

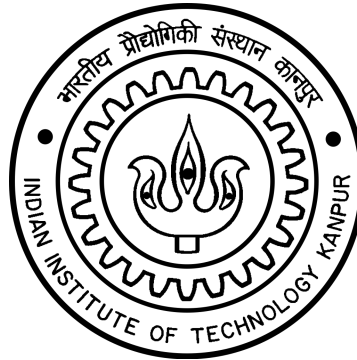
INDIAN INSTITUTE OF TECHNOLOGY KANPUR  
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

MULTI AGENT SYSTEMS : CS785A

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## Electoral Systems

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Team Members:

|                   |       |
|-------------------|-------|
| NIKHIL GHANTUDIYA | 14246 |
| SAGAR CHAND       | 14579 |
| SAURAV THAKUR     | 14619 |

Supervisor:

PROFESSOR HARISH  
KARNICK

# 1 Introduction

In this project we would be analysing the general elections of India 2014. Since a single party won absolute majority(282 out of 543)but won only 31.3% of total votes casted. Whereas another party with nearly 20% of the popular votes won only 44 seats. Many opposition leaders like Sitaram Yechury of CPI(M) pointed out that this type of elections are not fair as 68.7% of Indians didn't want this party to come to power. Also it represents only few of the cast and vote banks.

So here, in our project, we present you few alternative methods which could have been considered for our elections in which result would have been fairer than first past the post system currently in use in our country. We would be analyzing the result of each constituency and the finding out the seat share of different parties/candidates in the General elections of 2014. Then on basis on number of seats won by each party and possible coalition at that time, we would try to predict who would have come to power.

Since India is a vast and diverse nation, every voter is not literate, as many as 42 candidates stood for elections in a constituency in 2014 and there is high voter density in each booth so we want a method that is more representative, not too complex while also ensuring that casting vote does not take much time. All this should be done with almost minimal changes to current EVM Machines. Methods used by us:-

- Plurality
- Approval
- Bucklin with some Modification(Runoff)
- DMP
- Proportionate System

# 2 Assumptions And Data-Sets being used

Here is the list of possible assumptions and data we would be using:-

- 2011 Census data for gender wise, religion wise and caste wise breakup of voters in a particular area.
- 2014 General Elections' data for vote share of each party in every constituency.
- Generally candidates with less than 5% votes is not being considered because (s)he didn't stand a chance to win.
- His vote share would be distributed proportionally to other candidates.
- For possible post election coalition and breakup at that time, we would be considering the news and scenario of aftermath of declaration of result of General elections of 2014.
- For analysis of "Preferential Voting", we would assume that a particular vote bank votes for particular party or set of parties in states where caste plays an important role and political ideology in others.
- Demographical breakup of Voters is assumed to be same as the overall population breakup of the constituency

### 3 Methods used

#### 3.1 Plurality

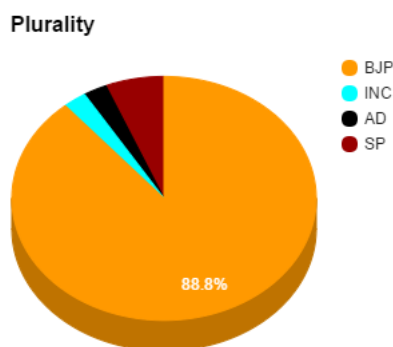
Plurality voting is an electoral system in which each voter is allowed to vote for only one candidate, and the winner of the election is whichever candidate represents a plurality of voters, that is, whoever received the largest number of votes. This makes plurality voting among the simplest of all electoral systems for voters and vote counting officials.

