Simulating Electoral College Results using Ranked Choice Voting if a Strong Third Party Candidate were in the Election Race

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Ranked choice voting, also known as instant runoff voting (IRV) in the US [3] or the alternative vote (AV) in Australia [1], is a voting method in which the voters are allowed to rank the candidates in order of preference. While the voting system currently used in most of the United States requires a simple plurality of the votes to win, ranked choice voting requires a candidate to have a majority of the votes, i.e. over 50% of the votes. If a candidate has not received a majority of the first choice votes in the initial vote count, the candidate with the fewest votes is eliminated and their votes are redistributed to the voters' next choice. Once the votes have been redistributed, the vote totals are revised. This process of elimination, redistribution, and revision repeats until a candidate has a majority of the votes; see Figure 1.

In the modeling process, we use two main sources of data, the Cooperative Congressional Election Study (`https://cces.gov.harvard.edu`), or CCES, and the official presidential election results (`https://www.fec.gov/pubrec/fe2016/2016presgeresults.pdf`). The CCES is used to create the predictive models necessary in the redistribution of votes in the RCV elimination process while the official election results are used as initial conditions for this process.

In simulating the effects of implementing ranked choice voting in the 2016 presidential election, we used predictive modeling to determine how the votes would be redistributed when a candidate is eliminated. Since there have not been a lot of studies in the third party voters' ideologies and how they relate to the major party candidates, we use predictive modeling as a means for estimating for which of the two major party candidates a third party voter might have voted as their second choice.

Simulated results of implementing ranked choice voting using official election results indicated that a handful of states may flip preference from one major party to another; however, the winner of the presidential election would not have changed. We hypothesized that the third party candidates did not have enough votes to swing the election one way or another. To simulate the potential effects a strong third party candidate might have had on the election, we considered the scenario in which several of the primary major party candidates were also official candidates in the final presidential election. In the 1992 election, Ross Perot was such a candidate, winning approximately 19% of the popular vote and having over 30% of the final vote in Maine and 27% in Utah [2]. Since candidates such as Bernie Sanders and Ted Cruz rivaled Clinton and Trump, we hoped to discern the potential impact a candidate with a lot of support might have had on the election process had they been included and ranked choice voting been implemented. Therefore, we assume that ranked choice voting is implemented in the 2016 presidential election with Democratic candidates Bernie Sanders and Hillary Clinton and four Republican candidates, Donald Trump, Ted Cruz, John Kasich, and Marco Rubio, along with the previous third party candidates, Gary Johnson, Jill Stein, and Evan McMullin.

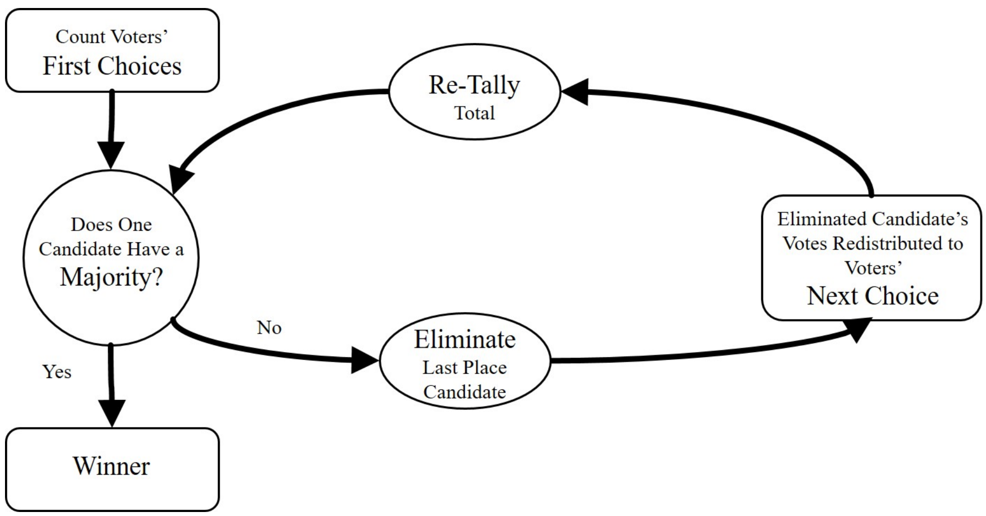

Figure 1: This figure shows the process by which a candidate is elected using ranked choice voting.

The first step in simulating this scenario is to determine initial vote counts for each of the nine candidates (2 democratic, 4 republican, and 3 original third party) prior to implementing Ranked Choice Voting. From the CCES data, we have information about the respondents voting preference in both the primary and final election. For example, Figure 2 illustrates the distribution of CCES respondents who voted for Clinton in the final election. Of the respondents who indicated they voted for Clinton in the final election, 44% also voted for her in the primary election. However, 56% of these respondents voted for a different candidate in the primary or didn't vote in the primary election at all. We make the assumption that if a respondent voted for a different candidate in the primary election, this would be the voter's first choice unless their primary candidate choice was one of the five candidate options in the final election (for example, if someone voted for Clinton in the primary election but Stein in the final election, then the voter had the option of voting for Clinton and chose not to do so). For those voters who did not vote in the primary election but voted for Clinton in the final election, we make the assumption that the distribution of this group is the same as for the remainder of the voters (see Figure 2). Therefore, to reallocate Clinton's votes to consider all nine candidates in the election, we redistribute Clinton's initial vote count according to the final distribution in Figure 3. In this figure, we see that Clinton keeps 60% of her votes while 35% is reallocated to Sanders, 3% to Kasich, and 1% to both Rubio and Cruz.

