Apportionment the 2016 Election

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Abstract

The 2016 election between Hillary Clinton and Donald Trump was one of five cases where the winner of the popular vote was not the winner of the election. In this project, we examine the 2016 election to determine the reasoning behind the popular vote vs. electoral vote discrepancy. First, we observe the effects of four different apportionment methods. Then, taking inspiration from Neubauer and Zeitlin's study on the 2000 election, we change the size of the House of Representatives to numbers ranging from 400 to 1008, and model the election [1]. We also observe the effects of using a proportional voting method within the states instead of the traditional winner-take- all method. Ultimately, using various approaches, we attempt to determine if there is a way to model the election that changes the outcome so the popular vote and electoral vote produce the same winner.

1 Introduction

As a democratic republic, the United States chooses its leader using the Electoral College. This system apportions a certain number of votes to each state based on its population. Currently, the apportionment method used is the Huntington-Hill method. While the system of the Electoral College usually leaves an election with no questions, on a few occasions there has been a discrepancy between the winner of the election and the winner of the popular vote. In these instances, it is interesting to examine the system we use to elect our president. [9]

The 2016 election between Hillary Clinton and Donald Trump was one of five instances where the president elected did not win the popular vote. We can examine this rare occurrence by investigating the apportionment method. Neubauer and Zeitlin completed a study on the 2000 election that examined whether the size of the House of Representatives effected the outcome of the election [1]. This study aims to examine the 2016 election in a similar way. Note that the size of the House of Representatives, and by extrapolation the size of the Electoral College, was set to 435 in 1941. Using this information, the voting totals from each state, and several different apportionment methods, we can calculate scenarios that determine the outcome of the election.

2 Definitions and Development

Before delving into the research, it is important to state a few definitions. In particular, we will outline apportionment and the particular methods of apportionment considered throughout this research.

Definition 1 Apportionment is the method the government uses to divide the House of Representative seats among all 50 states [2].

Definition 2 The **standard divisor** is the average number of people represented by one delegate. It is determined by dividing the US population by the number of seats in the House of Representatives [2].

Definition 3 The **quota** is the exact number of delegates a state would receive if fractional parts could be given. It is determined by dividing a state's population by the divisor. This is the number that is rounded to determine the number of representatives a state receives [2].

Definition 4 The **Huntington-Hill** method of apportionment divides the state population by the divisor to find a quota, then based on how the quota compares to the geometric mean of the surrounding whole numbers, the quota is rounded up or down to determine the number of delegates a state receives [2].

Definition 5 Jefferson's method of apportionment divides the state population by some divisor and then rounds down. The only exception is that each state must have one representative [4].

Definition 6 Adams' method of apportionment divides the state population by some divisor and then rounds up [5].

Definition 7 Hamilton's method of apportionment divides the state population by the divisor and rounds down. Then, instead of altering the divisor to ensure that the total number of votes is correct, it awards additional representatives to states with the largest fractional parts [3].

Note that the way a particular apportionment method rounds tends to cause some form of bias. Jefferson's method shows bias towards larger states and Adams' and Huntington-Hill's methods show bias toward smaller states. However, Huntington-Hill's bias is not as strong as Adams'.

3 Results

In order to understand the discrepancy in the winner of the popular vote and the winner of the election, various methods were used to determine if there would be a change in the election. These methods were all changes to the current voting system.

Currently, the United States uses the Huntington-Hill method to apportion the 435 votes to the states; however, each apportionment method has a different bias, so we compared the apportionment of four different methods to determine if there was any significant change in the election.

After computing apportionments using four apportionment methods—Huntington-Hill, Jefferson, Adams, and Hamilton—there is a change of at least one delegate between the four methods in twenty-four states, which is shown in Figure 1. The bolded states—California, New York, and Texas—display a difference of greater than one delegate between the four methods. For instance, with California, there is a gain of two delegates with Jefferson's method and a loss of three delegates with Adams' method. Despite these changes, there is no significant difference in the outcome of the election with all four methods of apportionment as shown in Figure 2.

