

Decision Modelling

Practical 3

Ali ABUSALEH & Rishika Gupta

Question #6

Practical Session III

28/10/2023

Ali ABUSALEH & Rishika Gupta

Question #6

Provide an example that satisfy the **following conditions**

- Number of candidates ≥ 6 .
- Number of votes ≥ 40 .
- At least 10% of voters should have different preferences.
- **No more than 70%** of voters has the same ‘best candidate’
- The winner is **the same for the four** voting rules:
 1. Plurality.
 2. Plurality with Runoff.
 3. Condorcet Principle.
 4. Borda rules.

Question #6

Provide an example that satisfy the **following conditions**

- Number of candidates ≥ 6 .

#	1	2	3	4	5	6	7
6	B > A > C > D > E > F > G						
12	A > C > D > B > E > F > G						
13	A > D > B > C > E > F > G						
10	C > A > D > B > E > F > G						
8	D > C > A > B > E > F > G						

Question #7

Provide an example that satisfy the **following conditions**

- Number of candidates ≥ 6 .
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#	1	2	3	4	5	6	7
6	B > A > C > D > E > F > G						
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49

Question #6

Provide an example that satisfy the **following conditions**

- Number of candidates ≥ 6 .
- Number of votes ≥ 40 .
- At least 10% of voters should have different preferences.

$$\frac{\# \text{ unique preferences}}{\# \text{ total votes}} * 100 \% = \frac{5}{49} * 100\% \cong 10.20\%$$

#	1	2	3	4	5	6	7
6	B > A > C > D > E > F > G						
12	A > C > D > B > E > F > G						
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```
Function CALCULATE_PERCENTAGE(preferences, num_voters):
    Initialize candidate_votes as an empty dictionary
    For each voter in preferences:
        best_candidate <- voter's first preference
        If best_candidate not in candidate_votes:
            Add best_candidate with 0 votes
        Increment votes for best_candidate by num_voters[voter]
    max_votes <- Maximum votes in candidate_votes
    percentage <- (max_votes / Total votes) * 100
    Return percentage
End Function
```

51.02%

#	1	2	3	4	5	6	7
6	B > A > C > D > E > F > G						
12	A > C > D > B > E > F > G						
13	A > D > B > C > E > F > G						
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Plurality:

A: 25

B: 6 \rightarrow ‘A’ is the winner

C: 10

D: 8

#	1	2	3	4	5	6	7
6	B > A > C > D > E > F > G						
12	A > C > D > B > E > F > G						
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Plurality Runoff:

1 st round	<p>‘A’: 25 ‘B’: 6 ‘C’: 10 ‘D’: 8</p>	\rightarrow	<p>But $\frac{25}{49} \geq 50\%$, No need for 2nd round</p>
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‘A’ is the winner

#	Winner	Plurality: ‘A’						
		1	2	3	4	5	6	7
6	B	>	A	>	C	>	D	>
12	A	>	C	>	D	>	B	>
13	A	>	D	>	B	>	C	>
10	C	>	A	>	D	>	B	>
8	D	>	C	>	A	>	B	>

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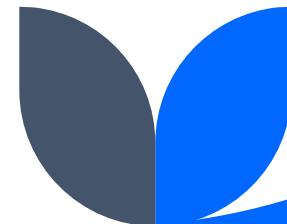
Condorcet Principal Voting:

	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’	‘G’
‘A’		43	31	41	49	49	49
‘B’	6		19	6	49	49	49
‘C’	18	30		28	49	49	49
‘D’	8	43	21		49	49	49
‘E’	0	0	0	0		49	49
‘F’	0	0	0	0	0		49
‘G’	0	0	0	0	0	0	

Winners | Plurality: ‘A’
Plurality Runoff: ‘A’

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A is the winner



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Borda Voting:

$$Score_{candidate} = \# \text{ voters}_{candidate} * rank_{candidate}$$

$$Winner = \min(score)$$

Candidate	'A'	'B'	'C'	'D'	'E'	'F'	'G'
score	81	165	120	124	245	295	343

A is the winner

Winners

Plurality: 'A'
Plurality Runoff: 'A'
Condorcet: 'A'

#	1	2	3	4	5	6	7
6	B > A > C > D > E > F > G						
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- The winner is **the same for the four** voting rules:
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Winners

Plurality: ‘A’
Plurality Runoff: ‘A’
Condorcet: ‘A’
Borda: ‘A’

Question #7

Practical Session III

28/10/2023

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- Number of candidates ≥ 6 .
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12	d > b > c > a > e > f > g						
16	c > b > a > d > e > f > g						
4	d > c > b > a > e > f > g						
<hr/>							
54							

Question #7

Provide an example that satisfy the **following conditions**

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- At least 10% of voters should have different preferences.

$$\frac{\# \text{ unique preferences}}{\# \text{ total votes}} * 100 \% = \frac{6}{54} * 100\% \cong 11.11\%$$

#	1	2	3	4	5	6	7
10	a > b > c > d > e > f > g						
8	a > c > b > d > e > f > g						
4	d > b > a > c > e > f > g						
12	d > b > c > a > e > f > g						
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        If best_candidate not in candidate_votes:
            Add best_candidate with 0 votes
        Increment votes for best_candidate by num_voters[voter]
    max_votes <- Maximum votes in candidate_votes
    percentage <- (max_votes / Total votes) * 100
    Return percentage
End Function
```

