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Treatise of Electoral Systems and Political Campaign Strategies

Abstract

Lack of consensus is a frequent part of life, but by voting, we are all able to aggregate information across a group to reach a single conclusion. Using abstract models, we can observe different voting systems at a theoretical level to better understand the benefits of using one over another. We studied, modeled, and designed different voting systems such as ranked choice voting and modeling US elections before Election Day. We then analyzed and compared these voting methods to find the optimal way to aggregate voter information.

Value for society/participants. An abstract model of voting allows the participants to develop a strategy that will best position them to receive an optimal outcome. In the application of political elections, we can see this from the perspectives of both the voter and the candidates. In a binary voting system, candidates know that voters can only vote for the preferred candidate. This influences their strategy by forcing them to focus on maximizing the numbers of voters that favor them. They realize that any voter that is "lost" is of no value to them and can be ignored unless there is some indication that they can be swung in the other direction. On a similar note, this model forces voters to focus on one candidate; their top candidate. All they are in search of is the candidate that they can hand their vote to since they only can choose one, which leads them to ignore all other candidates. In a ranked-choice voting system, candidates cannot afford to disregard voters that do not have them as their top choice. In this model, it is possible for a voter, namely A, to still effectively vote for a candidate B that wasn't her top choice. Thus, a candidate must try to convince all voters that of her worth so that voters who might not have her as their top choice will still rank her "high enough" to receive their votes in later rounds of this voting system. Similarly, this model now forces voters to care about all candidates and not only figure out whom they prefer most, but also whom they prefer second-most, third-most, and so on. Without an abstract model of the voting system, as well as candidate actions, we would not be able to understand the effect on the participants of the system. This allows us to make assumptions about the motive of participants and better analyze the effectiveness of the model itself. It also allows us to find different kinds of voting systems based off of network effects, and determine which may be better for our society

Value for the system we're analyzing. While researching this specific topic, we realized that there were not many scientific papers that applied the network concepts that we were taught in class to these kinds of systems. By applying these kinds of models to something as complex and important as voting, we can make conclusions on whether certain systems really do reflect the will of the population. By applying a model, we take away the complex political fighting over these topics and stick strictly to the choices that people have to make when voting for the leaders of their county. Choice can be deceiving in how it is presented to people, and we can

understand certain decisions made by a population by applying models to assess specific characteristics or situations of a voting population.

Model analysis and design

The dimension that we decided to focus on was Modeling- we wanted to apply different models to voting in order to assess both voter preferences and candidate preferences, and explore their roles in campaign strategies. We present several different models of real-life voting-related situations, applying concepts we have learned in class. The first model that we would like to discuss is ranked-choice voting. This voting system is common in many countries around the world, such as Ireland and Malta, and some states in the US are starting to adopt this system of voting. The majority of US states use plurality voting - when you go to the polls, you cast one vote for one candidate in each race, and the candidate with the majority of votes in that state wins. Ranked-choice voting is more complicated - the system that we based this model off of is the ranked-choice voting system in Ireland. In ranked-choice voting, each person gets to rank candidates on the ballot according to how much they like them. Voters list their candidate preferences, which do not have to be complete. For instance, if a voter only likes one candidate, then they will only vote for that candidate. If a voter likes candidate 1 better than candidate 2, but would still like to vote for candidate 2 if candidate 1 is not an option, then they rank candidate 2 lower than candidate 1. Voters can choose to rank all candidates, or just one, in this fashion. With this system, there are multiple rounds of counting votes. In the first round, all votes are tallied up, and candidates must pass a certain threshold of votes in order to advance to the second round. After the votes have been tallied, the voters who voted for candidates that did not pass the threshold for the next round get their vote cast for the next candidate on their preference list (their second choice). This continues until a candidate gets over 50% of the vote. In Ireland, it can take up to 10 rounds of voting to choose a winner. We modeled this system as a bipartite graph.

