

Project 2: Election

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1 Introduction

We simulated and analyzed the 2020 election with the latest polling data. The polling data suggests that all the states except 9 are determined to vote for one side; however, there are 9 states (we call them "swing states") whose voters are quite evenly divided up between the two sides. The outcome of the election will be determined by the wins and losses in those states, so our focus of this report will be on the swing states.

2 Method

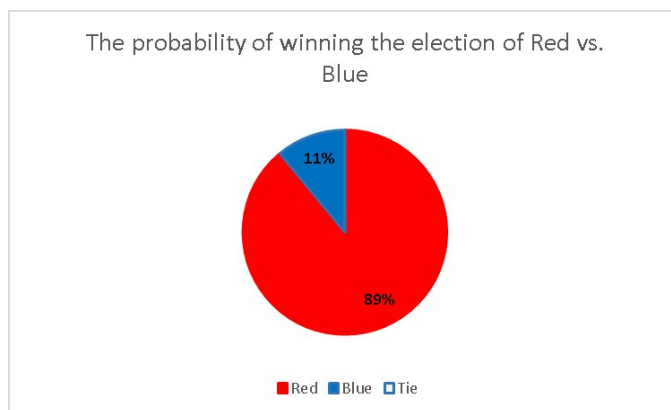
First, we calculate the percentage of population in the state who actually voted for Red by correcting the Red voters data from the poll using the Margin of Error. The way we treated the Margin of Error is by creating a Normal Random Variable whose standard deviation is half of the Margin of Error. By this way, with 95% of chances, it will fall between the range given by the Margin of Error, although it will most likely be 0, denoting that the polling data is correct; and its minimum and maximum values are the negation of the Margin of Error, and the Margin of Error itself, respectively.

Second, we repeat the aforementioned procedure to calculate the percentage of population in the state who actually voted for Blue. Then, we can calculate the percentage of population who are still undecided, or casted a blank vote by subtracting the percentage of voters for Red and Blue from 100.

For some states, the Margin of Error is too large, making the simulation unreliable and the percentage of undecided population negative. In that case, we ignore the result and regenerate the outcome. Else, we proceed to add all the electoral votes of that state to the winning side.

3 Election Result

The following pie chart illustrates the probability of winning the election for each candidate. We expect the Red candidate to win the election with probability of 89%. The Blue candidate only has 11% of winning the election. In particular, there should be no tie between the candidates.



We ran the election module 10,000 times for the experiment. As a result, Red wins for 8,893 out of 10,000 times and Blue wins the rest. There is no tie in our results. In other words, Red wins with the probability of 89%.

4 Analysis

Several analyses were done using the simulation code we wrote. Such analyses include finding states that are critical to each side to win the election, calculating the probability of landslide, which means one side

wins by having more than 300 electoral votes, and discussing the change in result if a scandal happens on one side and the undecided voters swing to the other.

4.1 Critical States

Since, we examined the probability of winning the election for each candidate, the next important part of the analysis is to find out which states are the most critical for the candidate. The table below breaks down the chance of winning a swing-state for each candidate:

State	EV	Red Win %	Blue Win %
Florida	29	100.	0.
Pennsylvania	20	27.2	72.8
Ohio	18	92.5	7.5
Virginia	13	81.5	18.5
Indiana	11	52.3	47.7
Missouri	10	99.8	0.2
Colorado	9	0.1	99.9
Kansas	6	0.4	99.6
Iowa	6	5.1	94.9

The method to get the results in this table is to run the simulation for each state individually to find the expected value of winning. Base on the results, we can see the obvious outcomes of winning at some states for each candidate. In particular, Red will get the EVs from Florida and Missouri (probability of winning is +99%). Blue will mostly likely win Colorado, Kansas and Iowa. Adding these states EVs to the non-swing states EVs of each candidate, Red will have 245 EVs and Blue will have 233 EVs. We are left with PA, VA, OH and IN.

Next, we will determine which states are critical for the Blue candidate to campaign since he only gets 11% chance of winning the election. Among the four states PA, VA, OH and IN, PA and OH have the most EVs with 20 and 18 respectively. Given the condition that each candidate can only campaign in a few states, then Blues campaign should focus on PA and OH. If Blue wins PA and OH and lose VA and IN, Blue still wins the election with 271 EVs, as opposed to Red with 269 EVs.

4.2 Landslide

As we discussed above, the probability of each side winning the election is about 89 percent for Red and 11 percent for Blue. Among these probabilities, there could be some chances for which they win with more than 300 electoral votes. By adding a variable that records such cases to our simulation, we found the probability of landslides occurring. As a result, the probability of landslide is approximately 11 percent for Red, whereas 0 percent for Blue.

4.3 In Case of a Scandal

What would happen to the election result if, for some kind of a scandal in one side, all the undecided voters would decide to vote for the other side? Figuring out the result in such case does not even require a simulation.

Since Blue is the challenger in this year's election, let us see what happens if all the undecided vote for Blue. If we add the percentage of Blue voters and undecided voters, Blue would win for sure in every swing state except Indiana. However, among the 122 electoral votes available to swing states, Indiana's is only 11, and even if Red wins in Indiana, Blue will win the election with no doubt. If there is a scandal in Blue and the undecided voters vote for Red, it is not difficult to predict Red's win.

5 Conclusion

Through a simulation of the 2020 election, we found that the winner of the election will be determined by the results among the 9 swing states. Although Red will very likely win the election by 89% of chance, Blue still has some chances of winning, especially if it wins Pennsylvania and Ohio. Therefore, if Blue can choose some states to campaign, it should choose PA and OH, or OH only if resources are limited. Unless there is a huge change in the percentage of undecided, Red will win the election, even having a landslide with 11% of chance. The both sides should not put off their guard, since if a scandal breaks out from one side and the undecided voters turn to the other side, any side can win the election.