M^3 Challenge Sixth Place, First Honorable Mention Team Prize of $2,500

Immaculata High School, Team #161
Somerville, NJ

Coach: Elaine Petsu

Students: James Danco, Mary Higgins, Brian Kutsop, John Osmond, Peter Stadtmueller

Making “Cents” of the 2010 Census

to count or not to count, that is the question...

1. Summary

In March of 2010, the United States will conduct its decennial census, the results of which will resound throughout the nation, affecting both the economy and redistricting of our country. Throughout history, errors and corruption have shrouded the census in controversy as political and economic leaders tried to amend the census process. Congress, however, is ultimately responsible for the methods used for the census and apportionment, with each state defining its own congressional districts.

In the 2000 census, a major error occurred because of undercount, where the census was less than the actual population. The result of undercounting is a decrease in funds and a less desirable economy. It was later found that the sources for error were numerous and near-uncorrectable without changing the system in which the census is carried out. While most error resulted from carelessness or other sources that can be fixed, the most affecting source of error, data editing, is imposed purposely. It was also found that the percent error generally decreases with time due most likely to advances in technology and more advanced ways to calculate the number of people in an area. Undercounting remains an issue that needs to be fixed in the next census; it would be most beneficial to the United States as a whole.

Once the population is properly accounted for, the statistics must be used to determine the seating in the House of Representatives. The six different methods used for apportioning the representatives in Congress to each of the 50 states in the U.S. are the Hamilton–Vinton, Webster, Adams, Jefferson, Dean, and Hill methods. The Hill method is the method currently used in the United States. All of the methods involve dividing each state’s population by the population of an “ideal-size” district (which is obtained by dividing the total population of the United States by the total number of representatives in Congress, 435). Each of the states receives the whole number in their quotients, but the methods differ on what to do with the fractional remainders. The Hamilton–Vinton method ranks the fractional remainders from greatest to least and assigns any remaining seats by this process. The other five methods use a certain rounding point to round the fractional remainders. All of the rounding methods have to use a *sliding divisor* if the total number of representatives does not turn out to be 435.

While each of the six methods has certain strengths and weaknesses, our team believes that the Hamilton–Vinton method is the superior method. It is also quite simple, and it seems to be the fairest because it doesn’t require any rounding. The five rounding methods are more complicated and less fair because they often give certain states advantages and other states disadvantages. Because of all of these reasons, the Hamilton–Vinton method will be the method our team uses to predict the number of representatives each state will have in 2010.

Aside from apportioning, data from each decennial census is used to form congressional districts within states. Although each state is allowed to create its own laws and methods concerning the factors of redistricting, certain Supreme Court rulings have established priorities for redistricting in all states. Such priorities include equal population in congressional districts and the consideration, but not the predominance, of racial groups. We have advised that states attempt to mirror the racial demographics of the whole state in individual congressional districts while maintaining equal populations. Our suggested order of priorities aims at decreasing the chances of gerrymandering. Our following plan, while imperfect, will help improve the United States Census by producing more accurate figures and establishing more fairly drawn districts.

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3. Introduction

3.1 Restatement

This challenge required our team to determine the reasons for the undercounting of the 2000 census figures, the positive and negative effects of over/under-counting, and a possible method that could be used to minimize the amount of over/under-counting. Next, we needed to explain the different methods used for apportioning the U.S. House of Representatives, choose which method we believe is superior to the others, and predict the number of representatives each state will have in 2010 using this method. Lastly, we were required to explain the problems that have arisen when Congressional districts have been drawn, describe the different methods used to draw Congressional districts, and determine which method we believe is superior to the others.

3.2 Global Assumptions

- We assumed there is a full Social Security Number list that includes each person's location.
- Illegal immigrants are not, and are not targeted to be, counted in the census.
- We assumed that state-appointed commissions that would handle redistricting would be unbiased and impartial.
- We assumed that by having the racial percentages of each district mirror those of the state, the fluctuations of such statistics will match those of the state.
- We assumed that data concerning the populations and demographics of states and of subdivisions is correct.

