) can violate the Quota Rule?

b.) Which Apportionment Method(s) can never violate the Quota Rule?

- 6.) The architecture department at OSU is made up of three divisions: architecture, city and regional planning, and landscape architecture. The department has enough money in its budget to support 30 faculty members and they decide to apportion the faculty positions to the different divisions based on the number of students in each division; these numbers are given in the table below. Use Hamilton's Method to decide how many faculty members each division will be assigned.

M = 30 faculty Standard Divisor = _____

	Architecture	City and Regional	Landscape Architecture	Total
Enrollment	220	815	465	1500
Standard Quota				
Apportionment				

Now, the department gets a late donation from a rich alumnus and they decide to add another faculty member. Find the new apportionment of 31 faculty members, again using Hamilton's Method.

M = 31 faculty Standard Divisor = _____

	Architecture	City and Regional	Landscape Architecture	Total
Enrollment	220	815	465	1500
Standard Quota				
Apportionment				

This problem is an example of what kind of paradox? Briefly explain why.

- 7.) The Republic of Tropicana is a small country consisting of five states (A, B, C, D and E). The total population of Tropicana is 23.8 million. According to the Tropicana constitution, the 119 seats in the legislature are apportioned to the states according to their populations, which are given below. Let $D_1 = 0.197$, $D_2 = 0.201$ and $D_3 = 0.205$. Use one of these modified divisors to determine the apportionment of the seats under Webster's Method. (Note: One of these modified divisors will work, and the other two will not.)

Webster's Method:

(First Try)

$M = 119$ Seats
Modified Divisor = _____

State	A	B	C	D	E	Total
Population (in millions)	8.1	5.94	4.73	2.92	2.11	28.3
Modified Quota						
Apportionment Using Webster's						

(Second Try)

$M = 119$ Seats
Modified Divisor = _____

State	A	B	C	D	E	Total
Population (in millions)	8.1	5.94	4.73	2.92	2.11	28.3
Modified Quota						
Apportionment Using Webster's						

What's the difference between Webster's Method and Adam's Method? That is, how would you change your approach if asked to calculate the apportionment with Adam's Method instead?

- 8.) A committee is electing a new chairperson; the committee members will be voting using preference ballots. Because the chairperson will need to work well with everyone on the committee, we'd like to avoid electing a candidate who is strongly disliked by a large number of committee members (so ideally, he or she would not receive many last- or next-to-last-place votes). Which of the four voting methods we've discussed in class do you think will best achieve this goal? Why do you think this one is the best choice? What are any drawbacks that may be associated with this particular method? (We're not looking for any specific method for this question--there is more than one correct answer.)