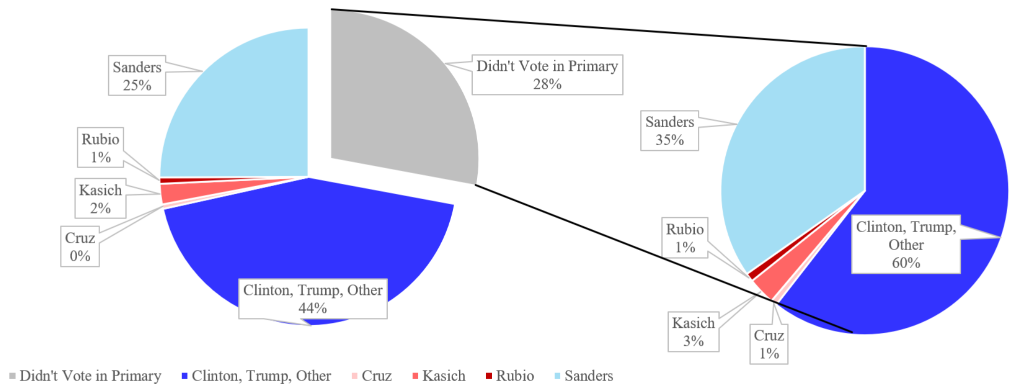

Figure 2: The pie chart on the left illustrates the distribution of CCES respondents who indicated they voted for Clinton in the final election according to who they voted for in the primary election. The pie chart on the right is how we allocate the portion of respondents who didn't vote in the primary election according to the same distribution as those who did vote in the primary election.

We do the same for each of the five original final candidates, Clinton, Trump, Johnson, Stein, and McMullin. Figure 4 gives the distribution for how we allocate the remaining candidate's votes to each of the new candidates. Note that Trump keeps 59% of his votes while 22% is allocated to Cruz, 7% to Rubio and 6% to both Sanders and Kasich. The majority of Johnson's votes are almost evenly split between Johnson and Sanders with 28% remaining with Johnson and 30% reallocated to Sanders. The remaining votes are split almost evenly across Kasich, Cruz and Rubio. The majority of Stein's initial vote count is reallocated to Sanders with only 11% remaining with Stein and then a small percentage to Cruz, Kasich, and Rubio. Finally, 47% of McMullin's votes are reallocated to Cruz, 24% to Rubio, 17% to Kasich, 8% to Sanders and only 4% remaining with McMullin. The total initial votes nationwide for this scenario is given in Figure 5. We notice that as was the case originally, Clinton still has the largest percentage of the popular vote with 29.41% of the votes; Trump and Sanders follow closely behind with 27.62% and 21.43% respectively. Cruz has 11.27% of the initial popular vote with diminishing percentages for Kasich, Rubio, Johnson, Stein, and McMullin.

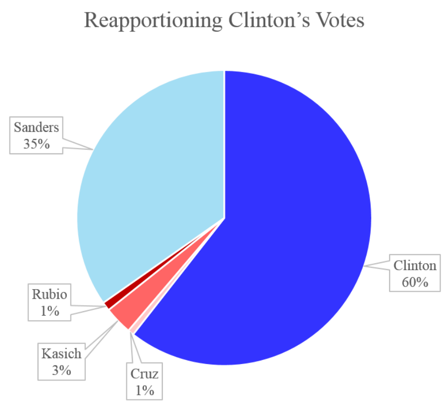

Figure 3: This pie chart shows how Clinton's initial votes are reallocated to all the new candidates not originally in the final election

In this scenario, we make several simplifying assumptions. First, we assume the bottom five candidates (McMullin, Stein, Johnson, Rubio and Kasich) will be eliminated in the first five rounds. In all states except the District of Columbia (already has a majority in this multiple candidate scenario so no reapportioning will occur), these five candidates have the lowest vote count (the order varies). Secondly, for simplicity, we assume the next choice candidate for all of the bottom five candidates is one of the top four candidates (Sanders, Clinton, Trump, and Cruz). In other words, we do not allow any of the votes from the bottom five candidates to be reapportioned amongst each other. Finally, after eliminating the bottom five candidates, the top four candidates are assumed to be eliminated one by one, allowing votes to be reapportioned amongst any of the remaining candidates until a candidate has a majority of the votes.