4. Adjusting for Undercounts and Overcounts

4.1 Reasons for Undercounts and Overcounts

There are many sources of error involved in taking the census. The first of these is non-response. Some people do not receive or respond to the census, and thus are not tabulated in the outcomes. In some cases, people answer questions incorrectly due to misinterpretation of the questions or otherwise. In other cases, the human tabulators that survey rural areas record answers incorrectly. [1]

Computers are used to scan most census forms, so census results are vulnerable to programming errors. Frequently, people, and often entire households, are counted multiple times in the census, having been included in more than one census result form. The final source of error is data editing. When the census tabulators think that a particular set of data "seems wrong" or is incomplete, models are used to adjust data to fit other trends.

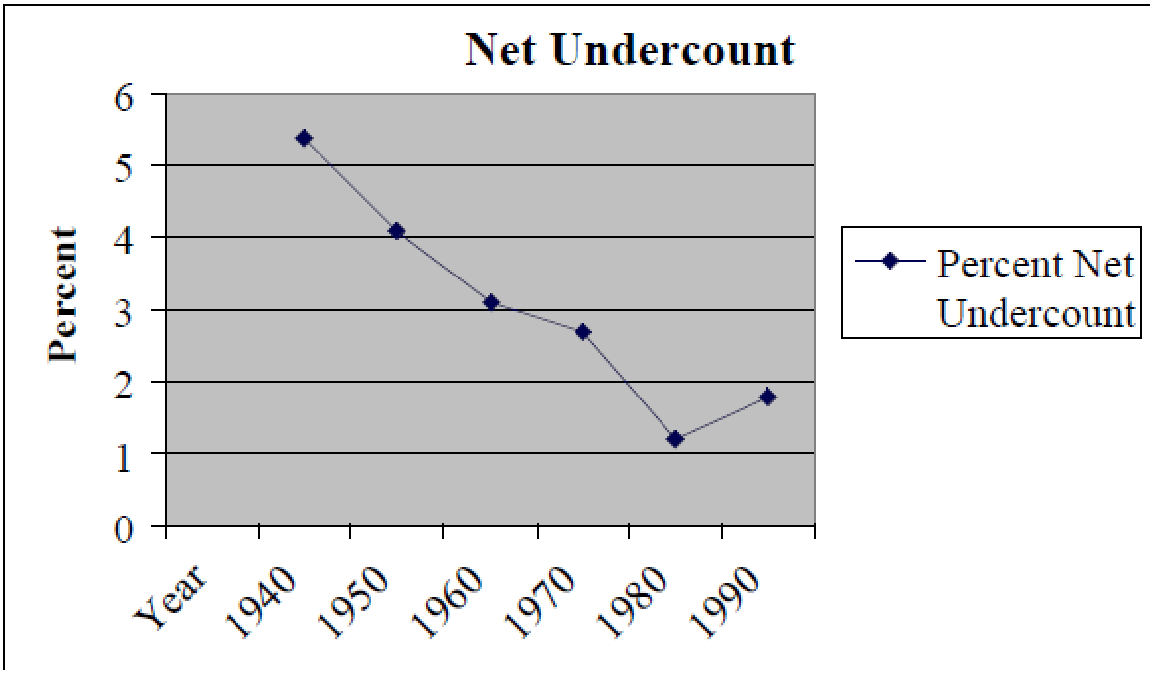
Because people are constantly being born, passing away, entering the country, and leaving the country, a single number cannot be 100% accurate all the time. Also, with so many sources of error, it is impossible to have an exact value.

Currently the U.S. Census Department has started an advertisement campaign to boost the number of people that fill out the census in 2010. There have been advertisements on the radio, and even a commercial during this past Super Bowl.