##### 3.1.1 Plurality - Pros & Cons

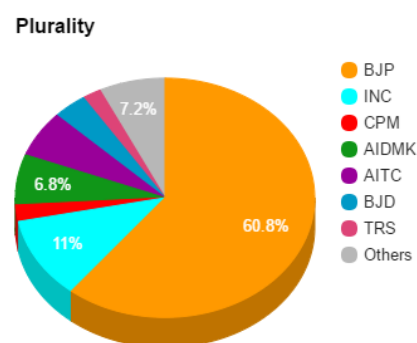
- Votes are simple to count and thus doesn't cost much to administer.
- Representatives can get elected on tiny amounts of public support as it does not matter by how much they win.
- It doesn't take very long to count all the votes and work out who's won.
- It encourages tactical voting, as many voters vote not for the candidate they like the most, but against the candidate they most dislike.
- Party with popular support might not win majority of seats as we saw in US elections recently.
- Some third party/candidate may eat into vote share of some party who is winning and that party may not win.
- Few voters do not vote for their favourite candidate if he does not stand a chance to win but vote for a lesser preferred candidate who can win.
- Used in various democracies including India.

##### 3.1.2 Simulated Results

###### Uttar Pradesh



###### Entire Country



## 3.2 Approval

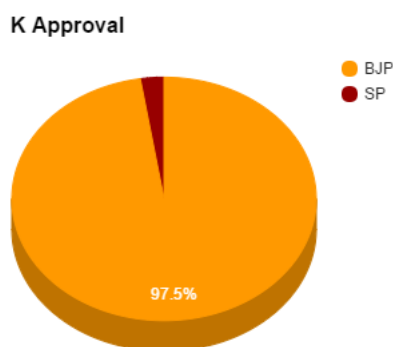
- Each voter gets a choice for approving any number of candidates from the candidate list.
- The no of candidates approved can be 1 to m (m = no. of candidates)
- Now for a vote  $v_i = (c_{i,1}, c_{i,2}, c_{i,3} \dots c_{i,m})$  where  $c_{i,j} \in \{1, 0\}$  and  $c_{i,j} = 1$  iff  $i^{th}$  voter approves the  $j^{th}$  candidate otherwise  $c_{i,j} = 0$ .
- For  $v_i = (c_{i,1}, c_{i,2}, c_{i,3} \dots c_{i,m})$  implies that the  $i^{th}$  voter gives equal weightage to all the candidates approved that is  $c_{i,j} / (\sum_j c_{i,j})$  for  $j^{th}$  candidate.
- And thus, the score for each candidate is counted as,  $\text{Score}(j^{th} \text{ candidate}) = \sum_i c_{i,j} / (\sum_j c_{i,j})$ .
- The candidate with the maximum score wins.
- Here it is assumed that the candidates that a voter approves are equal for the voter.

### 3.2.1 Approval Pros and Cons

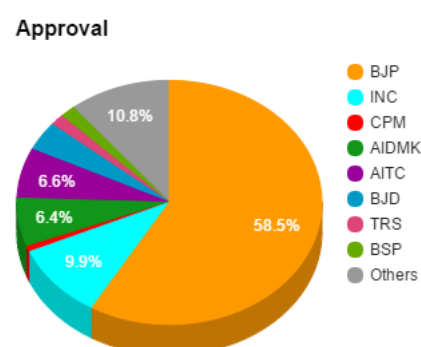
- Extremely and easy to explain to voters.
- All existing voting equipments can accommodate this system.
- Voters can vote for all the parties they like.
- Voters cannot indicate a strong preference for one candidate and a weak preference for another.
- Adoption of approval voting could cause the defeat of a candidate who was the favorite candidate of 51% of voters. If this result were to happen the system would likely be repealed.
- Used to elect top leaders in Green Party in USA.

### 3.2.2 Simulated Results

#### Uttar Pradesh



#### Entire Country



### 3.3 BUCKLIN With Some Modification(Runoff)

Since voting has to be fast and each voter does not know about every candidate of his/her constituency, only 3 preferences would be given by each voter. Now keeping in mind that every voter is not literate and would not understand complexity of the preferential system, we would not make preferential voting mandatory. Voter can give only 1 preference also(as it is the case now). Now there are few voters who would like to choose only 2 candidates only. So we would keep upper cap of 3 preferences for each voter i.e. each voter can give preference to up to 3 candidates (1, 2 or 3 candidates).

