MCU504 CST Math grade 11: **UNIT: Probability / Voting Procedures**

The types of voting procedures under study are: ***Majority vote, Plurality Vote,*** the ***Borda Count,*** the ***Condorcet Method,*** the ***Elimination Method,*** the ***Proportional Representation*** method, and the ***Approval Voting***.

Candidate	A	B	C	Total
# votes received	23	28	13	64

A) Majority Vote

In the above table no one wins because none of the candidates won majority votes (which is 50% +1 vote of the 64 total votes or 32 + 1 or **33**)

In a **majority voting rule**, the candidate must win at least 50% plus one vote.

B) Plurality Vote

In the above example, candidate B wins, with 28 votes, since he/she has the highest votes regardless of the fact he/she did not have the majority vote.

<u>Important note:</u>

If a table with order of preferences is given, the winner of the **majority vote** or the **plurality vote** will only be calculated from the results of the **1st choice votes**.

Example: Election results:

# of voters who ranked the candidates this way	45	32	28	23	Total **128**
1st choice	**B**	**C**	**C**	**A**	
2nd choice	**C**	**B**	**A**	**B**	
3rd choice	**A**	**A**	**B**	**C**	

- <u>No one wins</u> a majority vote: C has 32 + 28 or 60 votes, B 45, and A 23. To win, one has to have 64+ 1 or 65 votes
- <u>C wins a plurality vote</u> with 32 + 28 or 60 votes

C) Borda Count

Table is ranked by the voters in the order of their preferences of the candidates.

Election results:

# of voters who ranked the candidates this way	45	32	28	23
1^{st} choice (3 points)	**B**	**C**	**C**	**A**
2^{nd} choice (2 points)	**C**	**B**	**A**	**B**
3^{rd} choice (1 point)	**A**	**A**	**B**	**C**

Procedures:

- For each candidate, each preference choice is associated with a weighting value or point. If there are n candidates, the first choice will be associated with a value of n, the second will associated with the value of n-1, and so on.
- **Apply the Borda count**:
  Candidate A: 45(1) + 32(1) + 28(2) + 23(3) = 202 points (not votes)
  Candidate B: 45(3) + 32(2) + 28(1) + 23(2) = 273 points
  Candidate C: 45(2) + 32(3) + 28(3) + 23(1) = 293 points

  Conclusion: Candidate **C wins with Borda count**

D) Condorcet Method

The table shows the rankings in order preferences of the candidates.

Procedure:

1. Confront or compare every possible combination of pairs of candidates
2. Take into account their rankings in the table
3. Add the number of votes won by one over the other

The candidate with the highest number of wins during the process and with the highest votes will determine which candidate is mostly preferred or is the winner

# of voters who ranked the candidates this way	45	32	28	23
1^{st} choice	**B**	**C**	**C**	**A**
2^{nd} choice	**C**	**B**	**A**	**B**
3^{rd} choice	**A**	**A**	**B**	**C**

1) Compare A and C (or Confront A Vs C)

A is more preferred over C (or simply **A over C**): 23 voters prefer A over C
C is more preferred over A (or simply **C over A**): 45+32+28 = **105 voters prefer C over A**

→ Therefore, C wins over A in the first comparison with 105 votes

2) A Vs B

A over B: 28+23 =51 voters prefer A over B

B over A: 45+32 or 77 voters prefer B over A

→ B wins over A with 77 votes

3) B Vs C

B over C: 45+23 = 68 voters prefer B over C

C over B: 32+28 or 60 voters prefer C over B

→ B wins over C with 68

<u>**Conclusion**</u>**:** **B** wins twice with 77 + 68 or 145 votes **using the Condorcet method**.
C came second with 1 win of 105 votes
A came last, because, A never won any comparison

> <u>**Important Note**</u>**:**
> **With the Condorcet method, the winner will be the candidate with the most number of wins. In the event where two or more candidates have the same numbers of wins, then who ever has the highest number of votes will win.**

E) The Elimination Method

Procedure:

1) **Identify 1st choice votes only for each candidate**. If the candidate won a majority then the process stops. The candidate in question wins the overall vote, otherwise go to step 2) below.
2) Discard or **eliminate** the candidate with lowest 1st choice votes in the table
3) Re-arrange the rankings in the table by pushing the candidates below the empty cells upwardly.
4) Re-start the process from step 1) **until a candidate obtains a majority vote**

Example:

# of voters who ranked the candidates this way	45	32	28	23
1st choice	**B**	**C**	**A**	**A**
2nd choice	**C**	**B**	**C**	**B**
3rd choice	**A**	**A**	**B**	**C**

Elimination procedure:

Candidate A's 1st Choice votes: 28 + 23 = 51 votes

Candidate B's 1st Choice votes: 45 votes

Candidate C's 1st Choice votes: 32 votes

Candidate A has the highest votes 51, but it`s not a majority: 51 is not greater than half (or 50%) of the total number of votes (45+32+28+23) or 128 → half of 128 is **64**

Candidate C will be eliminated since it has the lowest votes (32)

# of votes who ranked the candidates this way	45	32	28	23
1st choice	**B**		**A**	**A**
2nd choice		**B**		**B**
3rd choice	**A**	**A**	**B**	

Move the candidates up in the empty cells.

# of votes who ranked the candidates this way	45	32	28	23
1st choice	**B**	**B**	**A**	**A**
2nd choice	**A**	**A**	**B**	**B**
3rd choice				

Re-start the Elimination procedure:

Candidate A's 1st Choice votes: 28 + 23 or 51 votes

Candidate B's 1st choice votes: 45+32 or 77 votes

Therefore, Candidate B wins since 77 is greater than 50% of 128 (which is 64)

F) **Proportional Representation Method**

In this type of voting procedure a number of elected members representing political parties or groups will be taking a number of seats out of a total number of available seats in a collegial institution, such as parliament, board of directors, City counsellors, and so on.

Example: During an election of municipal counselors in a small town, 10 seats must be filled in by members of 4 political parties. **The result of the election is shown in the table below. Determine how many seats each political party won?**

Party elected by voters	PARTY A	PARTY B	PARTY C	PARTY D	Total
Number of votes	400	370	280	160	1210

Procedure:
Determine the number of seats won by each party by applying the calculations below:

	Number of Seats Calculation	Results	Number of seats automatically won (whole number)	Decimal remainder
The number of seats won by PARTY A:	$\frac{400}{1210} \times 10\ seats$	3.305785124	3	**.305785124**
The number of seats won by PARTY B:	$\frac{370}{1210} \times 10\ seats$	3.05785124	3	**.05785124**
The number of seats won by PARTY C:	$\frac{280}{1210} \times 10\ seats$	2.314049587	2	**.314049587**
The number of seats won by PARTY D:	$\frac{160}{1210} \times 10\ seats$	1.32231405	1	**.32231405**

1) **Identify the number of seats automatically won by each party, which is the whole number resulting from the calculation of the number of seats:**
   Party A won 3 seats, PARTY B 3, Party C 2 and PARTY 1, which make up a total of 9 seats (3 +3 +2 +1).
   One more seat needs to be filled
2) **Identify the party that has the highest decimal remainder**
   In the table above, PARTY D has the highest decimal remainder. An additional seat is given to PARTY D.
   If two seats were to be filled at the end of the calculation, then the party with the second highest remainder would get the second seat and so on….

Conclusion: Official result showing the seats won by each party.

PARTY A	PARTY B	PARTY C	PARTY D	Total # of seats
3	**3**	**2**	**2**	**10**

G) Approval Voting

The voters are free to vote as many candidates as they like, in any order of their preferences.
<u>Example:</u>

The results of an election, where A, B, C and D are the candidates, are summarized below.

Number of voters who votes for a candidate or candidates	45	32	28	23
	A	B	A	D
	C	C	B	
		D	C	
			D	

The number of votes received by each candidate is as follows:

Candidate A: 45 + 28 = 73 votes

Candidate B: 32 + 28 = 60 votes

Candidate C: 45 + 32 + 28 = **105 votes** *

Candidate D: 32 + 28 + 23 = 83 votes

<u>Conclusion</u>: Candidate C wins. (Most voted candidate. Ranking is not a factor here)