4.2 Historical Quantitative Analysis

Since 1940, the undercount rates have significantly decreased, but they can still be improved. In 1940, there was a 5.4% undercount in population. Ten years later, in 1950, the undercount percentage decreased by 1.3% to 4.1%. After another ten years, the undercount dropped another whole percentage point, to 3.1%. In 1970, the undercount dropped to 2.7%, and reached a local minimum in 1980 with 1.2%. In 1990, the percentage rose to 1.8%, then successfully dropped back down to 1.18% in the year 2000. [2]

Graph 1: Percent Undercount from 1940 to 1990. [2]



4.3 Effects of Undercounts and Overcounts

The results of undercounting are negative to the economy of the United States. The tax rates are increased to make up for the supposed decrease in population. People will be paying unnecessary amounts of money to the government. An undercount affects the number of representatives a state has. If the population of a state is undercounted, the state may not receive their rightful number of representatives. A state's number of representatives may increase or decrease due to the change in state-to-country population ratio. The biggest problem is that it minimizes the flow of government funds. The 2000 census undercount will cause a loss of 4.1 billion dollars used for funding a number of federal programs that amount to 166 billion dollars over the period of 2002–2012. [3]

Table 1: Program Obligations.

Government Program	Obligations
1. Medicare	130
2. Foster Care	5.1
3. Rehabilitaion Services Basic Support	2.4
4. Child Care and Development Block Grant	2
5. Social Services Block Grant	1.7
6. Substance Abuse Prevention and Treatment Block Grant	1.7
7. Adoption Assistance	2.1
8. Vocational Education Basic Grants	1.1
Total for Eight Programs	145.1
All Major Grant Programs Affected by Undercount	166.6

Besides federal funding, state funding is also based on the population of the states. An undercount will decrease the amount of funding a state receives from the government. This also leads to a lack of government funding in some major counties including Los Angelas at $636 million, Bronx County at $362 million, and New York County $212 million.

4.4 Description of Different Compensation Methods

One way to fix the undercounting or overcounting for the census is to take the census regularly. Afterwards, select random population blocks throughout the U.S. and survey them. In the survey, count how many match up to the census and how many people from the population blocks that took the census were not surveyed. Compile the results and insert them into this equation to find the adjustment factor:

$$\left(1-\frac{\text{\# of people in the census but not surveyed}}{\text{\# of people in the census}}\right) \times \left(\frac{\text{\# of people surveyed}}{\text{\# of people surveyed \& match census}}\right)$$

Multiply this adjustment factor by the number of people found in the census in that block to get the new population for that block. Add up the new population counts for all the blocks in the state to find the population of that state. [4]

4.5 Proposed Solution

Our proposal to find the population of the United States is to add the number of active Social Security Numbers from the previous ten-year cycle and the births/immigrants entered since the previous tabulation. This will give you a base population growth since the previous tabulation. Then subtract from this base population number the number of deaths and emigrants that left the country. This should result in the number of United States citizens or legal residents.

(Population Now) = (Quantity of active SSN on last count) + (Births since last count) – (Deaths since last count) + (immigration since last count) – (emigration since last count)

4.6 Errors in Solution

One source of error when enacting this plan would be the amount of illegal or unregistered residents. Another source of error is that some people may choose not to answer the census or the post-census survey. The survey may also not reach some of the population of the U.S. Human and programming errors may also appear in these situations. It is impossible to count the exact population of an area. [1]

5. Apportioning the House of Representatives

5.1 Description of Different Apportioning Methods

Since the first census in the United States in 1790, six different methods for apportioning the House of Representatives have been used. Five of these methods are based on rounding fractions, and out of these, three have fixed rounding points (the Webster, Adams, and Jefferson methods) and two use varying rounding points that rise as the number of seats given to the state grows larger (the Dean and Hill methods). The remaining method (the Hamilton–Vinton method) is based on ranking fractions. [5]

<u>Hamilton–Vinton Method</u>

The Hamilton–Vinton method was used in Congress from 1851 to 1901, but it wasn't strictly followed because changes were made that were not consistent with this method. In this method, the total population of all 50 states in the U.S. determined by the most recent census is divided by the total number of seats in the House of Representatives (435). This number produces the national "ideal size" district. Next, each state's population is divided by this number. The number of representatives that each state is given is the whole number in the resulting quotient (although every state must have at least one representative). If fewer than 435 seats have been given by this method, then the fractional remainders of the quotients of each of the 50 states are rank-ordered from largest to smallest, and the seats are assigned in this manner until 435 are given.