Now let 'M' be number of candidates in a particular constituency. See if there is any candidate with more than 50% of vote share. If there exist such a candidate, declare him winner. If there is not such a candidate, take  $(100/(2 * M))\%$  and remove/eliminate all candidates whose vote share fall below this number. Now reassign  $2^{nd}$  (or even  $3^{rd}$ ) preferences of eliminated candidates to candidates still in fray. Normalise the vote share. Repeat this process till we find a winner. In case of tie, look at  $1^{st}$  preference votes of candidates. If tie still exists, then look at number of  $2^{nd}$  preferences the candidate has received and then  $3^{rd}$  preference.

#### 3.3.1 How model will work?

- Analyze each constituency separately.
- In each constituency, see if there is any candidate with more than 50% of vote share. If there exist such a candidate, declare him winner. If there is not such a candidate, proceed further.
- If number of candidates remaining are 5 or more, take a cut off vote share(say  $(100/(2 * M))\%$  where M is number of candidates). Remove/eliminate all candidates whose vote share fall below this number. Now all those voters whose candidates were eliminated in this round, their vote would be transferred to their  $2^{nd}$  (or even  $3^{rd}$ ) preference candidates(provided they have given the preference and their candidates are still in fray). Check if atleast one candidate has been eliminated.
- Normalise the vote share so that sum of vote share of all candidates becomes 100%. Update value of M(Remaining number of candidates).
- Repeat steps 2,3 and 4 till number of candidates reaches 4 or less OR no candidate has been eliminated.
- Now take the candidate with least vote share and eliminate it. Reassign its "normalised" vote share to candidates in fray. Normalise the vote share again so that sum of all vote share becomes 100%. Check if any candidate has now got more than 50% of vote share.
- If number of candidates are 5 or more then repeat step 3 and 4, otherwise repeat step 6 till winner is declared.

#### 3.3.2 In case of tie

Use kind of "Bucklin" system. Add 2nd preferences to the 1st . Now eliminate candidate with least number of votes. If tie still persists, then add 3rd preference as well.

If tie still exists, eliminate candidate with least 1st preference, then 2nd preference and then 3rd preference.

#### 3.3.3 Why $100/2 * M$ as cut off?

This will ensure that all non serious candidates are eliminated in this round. On average, there are 15.2 candidates in fray in a constituency. So basically on an average we are eliminating all candidates whose vote share is less than  $(100/30.4)=3.3\%$ .

Let's take a boundary case. Assume that  $M-2$  candidates are being eliminated in this round. Let's say they all have maximum possible vote share ie  $(100/(2*M))\%$ . Even if one of the eliminated candidates gets all the 2nd preferences, his vote share would be  $(100*(M-2)/2*M);50\%$ .

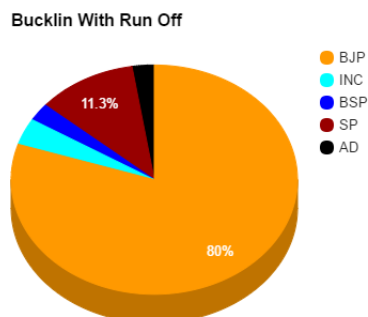
If we would have taken  $100/3*M$  or  $100/4*M$ , it could have given better result(although it is highly unlikely that a person who does not get even 3% votes wins the elections) but would have increased number of iteration and hence increasing the time taken. Also keeping cutoff as  $100/2 * M$  there is more probability that at least one candidate is being eliminated in every round.

### 3.3.4 Bucklin With Modifications - Pros & Cons

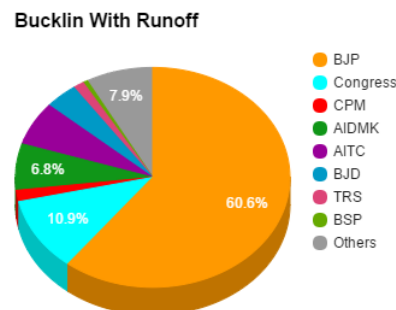
- Candidates can give preferences to more than 1 candidate if they like and their preferences order would be considered(in case their candidate wins early).
- A bit difficult to explain to voters.
- All existing voting equipments may accommodate this system. Since we are considering preferences here, it might require a little of more modifications.
- Time consuming and very complex to calculate result.
- Bucklin with runoff used to elect President of India and also for selecting host cities for various sports like FIFA World Cup, Olympics games, Commonwealth games etc.