37.03%

#	1	2	3	4	5	6	7
10	a > b > c > d > e > f > g						
8	a > c > b > d > e > f > g						
4	d > b > a > c > e > f > g						
12	d > b > c > a > e > f > g						
16	c > b > a > d > e > f > g						
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Plurality:

a: 18

d: 20 \rightarrow ‘d’ is the winner

c: 16

#	1	2	3	4	5	6	7
10	a > b > c > d > e > f > g						
8	a > c > b > d > e > f > g						
4	d > b > a > c > e > f > g						
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Plurality Runoff:

1 st round	'a': 18 'd': 20 'c': 16	→	But $\frac{20}{54} \leq 50\%$, second round, with 'd' and 'a'
2 nd round	'a': 34 'd': 20	→	'a' is the winner

#	Winner Plurality: 'd'						
	1	2	3	4	5	6	7
10	a > b > c > d > e > f > g						
8	a > c > b > d > e > f > g						
4	d > b > a > c > e > f > g						
12	d > b > c > a > e > f > g						
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Condorcet Principal Voting:

	‘a’	‘b’	‘c’	‘d’	‘e’	‘f’	‘g’
‘a’		18	22	34	54	54	54
‘b’	36		26	34	54	54	54
‘c’	32	28		34	54	54	54
‘d’	20	20	20		54	54	54
‘e’	0	0	0	0		54	54
‘f’	0	0	0	0	0		54
‘g’	0	0	0	0	0	0	

Winners | Plurality: ‘d’
Plurality Runoff: ‘a’

#	1	2	3	4	5	6	7
10	a > b > c > d > e > f > g						
8	a > c > b > d > e > f > g						
4	d > b > a > c > e > f > g						
12	d > b > c > a > e > f > g						
16	c > b > a > d > e > f > g						
4	d > c > b > a > e > f > g						

C is the winner

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Borda Voting:

$$Score_{candidate} = \# \text{ voters}_{candidate} * rank_{candidate}$$

$$Winner = \min(score)$$

Candidate	‘a’	‘b’	‘c’	‘d’	‘e’	‘f’	‘d’
score	238	120	174	156	270	324	378

B is the winner

#	Winners						
	1	2	3	4	5	6	7
10	a > b > c > d > e > f > g						
8	a > c > b > d > e > f > g						
4	d > b > a > c > e > f > g						
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Winners

Plurality: ‘d’
Plurality Runoff: ‘a’
Condorcet: ‘c’
Borda: ‘b’

Thank you

Ali ABUSALEH

Rishika Gupta