While the Hamilton–Vinton method does have simplicity in its favor, its downfall was known as the *Alabama paradox*. While this issue had been observed previously, it was first brought up as an issue after the 1880 census. When the size of the House of Representatives was increased by one (from 299 to 300), Alabama actually lost a seat (from eight seats to seven seats) because the fractional remainders of the quotients of two other states became higher-ranked than Alabama's remainder. Because of this, those two states got an additional seat, but because the house size only increased by one, Alabama lost one seat. Another problem that this method was prone to is what is known as the *population paradox*, which occurs when a state that grows at a greater percentage rate than another state has to give up a seat to the slower-growing state. A third problem was known as the *new states paradox*, which can occur any time a new state enters the Union. When this happens, the increase in the House size caused by the additional state can cause seat shifts among the other states. These issues became enough of a problem that the formula was changed in 1911. [5]

<u>Basis of Other Methods</u>

The five rounding methods originally follow the same general procedure as the Hamilton–Vinton method. The total population of all 50 states is divided by the total number of seats in the House of Representatives (435). This number represents the "ideal-size" district. Each state's population is then divided by this number, but instead of ranking the fractional remainders of the quotients like the previous method did, they round them up or down to whole numbers based on a certain rounding point that varies for each of the five methods. Because these methods use rounding, they will result in a certain number of total allocated seats that may not be exactly the desired 435. If the total number is not exactly 435, the common divisor divided into the populations of all 50 states must be adjusted until the exact number of desired seats is achieved. If the total number of allocated seats is higher than 435, then a divisor larger than the ideal-size district is tried, and if the total number of seats is lower than 435, then a lower divisor is tried. [5]

Webster Method

The Webster method (also known as the "major fractions" method) rounds the quotients of each of the 50 states using a fixed rounding point of 0.5. Therefore, when the fractional remainder of a state is 0.5 and above, the number of seats assigned to that state is rounded up to the next whole number. [5]

Adams Method

The Adams method (also known as the "smallest divisors" method) rounds up to the next whole number for any fractional remainder. Therefore, whenever a state has a quotient with a fractional remainder, the number of seats assigned to that state is automatically rounded up to the next whole number. One significant problem with this method is that it gives states with a smaller population a very large advantage over states with a larger population. [5]

Jefferson Method

The Jefferson method (also known as the "largest divisors" method) rounds down any fractional remainder. Therefore, whenever a state has a quotient with a fractional remainder, the number of seats assigned to that state is automatically rounded down. A significant problem with this method is that less populated states have a large disadvantage compared to more populated states. [5]

Dean Method

The Dean method rounds at a point that varies depending on the number of seats already assigned to the state. This point, known as the *harmonic mean*, is obtained by multiplying the product of the two consecutive numbers by two and then dividing by the sum of the two numbers. For example, the harmonic mean between the numbers 1 and 2 is found by multiplying the doubling the product of 1 and 2, which results in 4, and then dividing that by the sum of the two numbers (3) to yield 4/3 (or about 1.33). As the numbers become larger, the rounding point also gets larger. For instance, the harmonic mean between 10 and 11 is 10.476. One possible negative factor of this method is that it favors the smaller, less populous states at the expense of the larger, more populated states because the rounding point of the larger states is higher than the rounding point of the smaller states. Therefore, the fractional remainders of the quotients of the larger states need to be larger in order to be rounded up than the fractional remainders of the quotients of the smaller states need to be. [5]

Hill Method

The Hill method (also known as the "equal proportions" method) is the method currently used in the United States for apportioning seats for the House of Representatives. The rounding point used by this method is known as the *geometric mean*, which is the square root of the multiplication of the two numbers. For example, the geometric mean between 1 and 2 is the square root of 2 (or about 1.41). Once again, as the numbers become larger, the rounding point also gets larger. For instance, the geometric mean between 10 and 11 is the square root of 110 (or about 10.487). This method also has the possible downfall described in the Dean method. [5]