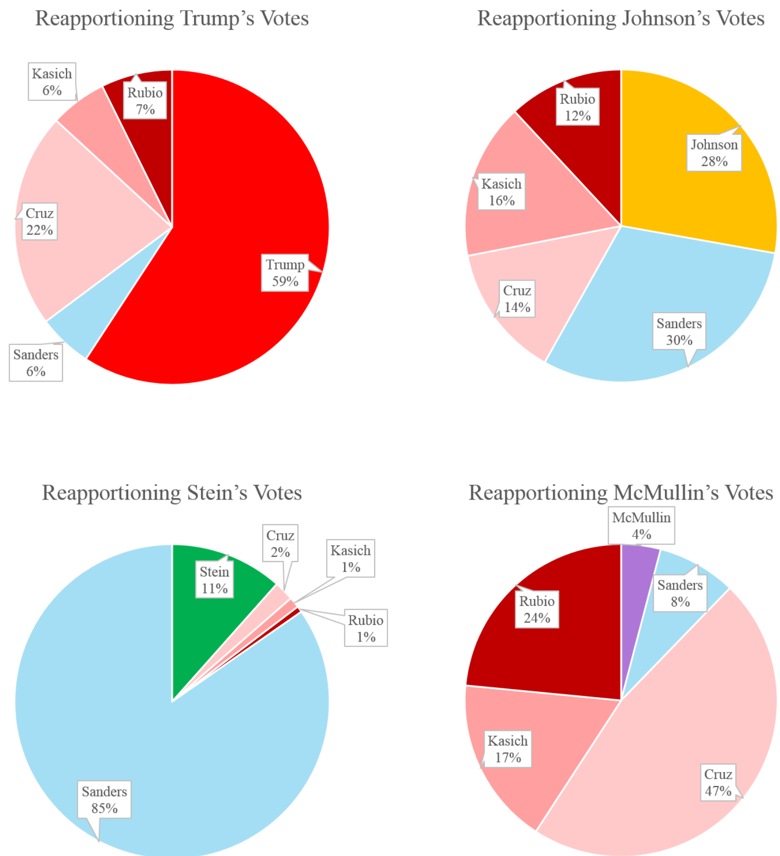

Figure 4: This pie chart shows how Trump's, Johnson's, Stein's and McMullin's initial votes are reallocated to all the new candidates not originally in the final election

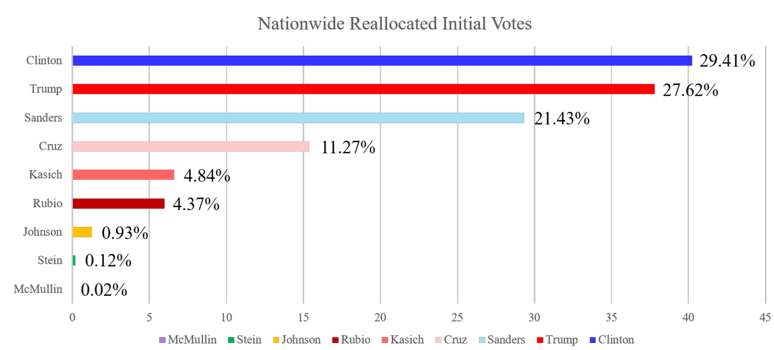

Figure 5: This bar graph shows the nationwide totals after all the initial votes are reallocated to include the new candidates from the primary election.

To implement ranked choice voting (RCV) in this multiple primary candidate scenario, we follow the algorithm given below:

Algorithm for Implementation of RCV for Multiple Candidate Scenario

Step 1: Initialize the votes for all candidates to the official 2016 results for the state.

Step 2: Reallocate votes from Step 1 to include all primary and third party candidates as discussed in the text (see Figures 3 and 4).

Set w = number of Trump's votes.

Set x = number of Clinton's votes.

Set y = number of Cruz's votes.

Set z = number of Sander's votes.

Step 3: For each of the bottom five candidates, in order from least votes to most, reapportion votes to either Clinton, Trump, Sanders, or Cruz until a majority is reached or until all votes are reapportioned.

Step 3a: Reapportion votes as either Republican or Democratic using probability ρ_R picked from a normal distribution with mean μ_R (using the Clinton/Trump random forests predictive algorithm and results in Table 2) and standard deviation 0.15/1.96.

- Set N = the number of eliminated candidate's votes.
- Generate a uniformly distributed vector $\mathbf{v}$ of numbers between 0 and 1 of length N.
- Determine n_R, the amount of numbers in $\mathbf{v}$ which are less than ρ_R. (Number of reapportioned votes to Republican)
- Set $n_D = N - n_R$. (Number of reapportioned votes to Democrat)

Step 3b: Reapportion Republican votes to either Trump or Cruz using probability ρ_T picked from a normal distribution with mean μ_T (using the Trump/Cruz random forests predictive algorithm and results in Table 2) and standard deviation 0.15/1.96.

- Generate a uniformly distributed vector $\mathbf{v}_R$ of numbers between 0 and 1 of length n_R.
- Determine n_T, the amount of numbers in $\mathbf{v}_R$ which are less than ρ_T. (Number of reapportioned Republican votes for Trump)
- Add votes to either Trump or Cruz.
  - Trump: $w = w + n_T$
  - Cruz: $y = y + (n_R - n_T)$

Step 3c: Reapportion Democratic votes to either Clinton or Sanders using probability ρ_C picked from a normal distribution with mean μ_C (using the Clinton/Sanders random forests predictive algorithm and results in Table 2) and standard deviation 0.15/1.96.