We define our model and matching mechanism as follows:
Definitions:

- *Voter:* the agents in our graph. These are individual people who cast their vote for a candidate. They can only be matched to one candidate.
- *Candidate:* The objects in our graph. These candidates can be matched to any number of voters, and do not have preferences.
- *Preference profile:* The ranked list of the candidates voters would like to give their votes to
- *Threshold:* The percentage of the vote a candidate needs to get to advance to the next round. It is determined by each district that uses it, and adjusts relative to the number of candidates in running. The threshold for the last round (2 candidates left) is always 50% of the total vote

Assumptions and rules:

- *Rounds:* unlike a typical bipartite graph matching, we must have multiple rounds of matching in order to realistically frame this model. After a full matching is created, we assess how many votes each candidate got, and remove those who did not pass the threshold from the market

- We assume that all voters are reporting preferences truthfully (while we acknowledge that this method of voting is proven not to be strategyproof)
- Assuming that there are more than the presented amount of voters participating in the election- the example is smaller for simplicity

Preference profile:

v_1 :c_1> c_2> c_3> c_4

v_2 :c_1

v_3 :c_2

v_4 :c_2> c_3> c_4

v_5 :c_3> c_4> c_1> c_2

As you can see above, this is how this mechanism would function with the given preference profile. There are three rounds, and each round, the candidate who does not pass the threshold is removed from the market. On the last round, the candidate with more than 50% of the vote wins.

Our Mechanism: Campaign strategy. This model illustrates the volatility of voters' allegiances to candidates over a length of time, between the announcement of a campaign until election day.

Definitions:

- *Voter*: an individual whose vote will determine the outcome of an election; in this model, v_i refers to groups of voters who share the same interest
  - i.e v_B: Banks, v_F: Farmers, v_S: Fishermen, v_R: Republican, v_D: Democrat
- *Candidate*: a person nominated for an election
  - i.e presidential candidates (Hilary Clinton, Donald Trump)
- *Conditional Vote/Proposal*: a vote offered by any voter v_i to a candidate c_i that is contingent on v_i's demands being met; v_F will support candidate c_1 only if v_B is not supporting c_1
  - i.e. The Coalition to Stop Gun Violence (CSGV) will only support Candidate 1 if Candidate 1 enforces a certain policy that is detrimental to The National Rifle Association (NRA), losing the support of the NRA but gaining the support of CSGV
- *Incompatible*: voters are incompatible if they have conflicting views and a candidate cannot receive the support of both voting groups
  - i.e. The NRA has conflicting views with the CSVG; The CSVG would be in favor

of gun regulations/laws while the NRA would not, presumably, they would not support the same candidate

Preference profile:

c_1: v_B v_F v_S v_R v_D > v_D v_F v_S > v_D v_B > .... > v_B > v_F > v_S > v_R > v_D

c_2: v_B v_F v_S v_R v_D > v_R v_B v_F > v_R v_B > … > v_B > v_F > v_S > v_R > v_D

v_B: c_1

v_F: c_1 only without v_B (i.e. c_1 must enforce a policy that is detrimental to banks) > c_2

v_S: c_1 only without v_B (i.e. c_1 must enforce a policy that is detrimental to banks) > c_2

v_R: c_2

v_D: c_1 > c_2

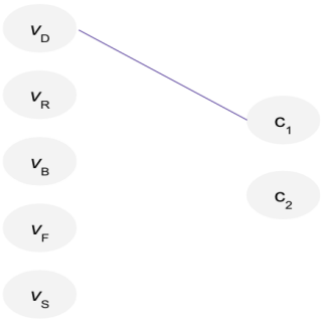
Assumptions and rules:

- c_i represent (presidential) candidates in the election process modeled below
- v_i in our model correspond to groups of voters in reality, such as v_F represents a group of farmers in a specified state, while v_B represents a group of banks voting in an additional state with conflicting interests
- The groups of voters (v_i) pictured below stand to give the majority vote in a state to the candidate; i.e. if c_1 gets v_D he will win the majority of the state v_D belongs to
- Similar to the Gale-Shapley Algorithm, voters can 'propose' to candidates; this is the equivalent of a voter giving their support to a candidate at some point in time in the interval between the announcement of a campaign and election day
- This model illustrates the ability of candidates to 'reject' a vote from v_i; this is the equivalent of a candidate announcing/supporting a policy that benefits v_j at the expense of v_i
- Voters have incomplete rank order preferences as defined in the rank choice model above
- Candidates have complete rank order preferences, as realistically a candidate would prefer any vote as an alternative to receiving no votes at all
- Assume certain voters are incompatible and as a result some v_i have conditional preferences, i.e. voters v_F and v_S will only vote for c_1 if v_B is not
- Voters can 'propose' at the same time; i.e. *v* can form groups/coalitions to 'propose' to v_i

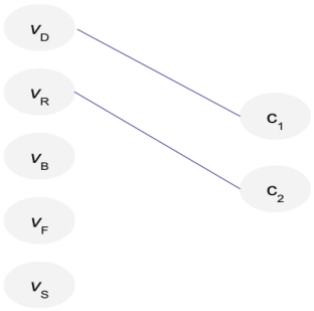
How to Find a Matching:

- In the first round, each unpaired voter v_i offers a vote to their top ranked candidate c_i. Each candidate c_i can:
    1. accept the votes or
    2. if the candidate has received a conditional vote from a number of voters v_i, the candidate must meet the condition of the vote or reject that voter
        a. if the candidate meets the condition of the voter, the voter(s) v_j that c_i rejected is now unmatched
        b. if the candidate does not meet the condition of the voter(s) v_i, v_i is unmatched
    3. in each subsequent round, unmatched voters propose to their next candidate (if there is one in their preference profile) until all voters are matched to a candidate or have exhausted the options in their preference profile

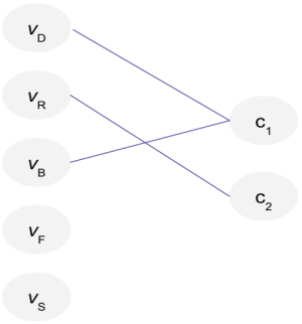
Example - *how to produce a matching:*
Round 1: Voter v_D proposes to c_1; voter v_D puts his support behind candidate 1
The democrats in New York state support c_1 so they give their support to c_1 who accepts and now has the majority in NY



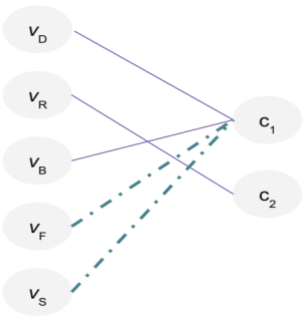
Round 2: Voter v_R proposes to c_2; voter v_R puts his support behind candidate 1; Republicans in Arkansas put their support behind the Republican candidate, c_2 wins AR



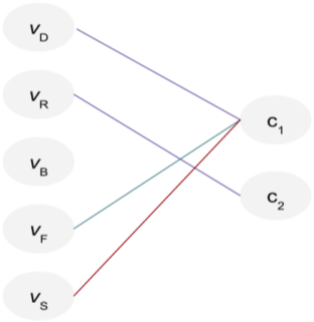
Round 3: Voter v_B proposes to c_1; voter v_B puts her support behind candidate 1



Round 4: Voter groups v_F and v_S propose to c_1 but will only fully support candidate 1 if c_1 breaks ties with v_B; v_S and v_F put their support behind candidate 1 only if there is no alliance between v_B and c_1; Farmers in Iowa and Fishermen in Maine will support Candidate 1 if he enforces a policy that is detrimental to the banks in Massachusetts



Round 5 - Final: The matching is finalized, leaving c_1 with the majority in NY, IA, and ME and c_2 with the majority in 1 (AR); c_1 wins the election



Benefits: This model has both strengths and weaknesses, this section details both and the motivation behind its conception.