Summary

While the Hill method is the method currently in use, it is not clear which of the five rounding methods is actually the "fairest" and best fitting to the "one person, one vote" standard. No apportionment formula can equalize districts exactly because there is a fixed size of the House of Representatives, there is a minimum of one seat per state, and districts cannot cross state lines. The goal should then be to minimize inequality, but which method fulfills this goal the most is unclear because there is no exact set of criteria that fulfills this. If the criterion is to minimize the difference between the largest district size in the U.S. and the smallest district size, then the Dean method is the fairest method. The Webster method is the best method if the goal is to minimize the difference in each person's individual share of his or her representative. If the criterion is to minimize the differences in average district sizes, or in a person's individual share of his or her representative, when those differences are expressed as percentages, then the Hill method is the fairest method. The Adams method is the best method if the goal is to favor the smaller states, while the Jefferson method is the best method if the goal is to favor the larger states. [5]

5.2 Proposed Solution

Our team believes that the best method for apportioning the U.S. House of Representatives is the Hamilton–Vinton method. Even though it was prone to certain paradoxes such as the Alabama paradox and the new states paradox, these problems are not currently relevant because their causes (changes in the number of total representatives in Congress and new states being added to the U.S.) have not occurred for many years and are very unlikely to happen in the foreseeable future. The method is also very simple and uncomplicated, especially since it allows one to always easily make the total number of representatives 435 without changing the divisor like the other methods often require. Lastly, this method seems to be the fairest for all of the states since it doesn't require any rounding (which often gives certain states advantages and other states disadvantages).

5.3 Predicting 2010 Population Demographics

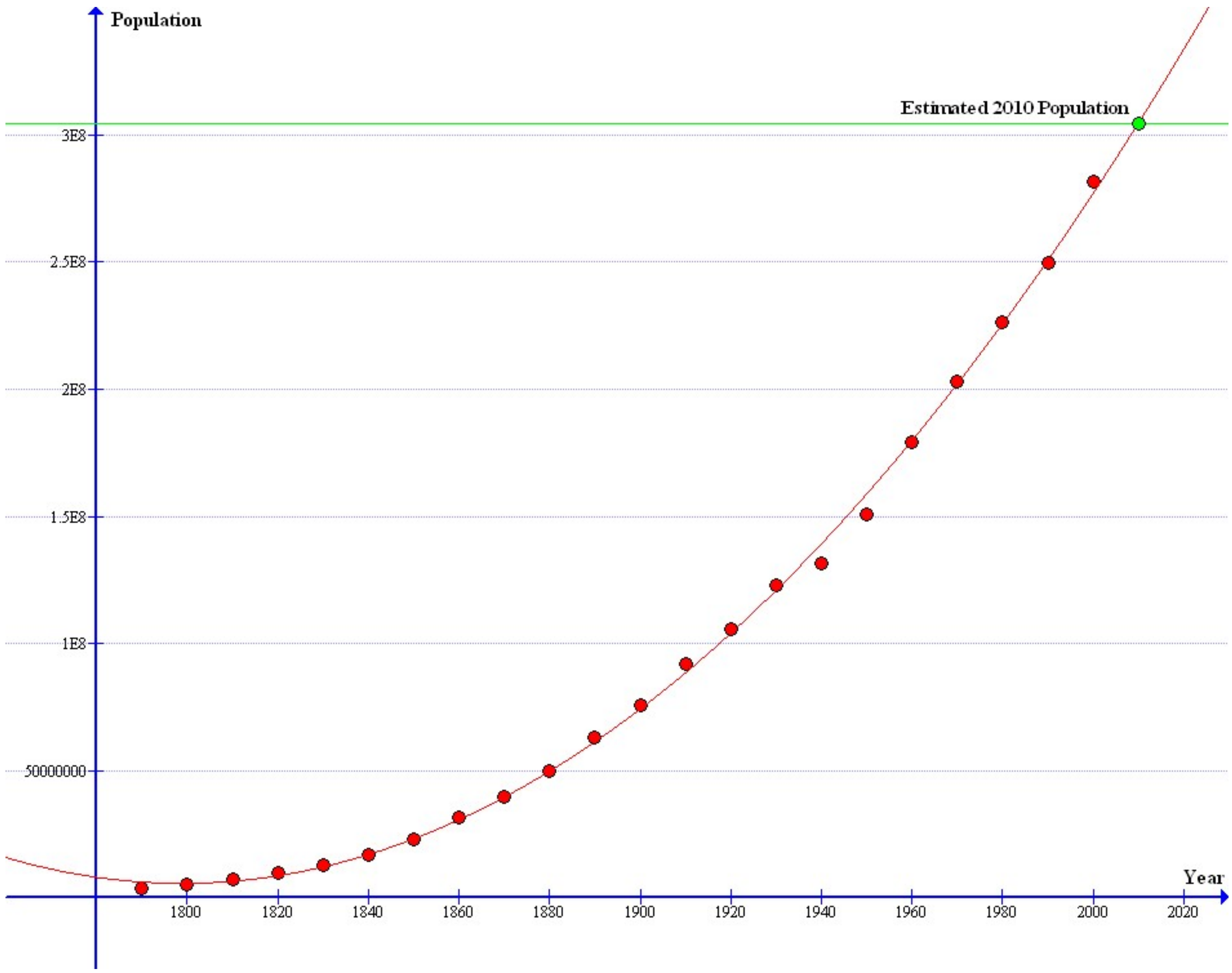
In order to immediately test the proposed solution, our team predicted the number of Representatives that each state would be apportioned after the 2010 Census if the Hamilton–Vinton method was used. After the 2010 Census actually is complete and the House Representatives have been apportioned using the current Hill method, the theoretical results of our proposal and the real-world results from the 2010 Census can be compared. Based on the differences in the results and U.S. citizens' overall feelings about the fairness of the new apportionments, it will then be possible to determine if the Hamilton–Vinton method truly is a better alternative.