Number of Delegates Awarded to some States Using Different Apportionment Methods						
State	Population	Quota	Huntington-Hill	Jefferson's	Adam's	Hamilton's
California	37,341,989	52.538	**53**	**55**	**50**	**53**
Deleware	900,877	1.267	1	1	2	1
Flordia	18,900,773	26.592	27	27	26	27
Georgia	9,727,566	13.686	14	14	13	14
Idaho	1,573,499	2.214	2	2	3	2
Illinos	12,864,380	18.099	18	19	18	18
Iowa	3,053,787	4.296	4	4	5	4
Lousiana	4,553,962	6.407	6	6	7	6
Minnesota	5,314,879	7.478	8	7	8	8
Missouri	6,011,478	8.458	8	8	9	8
Montana	994,416	1.399	1	1	2	1
New Hampshire	1,321,445	1.859	2	1	2	2
New Jersey	8,807,501	12.392	12	13	12	12
New York	19,421,055	27.324	**27**	**28**	**26**	**27**
North Carolina	9,565,781	13.458	13	14	13	13
Ohio	11,568,495	16.276	16	17	16	16
Oklahoma	3,764,882	5.297	5	5	6	5
Oregon	3,848,606	5.415	5	5	6	5
Pennsylvania	12,734,905	17.917	18	18	17	18
Rhode Island	1,055,247	1.485	2	1	2	2
South Carolina	4,645,975	6.537	7	6	7	7
South Dakota	819,761	1.153	1	1	2	1
Texas	25,268,418	35.551	**36**	**37**	**34**	**36**
West Virgina	1,859,815	2.617	3	2	3	3

Figure 1: Number of Delegates Awarded to Each State Using Different Apportionment Methods

Winner of Election in the House with Different Apportionment Methods		
Method	**Trump**	Clinton
Huntington-Hill	**245**	190
Jefferson	**245**	190
Adams	**247**	186
Hamilton	**245**	190

Figure 2: Winner of Election in the House with Different Apportionment Methods

Since there was no significant difference in the election after changing the apportionment method, we took inspiration from Neubauer and Zeitlin's study of the 2000 election [1], in which they changed the size of the House of Representatives and computed the resulting election. The size of the House of Representatives was set at 435 in 1941, so we can approximate the

1941 divisor—using a population of about 133,400,000—to be around 306,600, which became our goal in the next calculations.

Effect of Changing the Size of the House of Representatives						
Divisor	Size of House	Total Votes	Votes for Trump	Votes for Clinton	Difference	Percent of Electoral College Vote
774000	400	500	285	215	70	57.00%
710000	435	535	305	230	75	57.01%
685500	451	551	314	237	77	56.99%
618000	502	602	345	257	88	57.31%
558150	553	653	372	281	91	56.97%
514000	604	704	400	304	96	56.82%
472500	655	755	430	325	105	56.95%
439250	706	806	461	345	116	57.20%
408250	758	858	487	371	116	56.76%
384500	808	908	517	391	126	56.94%
361000	859	959	543	416	127	56.62%
341400	908	1008	571	437	134	56.65%
306500	1008	1108	630	478	152	56.86%

Figure 3: Effect of Changing the Size of the House of Representatives

We changed the size of the House of Representatives to numbers ranging from 400 to 1008, as show from the sample of sizes in Figure 3 (full table available in Excel upon request). Note that the last size, 1008, results in a divisor of 306,500, which is approximately the same as the divisor in 1941. However, as the difference shows, the winner does not change, and the margin of victory continues to grow as the size increases. Additionally, the last column shows that Donald Trump is receiving roughly 57% of the Electoral College vote with every size of the House, which reiterates that the size of the House had no effect on the 2016 election.

To continue, we decided to consider proportional allocation of representatives within the states. Currently, 48 of the 50 states—all but Maine and Nebraska—use the winner-take-all method, where the candidate that wins the plurality in that state receives all that states' votes. In the first modification, we used election data to apportion each states' votes between the candidates. Note that we are including an independent candidate, but in this project, the independent candidate is the total votes for all independent candidates, not just one. Because of this independent candidate, we decided to use a modified Jefferson's method—not forcing each candidate to receive at least one vote—to apportion the 535 votes. Figure 4 shows some of the results from this method, bolded are the four states where the percent difference in the popular vote between Donald Trump and Hillary Clinton is less than one percent. Notice that in all four cases, the votes are split evenly between both candidates (full table available upon request). Also note that the Independent candidate does win a few electoral votes (highlighted in yellow). Figure 5 displays the final vote count from this method, and as shown, no candidate meets the 270 votes needed to win the presidency, which results in an election in the House of Representatives [10].

