West Virginia and the Apportionment Problem

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Because of changes in population numbers in the state and around the country, potential results of the 2020 census may mean that West Virginia will lose one of its three seats in the U.S. House of Representatives in the 2022 election. Whether or not that happens depends not only on a probable decrease in our state's population, but also on probable increases in the populations of other states.

Each state automatically gets two seats in the U.S. Senate, regardless of the state's size. However, the number of members in the House of Representatives varies, with the additional requirement that each state must have at least one representative. Article 1, Section 2 of the United States Constitution states that, "Representatives … shall be apportioned among the several states which may be included within this union, according to their representative numbers." The common interpretation of this law is that seats in the House must be apportioned on the basis of their population. But how this division should be done is not defined.

Prior to the 20th century, the number of representatives increased after each ten-year census as more states joined the union and as the overall population increased. However, since 1913 the total number has been set at exactly 435. As the country's population has increased, each of these men and women has represented a larger number of constituents, rising from an average of 33,000 people per representative in 1790 to an average of more than 742,000 people per representative today.

The problem of determining how many representatives each state has is known as apportionment. In general, the problem is first addressed by dividing the total population of the country by 435, the number of available seats, resulting in a **standard divisor**, or the average number of people per representative. Of course, this result is not likely to be an integer value.

The next step is to take each state's population and divide it by this standard divisor, resulting in the **standard quota**, or the number of representatives for that state. Again, it's not likely that the result is an integer. So, what happens with the fractional standard quotas since a fractional person cannot be considered and when simple rounding seldom works? Across the history of our country, several different methods of dealing with the apportionment problem have been proposed, each using the two terms defined above. Assuming the current number of seats as 435:

Standard divisor = U.S. population/435
Standard quota = state's population/standard divisor

1. **Jefferson Method:** Divide each state's population by some modified divisor that is slightly smaller than the standard divisor. Round the resulting modified quota down (e.g., both 5.1 and 5.9 become 5 representatives). Adjust the modified divisor until the sum of all the states' modified quotas equals 435. [Note: This method was used until 1850.]
2. **Hamilton Method:** Determine the standard divisor. Then divide each state's population by the standard divisor. Give each state the number of representatives equal to the integer value of its standard quota. Give the remaining seats, in order, to the states with the

largest fractional parts. [Note: This method was proposed by Alexander Hamilton and used from 1850 until 1941]

3. **Lowndes Method:** First determine the standard divisor. Then divide each state's population by the standard divisor. Give each state the number of representatives equal to the integer value of its standard quota. Then find the relative fractional part by dividing the fractional part by the integer value for each state. Give the remaining seats, in order, to the states with the largest relative fractional parts. [Note: This was proposed in 1822 by South Carolina Representative William Lowndes but was never used]
4. **Adams Method:** Divide each state's population by some modified divisor that is slightly larger than the standard divisor. Round the resulting modified quota up (e.g., both 5.1 and 5.9 become 6). Adjust the modified divisor until the sum of all the states' modified quotas equals 435. [Note: This was proposed by John Quincey Adams, one of several methods proposed during the 1820s and 1830s, but was never used.]
5. **Webster Method:** Divide each state's population by some modified divisor, which will be very close to the standard divisor. Use standard rounding rules (e.g., 7.5 becomes 8 and 7.49 becomes 7). Adjust the modified divisor until the sum of all the states' modified quotas equals 435. [This method was proposed by Daniel Webster in 1832 but was never used.]
6. **Huntington-Hill Method:** Divide each state's population by some modified divisor, which will be very close to the standard divisor. Determine the geometric mean of the state's modified quota by taking the square root of the product of the integer value of the modified quota and the next greater integer (e.g., if the modified quota is 13.67, the geometric mean is $\sqrt{(13)(14)}$). If the modified quota is greater than the geometric mean, the value is rounded up. If the modified quota is less than the geometric mean, then the state is given the integer value. Adjust the modified divisor until the sum of all the states' modified quotas equals 435. [Note: The Huntington-Hill Method, adopted in 1941, was named for Edward V. Huntington, professor of mechanics and mathematics at Harvard, and Joseph A. Hill, chief statistician of the Division of Revision and Results at the U.S. Bureau of Census. It is the current method used.]

With each method, the requirement that each state must have at least one representative must also be considered.

Challenge 1: Use projected population values for each state for 2020, and, using the Huntington-Hill Method, determine if West Virginia is likely to lose one seat.

Challenge 2: Use the projected population values and the other methods used or proposed historically. Which, if any, method(s) would result in West Virginia retaining all three seats?

Challenge 3: Research other methods that have been proposed: Dean Method, Hill Method, and Minimum Total Deviation Method. What are some advantages/disadvantages to West Virginia with these methods?

Challenge 4: Devise an alternative method that results in three seats for West Virginia.

Census Bureau projections for 2020 can be found at:

https://www.census.gov/prod/2/pop/p25/p25-1131.pdf
or at:
http://proximityone.com/outlook2030_states.htm

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