However, in order to predict the number of Representatives per state after the 2010 Census, it is necessary to predict the population in each state in 2010. To begin, our team attempted to predict the total population in the United States in 2010. This was done by obtaining the population determined in each census since 1790, as shown in Table 2. This data was then plotted in Graph 2, and the equation of best fit was determined. Typically, logistic curves are considered the best model for population growth since the logistic curve approaches a minimum zero (when the area was first being populated) and approaches a maximum of a certain value, depending on the equation. This maximum corresponds to an overpopulation of an area, where no more inhabitants can comfortably fill a region. However, because the trends in United States population have shown no indication of slowing down anytime soon, a simple quadratic equation was fit to the data. As the time (in years) increased on the obtained model, the graph rose more and more rapidly. This fits perfectly with the current trends in population. In order to obtain the population in 2010, the graph was extrapolated through this year, and the population value at this time was read off of the graph.

Table 2: U.S. Population as determined by Each Census since 1790. [6]

Census Year	Population (in millions)
1790	3.9
1800	5.3
1810	7.2
1820	9.6
1830	12.9
1840	17.1
1850	12.2
1860	31.4
1870	39.8
1880	50.1
1890	63.0
1900	76.0
1910	92.0
1920	105.7
1930	122.8
1940	133.7
1950	150.7
1960	179.3
1970	203.2
1980	226.5
1990	249.6
2000	281.4
(estimated) 2010	304.5

Graph 2: U.S. Population versus Year



Curve of best fit: P(t) = $6702.6067x^2 - 24114395x + 2.1695237 * 10^{10}$
Estimated 2010 population: 304.5 million

After using the extrapolation above, the obtained population (304.5 million) was compared to that predicted by the U.S. Census Bureau: 308.9 million [2]. These values were very close. However, it should be noted that the U.S. Census Bureau's calculations for the population in 2010 were based on much more complicated algorithms that took into account the immigration trends of specific races and other data that our team could not attempt to consider in the time allotted. Therefore, since the relative accuracy of the U.S. Census Bureau's prediction was verified through the method above, it was decided that the U.S. Census Bureau's prediction for the population of each state in 2010 would be used in calculating the number of Representatives. This data is summarized below (Table 3).