- Generate a uniformly distributed vector $\mathbf{v}_C$ of numbers between 0 and 1 of length n_D.
- Determine n_C, the amount of numbers in $\mathbf{v_C}$ which are less than ρ_C. (Number of reapportioned Democratic votes for Clinton)
- Add votes to either Clinton or Sanders.

  Clinton: $x = x + n_C$

  Sanders: $z = z + (n_D - n_C)$

Step 4: If a majority has not been reached, order the remaining candidates (Clinton, Sanders, Cruz, and Trump) in order of greatest to least votes with n_1 equal to the number of votes for the candidate in first place, etc. Then reapportion the votes for the candidate with the lowest votes using the appropriate random forests predictive algorithm and results in Table 3 in the same manner as above.

- Generate a uniformly distributed vector $\mathbf{v}_4$ of numbers between 0 and 1 of length n_4 where n_4 is the number of votes for the eliminated candidate (candidate with the least amount of votes).
- Let μ_1 be the estimated probability that the eliminated candidate's votes are reapportioned to the candidate in first place, μ_2 be the estimated probability that the eliminated candidate's votes are reapportioned to the candidate in second place and μ_3 be the estimated probability that the eliminated candidate's votes are reapportioned to the candidate in third place using the appropriate random forests predictive algorithm and results in Table 3.
- Choose ρ_1 and ρ_2 from a normal distribution with mean μ_1 and μ_2 respectively and standard deviation 0.15/1.96.
- Determine n_{e1}, the amount of numbers in $\mathbf{v}_4$ which are less than ρ_1. (Number of reapportioned votes for candidate currently in first place in the state)
- Determine n_{e2}, the amount of numbers in $\mathbf{v}_4$ which are between ρ_1 and $\rho_1 + \rho_2$. (Number of reapportioned votes for candidate currently in second place in the state)
- Add votes to remaining three candidates.

  $n_1 = n_1 + n_{e1}$

  $n_2 = n_2 + n_{e2}$

  $n_3 = n_3 + n_4 - (n_{e1} + n_{e2})$

Step 5: If a majority has not been reached, reapportion the votes from the candidate with the lowest number of votes of the three remaining using an appropriate random forests predictive algorithm for the top two candidates and results in Table 4.

Step 6: Appropriate the states electoral votes to the majority candidate.

Step 7: Repeat steps 1-5 for each state and the congressional districts in Maine and Nebraska.

Step 8: Determine the total number of electoral votes for each candidate.

In the algorithm, we use several predictive models to determine to which candidate the eliminated candidate's votes are reapportioned. When eliminating the bottom five candidates (McMullin, Stein, Johnson, Kasich, and Rubio), we always reapportion the votes to either Clinton, Sanders, Trump or Cruz. Predictive models with multiple outcomes typically have a lower training score than those with fewer outcomes; therefore, we broke this process into three steps. As the algorithm indicates in Step 3, we first determine the probability of a candidate's votes being reapportioned Democratic or Republican using the original Trump/Clinton random forest algorithm. We already have the current probabilities for Stein, Johnson and McMullin to vote either Democratic or Republican given in Table 1. Therefore, we additionally isolate the CCES respondents who voted for Kasich in the primary and use the random forests algorithm to predict the percentage of respondents predicted to vote either for Clinton (the Democratic party) or for Trump (the Republican party). We did the same for Rubio. These probabilities are given in Table 2 along with the individual probabilities to vote for a particular Republican or Democratic candidate.

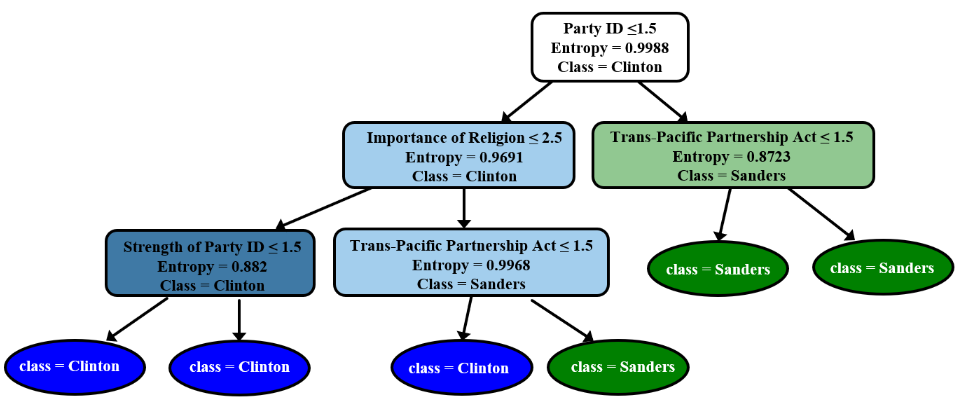

Figure 6: This figure shows a sample 6-leaf decision tree using CCES weighted data for predicting whether a voter will vote for Clinton or Sanders.