Candidate preferences. This model attempts to incorporate and display candidate preferences which are excluded from other models. In the model above, candidate preferences illustrate an overall strategy that candidates should utilize. If a candidate is to strategize to win the majority of states in an election, he should be thinking about how to get the support of the majority even if it is at the risk of alienating smaller organizations. This is illustrated above, and while the Democtratic candidate in our example 'rejected' the support of the Banks, he triumphed with the support of three states as opposed to the two he previously had.

Data. The data gathered over time from a model of this nature would reveal data about the dynamics of voter preferences over the course of an election. Data collected after big press conferences involving endorsements or announcements of a similar nature would produce a collection showing the support gained and lost over a campaign.

Detriments: This section details the shortcomings of the above model.

Miscalculations. This model revolves around the possibility of candidates sacrificing some votes but, as this is a model and candidates are aware of what voters they are alienating, this does not translate to reality where voters are not as public or concrete with their support. In reality, this would be high-risk and a miscalculation on behalf of the candidate could result in a loss.

Candidate preferences. In a real world application, candidates rarely actively alienate or 'reject' voters. If candidates approached elections more strategically and focused on gaining the majority as opposed to the supporters of all, it would generate a more difficult election to navigate. This would call into question the motivation behind candidate's stances - are they supporting a specific policy because they believe in it or are they simply scheming to win a majority. In the current system we hope that candidates believe what they preach.

Election Day/Real time. This model ends election day and does not allow for last minute scandals nor does it include the effects of personal scandals. The above model primarily relates to policies and public stances, both conscious choices of the candidate to make public.

Incompatibility. States are not strictly incompatible. Candidates have, in the past, won most states that typically have contrasting interest; Lyndon B. Johnson and Ronald Reagan both won 44 states. This model assumes that some states are firmly incompatible and does not account for a potential candidate being able to gain the support of almost all 50 states.

Further Explorations: The Ulysse Method - *Multimodal Modified Borda-Count Voting System*

In the 2016 U.S. presidential election, Hillary Clinton received 232 electoral votes, and won the popular vote, but lost to Donald Trump who received 304. The same thing also happened in the year 2000 when President George W. Bush beat Al Gore by 5 votes in the electoral college. In this voting system, a disproportionate amount of power is given to the rural voters in 'swing states', achieved election results that make most people in the nation unhappy,

whereas majority rule clearly does the opposite of the latter. In particular, the results of the 2016 elections have incited widespread movements to scrap the electoral college and simply go about majority rule, even gaining traction amongst some 2020 candidates such as Elizabeth Warren. This begs the question of what were the Founding Fathers' goals when implementing this, now unpopular, the voting process for the U.S.?

The Founding Fathers were afraid of pure democracy; in particular, they feared the possibility of nefarious decisions being made by the masses. In the Federalist no. 68 Alexander Hamilton wrote: " It was desirable that the sense of the people should operate in the choice of the person […] It was equally desirable, that the immediate election should be made by men most capable of analyzing the qualities adapted to the station." These were good intentions, but can we improve this electoral process? Let us first understand how the process works at a high level in the U.S. In general, each state chooses a candidate through a plurality of votes, and gives the winner all of the state's electoral college votes. Following this, the candidate who receives at 270 (out of 538) electoral college votes wins the general election.