Effect of Using a Modified Jefferson's Method to Apportion the Votes Within each State				
State	Total Electoral Votes	Electoral Votes for Trump	Electoral Votes for Clinton	Electoral Votes for Independent
Arizona	11	6	5	0
California	55	18	35	2
Colorodo	9	4	5	0
Flordia	29	15	14	0
Georgia	16	8	8	0
Illinos	20	8	11	1
Indiana	11	7	4	0
Iowa	6	3	3	0
Michigan	**16**	**8**	**8**	**0**
Nevada	6	3	3	0
New Hampshire	**4**	**2**	**2**	**0**
New York	29	11	17	1
North Carolina	15	8	7	0
Ohio	18	10	8	0
Oklahoma	7	5	2	0
Pennsylvania	**20**	**10**	**10**	**0**
Texas	38	20	17	1
Utah	6	3	2	1
Virgina	13	6	7	0
Wisconsin	**10**	**5**	**5**	**0**
Wyoming	3	3	0	0

Figure 4: Effects of Using a Modified Jefferson's Method to Apportion the Votes Within Each State

Total Electoral College Votes		
Trump	Clinton	Independent
265	264	6

Figure 5: Total Electoral College Votes Using a Modified Jefferson's Method on all 535 Votes

To model the election within the House of Representatives, we use a modified Jefferson's method to apportion the states' votes. Since there is no way to know how each representative will actually vote, this simulation is done under the assumption that the representatives' aim is to accurately represent their states. As shown in Figure 6, Hillary Clinton is the winner of this election with 218 votes to Donald Trump's 213. Note that even though the Independent candidate is receiving 4 of the votes, Donald Trump would still lose if those 4 votes were shifted his way.

Resulting House Election Results		
Trump	Clinton	Independent
213	218	4

Figure 6: House of Representatives Election

Since this first method of apportioning the states' votes is ultimately very similar to a popular vote, we decided to try a second method. This method is modeled after the way Maine and Nebraska cast their votes. That is, the votes received from the apportionment of the 435 votes are apportioned between the candidates as in the first method; however, the two votes each state receives that represent the 100 senate members will be awarded to the winner of the plurality in each state [7].

Effects of Modified Jefferson's Method and Winner Take All on the Election							
States	Delegates	Apportioned Votes			Total Votes		
		Trump	Clinton	Independent	Trump	Clinton	Independent
Alabama	9	5	2	0	7	2	0
Arizona	11	5	4	0	7	4	0
California	55	17	34	2	17	36	2
Flordia	29	14	13	0	16	13	0
Georgia	16	7	7	0	9	7	0
Hawaii	4	0	2	0	0	4	0
Illinos	20	7	11	0	7	13	0
Iowa	6	2	2	0	4	2	0
Minnesota	10	4	4	0	4	6	0
Mississippi	6	2	2	0	4	2	0
Montana	3	1	0	0	3	0	0
New York	29	10	17	0	10	19	0
Rhode Island	4	1	1	0	1	3	0
Texas	38	19	16	1	21	16	1
Utah	6	2	1	1	4	1	1
Virgina	13	5	6	0	5	8	0
Wisconsin	10	4	4	0	6	4	0

Figure 7: Effects of Using a Combination of the Modified Jefferson's Method and Winner-Take-All on the Election

A selection of results from states that were considered "hot-races" are shown in Figure 7 [11]. Note that the red and blue highlighting in the total votes column represents the winner of the plurality in each state. Also note that the yellow highlighting does show that the independent candidate is still receiving a few electoral votes in this method too. Figure 8 shows the voting totals for this method. As shown, Donald Trump is still the winner of the election; however, the margin of victory is much smaller than it was in the actual election.

Total Electoral Votes		
Trump	Clinton	Independent
273	258	4

Figure 8: Total Electoral College Votes Using a Combination of a Modified Jefferson's Method and Winner-Take-All

4 Conclusion and Directions for Further Research

Ultimately, we were able to determine what caused the discrepancy between the popular vote and the Electoral College vote. We can conclude that while the apportionment method used and the size of the House of Representatives does not affect the winner of the 2016 election, the way a state casts their vote does.

While it is also clear that the 2016 election was decisive, as the winner of the election remained the same in all but one of the methods used in this study, it is possible that the Electoral College does not always represent the people's vote. Since there were so many states that had such a small percentage difference in the popular vote between Donald Trump and Hillary Clinton, there was a discrepancy with the Electoral vote and the popular vote, which many believe should be the way the president is elected.

To better evaluate the Electoral College's role in this election, it could be beneficial to observe the four states—Michigan, New Hampshire, Pennsylvania, and Wisconsin—where the percent difference in the popular vote was less than one percent. Understanding these states, and the voters within the districts of each state, could lead to a better picture of what needs to be done to best represent the opinions of the state and of the people in each state. In fact, looking at the voting totals for each district in these states could provide valuable insight.

References

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