Table 1: Average Predicted Probability of Third Party Voters by State

Third Party Candidate	State	Percent Predicted to Vote Republican	Percent Predicted to Vote Democratic
Gary Johnson	Nation	0.67	0.33
	CA	0.65	0.35
	FL	0.65	0.35
	GA	0.66	0.34
	IL	0.71	0.29
	IN	0.63	0.37
	MA	0.60	0.40
	MI	0.64	0.36
	MO	0.74	0.26
	NY	0.63	0.37
	NC	0.81	0.19
	OH	0.70	0.30
	PA	0.60	0.40
	TX	0.62	0.38
	VA	0.69	0.31
	WA	0.77	0.23
Jill Stein	Nation	0.21	0.79
	CA	0.12	0.88
	FL	0.18	0.82
	IL	0.23	0.77
	MI	0.26	0.74
	NY	0.28	0.72
	PA	0.24	0.76
Evan McMullin	Nation	0.88	0.12

Since there are multiple Democratic and Republican candidates, we must then determine whether those respondents predicted to vote Democratic are likely to vote for Clinton or Sanders. Likewise, we also need to determine whether the respondents expected to vote Republican are likely to vote for Trump or Cruz. Therefore, we need two additional predictive models for this portion of the elimination process. We create two additional random forests predictive models for Clinton/Sanders and for Trump/Cruz. Sample decision trees using all the possible factors are given in Figures 6 and 7 for Clinton/Sanders and Trump/Cruz, respectively. We note that the most predictive factor for Clinton vs Sanders is whether the voter is a strong democrat or not. Other factors include the voter's importance of religion and whether they support or are against the Trans-Pacific Partnership Act. In the Trump/Cruz sample decision tree (Figure 7), the most important factor is whether a voter always supports a woman's right to have an abortion. Other factors include how liberal they rate themselves and Donald Trump.

Using a forest of 128 6-leaf decision trees in the random forest algorithm, we have an

Table 2: Nationwide Average Predicted Probability of Voters for Bottom Five Candidates in Multiple Candidate Scenario

Candidate	Percent Predicted to		Percent Predicted to	
Gary Johnson	Vote Republican		Vote Democratic	
	0.67		0.33	
	Vote Trump	Vote Cruz	Vote Clinton	Vote Sanders
	0.86	0.14	0.09	0.91
Jill Stein	Vote Republican		Vote Democratic	
	0.21		0.79	
	Vote Trump	Vote Cruz	Vote Clinton	Vote Sanders
	0.99	0.01	0.09	0.91
Evan McMullin	Vote Republican		Vote Democratic	
	0.88		0.12	
	Vote Trump	Vote Cruz	Vote Clinton	Vote Sanders
	0.47	0.53	0.03	0.97
John Kasich	Vote Republican		Vote Democratic	
	0.71		0.29	
	Vote Trump	Vote Cruz	Vote Clinton	Vote Sanders
	0.83	0.17	0.08	0.93
Marco Rubio	Vote Republican		Vote Democratic	
	0.90		0.10	
	Vote Trump	Vote Cruz	Vote Clinton	Vote Sanders
	0.65	0.35	0.04	0.96
Approximate Total Allocated Votes per Candidate in Reapportioning				
	Trump	Cruz	Clinton	Sanders
Gary Johnson	0.58	0.09	0.03	0.30
Jill Stein	0.21	0	0.07	0.72
Evan McMullin	0.41	0.47	0	0.12
John Kasich	0.59	0.12	0.02	0.27
Marco Rubio	0.59	0.31	0	0.10

average training score of 0.73 and a testing score of 0.72 for both the Clinton/Sanders and Trump/Cruz predictive models. Based on these models and the associated probabilities in Table 2, in the reapportioning process of the bottom five candidates when implementing ranked choice voting, we see that approximately 58% of Johnson's votes would be reapportioned to Trump, 30% to Sanders and smaller percentages to both Cruz and Clinton. The majority (71%) of Stein's votes are reapportioned to Sanders with 21% going to Trump and only 7% to Clinton. Only 12% of Evan McMullin's votes are reapportioned to Sanders while the remainder of his votes are almost equally split between Trump and Cruz. When either

Kasich or Rubio's votes are reapportioned, approximately 59% are reapportioned on average to Trump. For Kasich, it is predicted that on average 27% of the votes are reapportioned to Sanders and only 12% to Cruz. On the other hand, 31% of Rubio's votes are reapportioned on average to Cruz and only 10% to Sanders.