### 3.3.5 Simulated Results

#### Uttar Pradesh



#### Entire Country



### 3.4 DMP

Dual Member Proportional system is a proportional electoral system to build support for proportional representation.

With DMP, India's current single-member districts would be replaced with about half as many dual-member districts. All candidates would run in their local dual-member district, and voters would choose their preferred candidate or pair of candidates using a straightforward single-vote ballot. The first seat in every district would go to the local candidate with the most votes, while the second seat would be filled to create a proportional election outcome. Elected candidates would be responsible for representing their dual-member district and would rely on their local constituents' votes for re-election.

#### 3.4.1 How model will work?

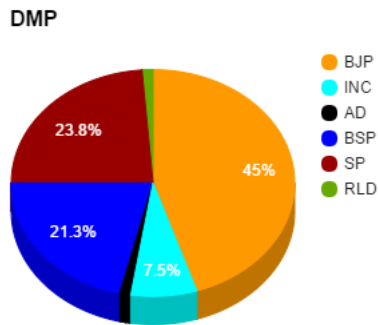
- To elect the two members from each district, DMP makes use of two methods. The first seat in each district is assigned by plurality (these will be referred to as the first seats). This ensures that the first place candidate always wins a seat. The second seat in each district, in general, is assigned in a manner that achieves proportional results at the regional level (these will be referred to as the second seats).
- Determine the winners of the first seats using plurality.
- Then determine the number of seats each party deserves.
- Determine the number of seats each party needs,  $N$ , in addition to the first seats they have been assigned.
- Assign each party the first  $N$  seats from its ranked list.
- Do this till all seats are assigned.

#### 3.4.2 DMP - Pros & Cons

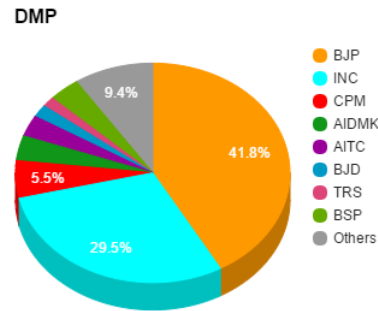
- Keeping the simple ballot design of Canada's Single Member Plurality electoral system. Eliminating the need for long party lists.
- Not increasing in complexity from the voter's perspective as region size increases.
- Retaining a higher degree of local representation and accountability.
- Finding which constituencies is to merged might be a bit tricky.
- Difficult for people from 2 different parties to sun same bigger constituency. Although this problem could be solved by giving separate original constituency to each winner.
- A lot of alliances and hence compromises would take place to form the government.
- To be used in Canada.

### 3.4.3 Simulated Results

#### Uttar Pradesh



#### Entire Country



## 3.5 Normalised Borda

In Normalized Borda's method voters rank the some specific candidates or choices in order of preference from the first choice to the last choice. The voter need not include every candidate in his/her preference list and this makes the system viable in our country and easily understandable by the masses. The votes are tallied as follows: Top candidate receives 1 point and subsequent candidates receives points = (total no. of candidates in voter's list less preferred than them+1)/Total no. of candidates in voter's list

The candidate with the maximum amount of points wins.

### 3.5.1 How model will work?

- Analyze each constituency separately.
- Every candidate's vote bank in the first past the post must have a preference list for the other parties along with his own party on the top and it is assumed to be same in the entire states.
- This preference is generated with the help of past alliances, local politics and conflicts of ideology between those parties.
- Each person can give any number of choices. Now his score given would be normalised depending on number of candidates he has given votes to.
- Eg- If a voter has given choice to N candidates, then score received by them would be 1,  $(N-1)/N$ ,  $(N-2)/N$ , ...,  $2/N$ ,  $1/N$ .
- Then all these scores are added up and winner is declared.
- The borda points are now calculated with the preference list for every candidate.
- The candidate with maximum points is declared the winner in the constituency.