An alternative process would be the following, which we call a 'Multimodal Modified Borda-Count Voting System' (i.e, The Ulysse method):

Assumptions

- Our voting system is defined as follows, a group of people evaluating a set of possible alternatives, in our case the alternatives are political candidates.
- We will assume that the state's preferences are strict, complete, and transitive. We will be using plurality voting to define group preferences, and there can be counter-intuitive results that may arise due to the Condorcet paradox: " The possibility of non-transitive group preferences arising from transitive individual preferences." So we will be ignoring individual preferences since they are only required to report their top choice.
- We will assume that there are no abstentions, and that every candidate gets at least one vote.
- We will also not consider the possibility of a tie amongst candidates in a state

Procedure

- Citizens of each state vote for their favorite candidate.
- We then take the three candidates with the most votes, then rank them by number votes, and define this as the preference of the State.
- We then run a positional voting process where for each state the bottom two candidates are assigned weights of 2 and 1 respectively, and the weight of the first ranked candidate depends on how populous the state is.

Let us now look at a simple example:
Let s_1, s_2, s_3, s_4, s_5 denote the states, and A, B, and C denote the candidates. Let the following be the voter preferences: s_1: A > B > C, s_2: C > B > A, s_3: C > A > B, s_4: B > A > C, s_5: A > C > B Furthermore, let each voter have the following weights for their preferences: s_1:10, 2, 1, s_2: 8, 2, 1, s_3: 3, 2, 1, s_4: 5, 2, 1, s_5: 20, 2, 1

Therefore if we ran the Ulysse method with these states and candidates, candidate A would win with 35 votes, C comes in second with 15 votes, and B comes in third with 11. We observe that as opposed to the current american electoral system, the voters of the second and third ranked candidates can still contribute to the tally and their vote is not erased, giving a more powerful to more voters.

Consider the 2000 U.S. presidential elections, let A: George W. Bush, B: Al Gore, C: Ralph Nader. The weight of the top candidate for each is their number of electoral votes, and the bottom two are 2, 1. In 2000, President Bush received 271 electoral votes, while Al Gore received 266, Ralph Nader received 0 points. Let us now apply the Ulysse method to this election. After careful inspection we observed that, candidate A would receive 271 points for winning 30 states, plus 42 points for coming in second in 21 states. Candidate B would receive 266 points for winning 21 states, and 60 points for coming second in 30 states, candidate C would receive 51 points for coming in 3 in each state. This means in our model Al Gore would have won the presidential election, Al Gore won the popular vote, and was a very frequent second choice in many states, which in our model allowed him to sneak past Bush and win the presidency. When we ran the Ulysse method on the 2016 presidential election (one can easily check this themselves), Trump would still win, this means that our model may not always agree with the popular vote.

Benefits & Shortcomings

Incorporates different systems. This process in some ways incorporates different voting methods such as the positional, and plurality voting, which could be a good compromise for people with different visions for the electoral system of the U.S. The Ulysse method gives more power to the larger states much like the electoral college, however it gives some more power to the supporters of candidates that live in states that largely oppose their own political views, which one might argue is more democratic.

Nontransitive preferences. The method disregards the fact that voters in fact do have preferences, which by the Condorcet paradox would imply that the state preferences are non-transitive.

Reflection of voter preferences. While it does give more power to the losing voters in each state, it can still produce outcomes that are in disagreement with the general population; however, it is entirely possible that the population would have made an objectively wrong choice in a majority vote so it can function as a safety check.

Strategyproofness. If we attempt to check the mechanisms strategyproofness, it is in reality not very feasible for a state to falsely report its preferences given the way they are defined, and even at an individual level it would be asinine for an individual to not vote for their top choice, since they can only report their top choice.

Conclusion

In this paper we have realized that not all voting systems are equal. We see that voting methods can be distinct, depending on the context, such as plurality voting in U.S. states and ranked choice voting in Ireland. Our mechanism illustrates the volatility of voters allegiances to candidates over a length of time, between the announcement of a campaign until election day. These moments are often ignored when modeling voting systems and brought interesting insight into potential strategies for candidates. Lastly, we designed and proposed a new model which incorporates different voting methods such as the positional, and plurality voting, as a potential substitute for the current U.S. electoral system, amongst other ranked choice voting systems.