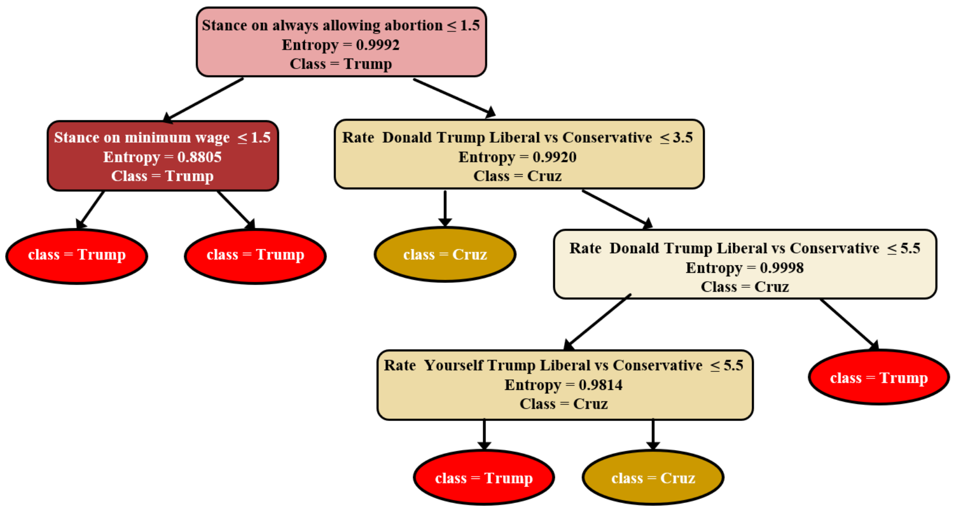

Figure 7: This figure shows a sample 6-leaf decision tree using CCES weighted data for predicting whether a voter will vote for Trump or Cruz.

In the algorithm, once all the votes from the bottom five candidates are reapportioned, if no majority is reached, the top four candidates will be eliminated one-by-one with all the votes reapportioned to the remaining candidates until a majority is reached. Table 3 shows the outcome of using random forests to predict the next choice candidate when votes are reapportioned from Trump, Clinton, Sanders and Cruz. We have four predictive models, each using a forest of 128 9-leaf decision trees in the random forest algorithm, which are used to predict the probability of the bottom candidate's votes being reapportioned to each of the remaining three candidates. We see from the table that, as expected, the majority of votes are predicted to stay within the party.

We then use the probabilities and predictive models in Table 4 to further reapportion the votes for the top three candidates. We consider predictive models using random forests for Trump vs. Sanders, Trump vs. Clinton, Trump vs. Cruz, Clinton vs. Sanders and Cruz vs. Sanders and run each of the remaining candidates through these models. It is evident when examining the differences in training and testing scores for the predictive models, that it is easier to predict across parties than within parties. When creating a predictive model across parties, the testing and training scores are in the 0.9 range; whereas, when creating a predictive model for candidates within the same party (Trump vs. Cruz and Clinton vs.

Table 3: Nationwide Average Predicted Probability when Eliminating One of the Top Four Candidates in the Multiple Candidate Scenario using 9-leaf Decision Trees in Random Forests

Eliminated Candidate	Predictive Model and Probabilities			
Ted Cruz	Next Choice Trump, Clinton or Sanders Training Score: 0.758; Testing Score: 0.754			
	Vote Trump	Vote Clinton	Vote Sanders	Vote Cruz
	0.97	0.02	0.01	0
Bernie Sanders	Next Choice Clinton, Trump, or Cruz Training Score: 0.800; Testing Score: 0.795			
	Vote Trump	Vote Clinton	Vote Sanders	Vote Cruz
	0.10	0.89	0	0.01
Hillary Clinton	Next Choice Sanders, Trump, or Cruz Training Score: 0.736; Testing Score: 0.731			
	Vote Trump	Vote Clinton	Vote Sanders	Vote Cruz
	0.02	0	0.98	0
Donald Trump	Next Choice Cruz, Clinton, or Sanders Training Score: 0.731; Testing Score: 0.726			
	Vote Trump	Vote Clinton	Vote Sanders	Vote Cruz
	0	0.05	0.06	0.89

Sanders), the testing and training scores are in the 0.7 range. We also note that similar to the previous models, the results indicate that there is a higher probability of a voter voting within the original party than changing votes to another major party candidate. However, there are some slight differences. For instance, if Cruz's votes are reapportioned, there is a probability of 0.96 of the votes going to Trump; however, if Trump's votes are reapportioned, there is only a probability of 0.85 of being reapportioned to Cruz. Furthermore, when Trump is eliminated and only Clinton and Sanders remain, an overwhelming majority of votes will be reapportioned, on average, to Sanders with a probability of 0.94. Furthermore, when Sanders is eliminated and only Trump and Cruz remain, there is a probability of 0.99 of votes being reapportioned to Trump over Cruz.

Using the algorithm discussed above and the probabilities in Tables 2 - 4, we implement ranked choice voting in the multiple major party candidate scenario. We first initialize votes for all nine candidates with mean proportions indicated in Figures 3 and 4. We then randomize these percentages using a normal distribution with 95% of the points lying within 4% of the estimated percentage to account for any inaccuracies in the estimate. We create 100 different sets of initial vote counts using the randomized reallocation percentages. Prior to implementing ranked choice voting, Trump wins the presidency with over 270 electoral votes in 54 of the 100 initial vote counts considered. In the other 46 cases, Clinton starts off as the winner with over 270 electoral votes. In this scenario, the only state in which a candidate wins with a majority is District of Columbia in which Clinton keeps over 50% of the initial votes for all runs. Therefore, this is the only state in which ranked choice voting is not implemented.