### 3.5.2 Normalised Borda - Pros & Cons

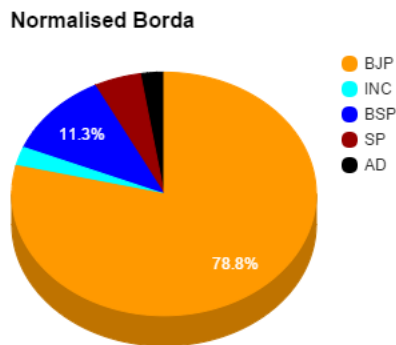
- Candidates can give preferences to more than 1 candidate if they like and their preferences order would be considered (in case their candidate wins early).
- A bit difficult to explain to voters.



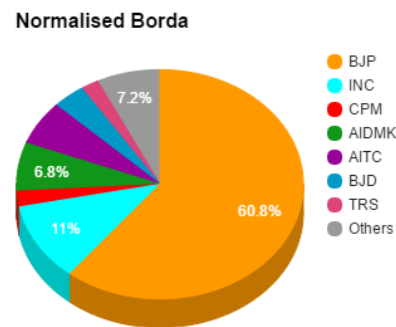
- All existing voting equipments may accommodate this system. Since we are considering preferences here, it might require a little of more modifications.
- Time consuming and very complex to calculate result.
- Borda is used in Slovenia, Kiribati and Nauru.

### 3.5.3 Simulated Results

#### Uttar Pradesh



#### Entire Country



## 3.6 Proportionate System

In Proportionate system, the overall vote share of a party has to be reflected in the number of seats won by the party i.e., m% vote share in the state won by the party grabs them almost m% of the total number of constituencies in the state.

The system makes every vote count in the final result of the state

### 3.6.1 How model will work?

- Analyze the entire state.
- Calculate the vote share of each party in the state from every constituency's first past the post results
- Remove the parties or candidates with less than 5% of vote shares.
- Normalize the remaining parties vote share.
- Give the party with maximum vote share the number of constituencies in the state just greater than  $(\% \text{ vote share}) \times (\text{no. of constituencies in the state})$
- Do the same for every party and give the remaining to the last party

### 3.6.2 Proportionate System - Pros & Cons

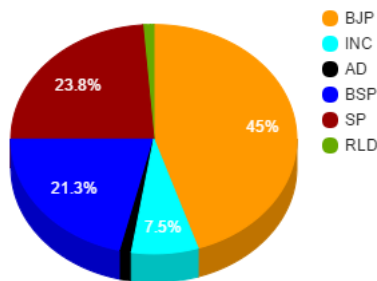
- With more than two parties, voters experience more choice options. There is a higher likelihood of having ones beliefs or convictions represented.
- A majority for any one party is less probable due to the high number of parties represented.

- Unlike a majority type vote, the borders of the constituencies are not as important or relevant to the election. This also leads to disincentivizing border manipulation, which is seen in majority elections.
- Small parties have the potential to abuse their position to get support for special interest.
- With multiple small parties comes the risk of lacking consensus and widespread disagreement. If disagreement prevails there may be a threat to political stability.
- In some cases with proportional elections parties decide who will represent them. If this is the case, the leader chosen might not be the most representative due to bureaucracy and party hierarchy.
- Used in Germany