Table 4: Nationwide Average Predicted Probability when Reapportioning Votes for the Top Three Candidates using 6-leaf Decision Trees in Random Forests

Predictive Model and Probabilities		
Trump vs. Sanders Training Score: 0.921; Testing Score: 0.919		
Eliminated Candidate	Trump	Sanders
Cruz	0.96	0.04
Clinton	0.03	0.97
Trump vs. Clinton Training Score: 0.940; Testing Score: 0.939		
Eliminated Candidate	Trump	Clinton
Cruz	0.96	0.04
Sanders	0.10	0.90
Trump vs. Cruz Training Score: 0.727; Testing Score: 0.716		
Eliminated Candidate	Trump	Cruz
Clinton	1	0
Sanders	0.99	0.01
Clinton vs. Sanders Training Score: 0.727; Testing Score: 0.720		
Eliminated Candidate	Clinton	Sanders
Trump	0.06	0.94
Cruz vs. Sanders Training Score: 0.937; Testing Score: 0.935		
Eliminated Candidate	Cruz	Sanders
Trump	0.85	0.14

For each of the 100 different initial vote counts, we ran the simulations for implementing ranked choice voting 100 times using randomly generated probabilities as explained in Steps 3 and 4 of the algorithm above with mean values in Tables 2, 3, and 4. The overall results for the winner of the presidential election is given in Figure 8. On first glance it appears as if ranked choice voting had only a slight impact, since Trump won in 60% of the simulations while he started as the winner in 54% of the initial vote counts. However, upon closer examination of the results, in 33% of the trials, the presidency switched from one winner to either another winner or to no winner. See Figure 9 for details on the percentage of times ranked choice voting changed the original outcome of the election in our simulated studies. In the trials in which Trump started with over 270 electoral votes initially, 76% (41/54) of the time, Trump still wins the presidency with over 270 electoral votes; however 22% (12/54) of the time, ranked choice voting leads to Clinton winning the presidency and 2% (1/54) of the time there is no winner with over 270 electoral votes. Similarly, when the election starts with Clinton having over 270 electoral votes, 57% of the time, Clinton still wins the presidency with over 270 electoral votes; however, when ranked choice voting is implemented, 41% (19/46) of the time, Trump wins the presidency and 2% of the time there is no winner with over 270 electoral votes. The spread in total electoral votes for both Trump and Clinton is given in Figure 10. We note that although the initial number of electoral votes are centered away from the critical 270 value threshold, after implementing ranked choice voting there is a wider spread in votes and they are centered towards the critical value of 270 electoral votes required to win the presidency.

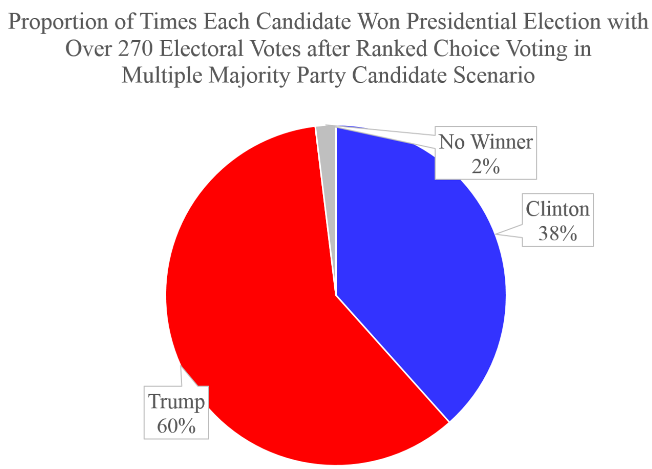

Figure 8: This figure shows the proportion of times each candidate won the presidency with over 270 electoral votes after ranked choice voting was implemented with multiple majority party candidates.

We further note that in this scenario, in several instances, Sanders acted as a spoiler candidate. In fact, 13.54% of the simulations results in Sanders getting at least one electoral vote. The total number of electoral votes for Sanders comes from winning one or more states, a direct result of ranked choice voting. We have listed the most common states in which Sanders wins electoral votes in Table 5. As seen from this table, of the times that Sanders wins a state, 50% of those times, the state is Hawaii with 4 electoral votes. Less likely, Sanders also wins New Mexico and Maine's second congressional districts with 12% and 10% of Sanders' wins respectively. Although the number of electoral votes for these states are small, if the race is close, these votes could sway the election. Since voters tend to stay within the same party, we hypothesize that if Sanders did not win these electoral votes, Clinton most likely would have won them. In 194 simulations, no candidate receives over 270 electoral votes, and in 115 of these cases, the sum of Clinton's and Sanders' electoral votes result in over 270. Although rare, in 71 of the simulations (0.7% of the total simulations), only Clinton and Trump procured electoral votes; however, both candidates tie with 269 votes each. In all the instances in which no candidate receives the required 270 electoral votes, the presidency is *not* decided by the people, but it is decided upon by the House of Representatives. Therefore, although rare, ranked choice voting can have the opposite effect than what the proponents of ranked choice voting desire; it can cause the people to have less say in the election, making the election less democratic instead of more. We do note that Sanders is not simply a strong third party candidate but instead a strong Democratic candidate. Therefore, to interpret these simulations in terms of a strong third party candidate, we need to assume the strong third party candidate has a substantial influence with voters of one particular party. The results may be very different if the strong third party candidate has strong support from both major party voters. We would need a different way to simulate that scenario.

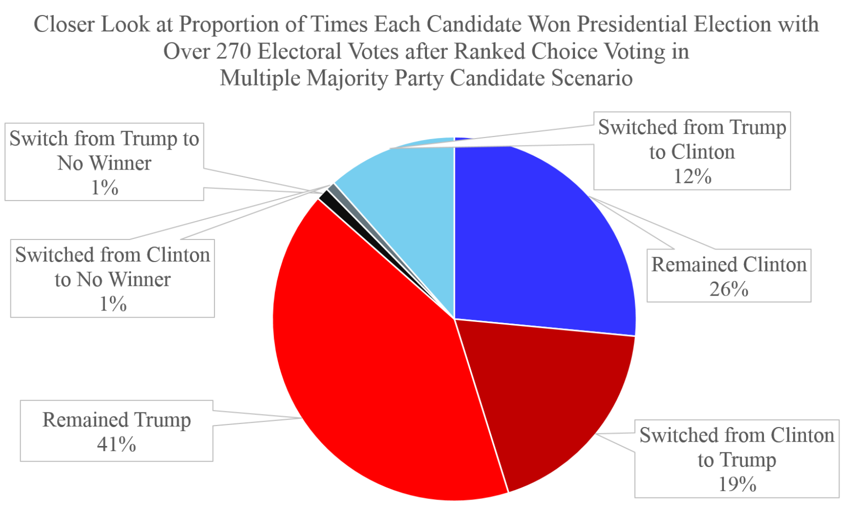

Figure 9: This figure shows details about the effects of ranked choice voting on potential outcomes of the presidential election when considering multiple majority party candidates.

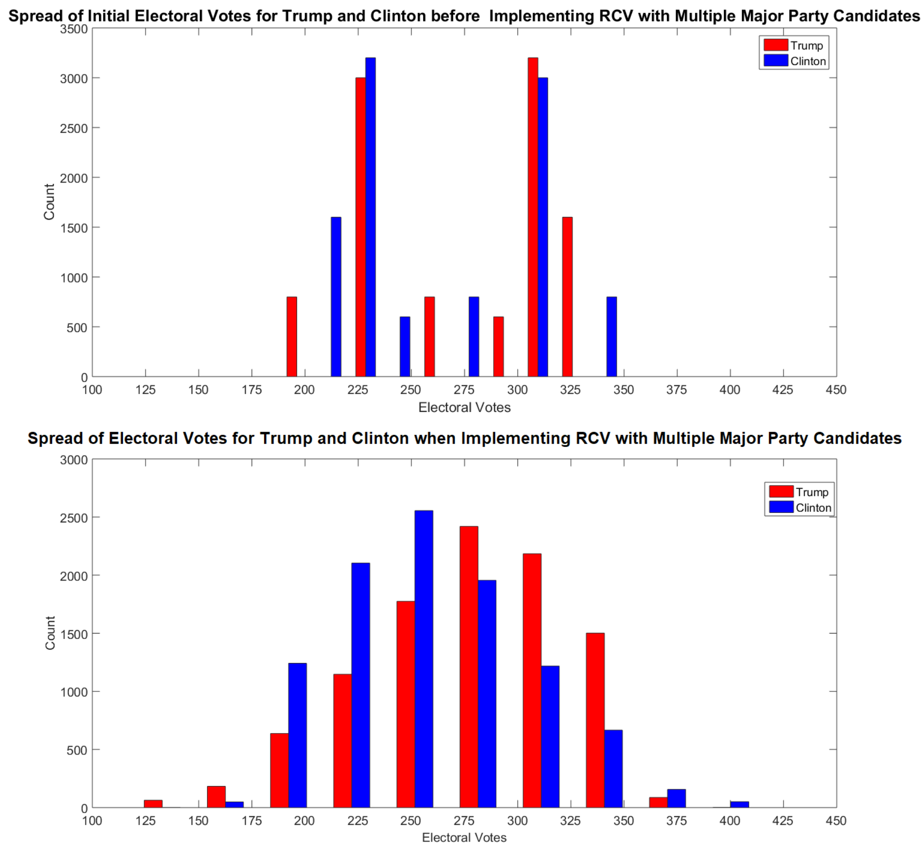

Figure 10: The top figure shows the initial spread in electoral votes won before ranked choice voting was implemented and the bottom figure shows the spread after ranked choice voting was implemented with multiple majority party candidates.

References

[1] Clive Bean. Australia's experience with the alternative vote. *Representation*, 34(2):103–110, 1997.

[2] Federal Election Commission. Federal elections 92: Election results for the u.s. president, the u.s. senate and the u.s. house of representatives. Technical report, Washington, D.C., June 1993.

[3] FairVote. How rcv works. `www.fairvote.org/rcv#how_rcv_works`. Accessed: 2017-08-15.

Table 5: Percentage of Times Sanders Win Selected States when Receiving Electoral Votes

State	Total Electoral Votes for State	Percentage of Sanders' Wins
Hawaii	4	50%
New Mexico	5	12%
Maine 2nd CD	1	10%
California	55	6%
Nebraska 2nd CD	1	3%
Arizona	11	3%
Vermont	3	2%
Ohio	18	2%
Minnesota	10	2%
Colorado	9	2%
Iowa	6	1%
Alaska	3	1%
Texas	38	1%
Oregon	7	1%
Wisconsin	10	1%