### 3.6.3 Simulated Results

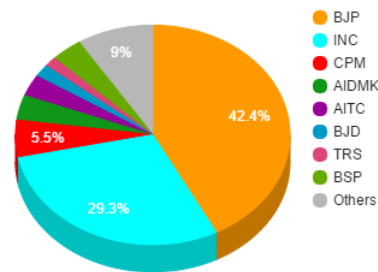
#### Uttar Pradesh

Proportionate Voting



#### Entire Country

Proportionate System



| <b>Party =&gt;</b>       | BJP(NDA) | AD(NDA) | INC(UPA) | RLD(UPA) | SP | BSP | CPM |
|--------------------------|----------|---------|----------|----------|----|-----|-----|
| <i>Plurality</i>         | 73       | 2       | 2        | 0        | 0  | 5   | 0   |
| <i>Approval</i>          | 75       | 2       | 0        | 0        | 0  | 3   | 0   |
| <i>Bucklinwithrunoff</i> | 62       | 2       | 3        | 0        | 2  | 9   | 2   |
| <i>DMP</i>               | 36       | 1       | 6        | 1        | 17 | 19  | 0   |
| <i>NormalisedBorda</i>   | 63       | 2       | 2        | 0        | 9  | 4   | 0   |
| <i>Proportionate</i>     | 36       | 1       | 6        | 1        | 17 | 19  | 0   |

Table 1: Simulation results of various methods for Uttar Pradesh

| <b>Alliance =&gt;</b>    | NDA | UPA | Left | AIDMK | AITC | BJD | TRS | BSP | Others |
|--------------------------|-----|-----|------|-------|------|-----|-----|-----|--------|
| <i>Plurality</i>         | 330 | 60  | 12   | 37    | 34   | 20  | 11  | 0   | 39     |
| <i>Approval</i>          | 318 | 54  | 4    | 35    | 36   | 21  | 8   | 9   | 59     |
| <i>Bucklinwithrunoff</i> | 329 | 59  | 9    | 37    | 35   | 21  | 7   | 3   | 43     |
| <i>DMP</i>               | 227 | 160 | 30   | 20    | 17   | 10  | 8   | 20  | 51     |
| <i>NormalisedBorda</i>   | 288 | 61  | 3    | 31    | 42   | 4   | 7   | 16  | 91     |
| <i>Proportionate</i>     | 230 | 159 | 30   | 20    | 17   | 10  | 8   | 20  | 49     |

Table 2: Simulation results of various methods for India as a whole

## 4 Result

So we conclude that DMP is best alternative for Electoral process in India because:-

- Keeping the simple ballot design of India's Single Member Plurality electoral system.
- Eliminating the need for long party lists.
- Retaining a higher degree of local representation and accountability.
- Not increasing in complexity from the voter's perspective as region size increases.
- Reducing parties' recruitment burden.
- Gives chance to independents as well.

## 5 Analysis

- Plurality is cheapest and most under representative way of electing a leader. A winner just needs enough to get more than other leaders. In some constituencies, winners won with just more than 20% votes polled in their constituency.
- In Approval method, we see that a person can vote for any number of candidates is good. This can be achieved with just slight modification in EVM machines. As it is just counting of more number of votes, some more EVM machines might be required.
- Bucklin with modifications is much better way as preference of every vote is important, it is representative and is suited for all kinds of people and constituencies. But this method is very complex and might be a bit more expensive and more time would be required to display the results. Much modification would be required to give the preferences which could prove expensive.

- Proportionate representation is a great inexpensive way of doing the Elections. It is used in Germany. It does not represent the independents. In country like where there are so many popular leaders who create their own party or run as independents, they would not be represented. It is surely not the right choice(at-least for Indian electoral system) .
- Normalised Borda is an interesting method, but problem is that whenever there is there is preferences, there is to be modifications for the EVMs which might not be possible.
- DMP is great method. It elects most preferred candidate in the combined constituency while also maintaining proportionate system. It give representation to independents as well provided they are in top 2 in their constituency. No modification in EVMs required.

## 6 Conclusion

So we conclude that DMP is best alternative for Electoral process in India because:-

- Keeping the simple ballot design of India's Single Member Plurality electoral system.
- Eliminating the need for long party lists.
- Retaining a higher degree of local representation and accountability.
- Not increasing in complexity from the voter's perspective as region size increases.
- Reducing parties' recruitment burden.
- Gives chance to independents as well.

Although after this, it would be very difficult, even for any alliance to get majority in India which could lead to lot of compromises and hence not so strong decisions from the centre but it is still the best possible alternative given the demographics of India.

## Acknowledgments

We thank our instructor, **Professor Harish Karnick** for helping us in selecting the topic and also for motivating and guiding us throughout the project.