Table 3: Projections of the Total Population of the 50 States: April 1, 2000 to July 1, 2010. [7]

Geographic Area	Census April 1, 2000	Projections July 1, 2005	Projections July 1, 2010
United States	**281,421,906**	**295,507,134**	**308,935,581**
Alabama	4,447,100	4,527,166	4,596,330
Alaska	626,932	661,110	694,109
Arizona	5,130,632	5,868,004	6,637,381
Arkansas	2,673,400	2,777,007	2,875,039
California	33,871,648	36,038,859	38,067,134
Colorado	4,301,261	4,617,962	4,831,554
Connecticut	3,405,565	3,503,185	3,577,490
Delaware	783,600	836,687	884,342
District of Columbia	572,059	551,136	529,785
Florida	15,982,378	17,509,827	19,251,691
Georgia	8,186,453	8,925,796	9,589,080
Hawaii	1,211,537	1,276,552	1,340,674
Idaho	1,293,953	1,407,060	1,517,291
Illinois	12,419,293	12,699,336	12,916,894
Indiana	6,080,485	6,249,617	6,392,139
Iowa	2,926,324	2,973,700	3,009,907
Kansas	2,688,418	2,751,509	2,805,470
Kentucky	4,041,769	4,163,360	4,265,117
Louisiana	4,468,976	4,534,310	4,612,679
Maine	1,274,923	1,318,557	1,357,134
Maryland	5,296,486	5,600,563	5,904,970
Massachusetts	6,349,097	6,518,868	6,649,441
Michigan	9,938,444	10,207,421	10,428,683
Minnesota	4,919,479	5,174,743	5,420,636
Mississippi	2,844,658	2,915,696	2,971,412
Missouri	5,595,211	5,765,166	5,922,078
Montana	902,195	933,005	968,598
Nebraska	1,711,263	1,744,370	1,768,997
Nevada	1,998,257	2,352,086	2,690,531
New Hampshire	1,235,786	1,314,821	1,385,560
New Jersey	8,414,350	8,745,279	9,018,231
New Mexico	1,819,046	1,902,057	1,980,225
New York	18,976,457	19,258,082	19,443,672
North Carolina	8,049,313	8,702,410	9,345,823
North Dakota	642,200	635,468	636,623
Ohio	11,353,140	11,477,557	11,576,181
Oklahoma	3,450,654	3,521,379	3,591,516
Oregon	3,421,399	3,596,083	3,790,996
Pennsylvania	12,281,054	12,426,603	12,584,487
Rhode Island	1,048,319	1,086,575	1,116,652
South Carolina	4,012,012	4,239,310	4,446,704
South Dakota	754,844	771,803	786,399
Tennessee	5,689,283	5,965,317	6,230,852
Texas	20,851,820	22,775,044	24,648,888

Utah	2,233,169	2,417,998	2,595,013
Vermont	608,827	630,979	652,512
Virginia	7,078,515	7,552,581	8,010,245
Washington	5,894,121	6,204,632	6,541,963
West Virginia	1,808,344	1,818,887	1,829,141
Wisconsin	5,363,675	5,554,343	5,727,426
Wyoming	493,782	507,268	519,886

5.4 Predicting the Number of Representatives from the 2010 Census

As mentioned above, the Hamilton–Vinton method was used to determine the approximate number of House Representatives appropriated to each state using the 2010 population predictions found above. A sample calculation for the number of representatives assigned to the state of New Jersey is shown below:

1. The "ideal-size" district was obtained by dividing the total projected population of the United States in 2010 (308,935,581) by the total number of representatives in Congress (435). This number was 710,196.7379.
2. The projected population of New Jersey in 2010 (9,018,231) was then divided by the "ideal-size" district. This quotient was approximately 12.698.
3. Since the whole numbers of the quotients of all 50 states added up to 416, and the desired sum was 435, the top 19 fractional remainders needed to be listed. New Jersey's fractional remainder (about 0.698) was in the top 19, so its quotient was rounded up to the nearest whole number. This produced the total number of projected representatives in New Jersey using this method: 13.

The projected number of representatives that each state will have based on the 2010 census using the Hamilton–Vinton method was calculated in a similar fashion, and the summary of these calculations is summarized in Table 4.

Table 4: Summary of Calculations for Appropriated Representatives.
(States listed in order of fractional remainders from greatest to least)

State	Quotient (Theoretical Number of Representatives per State)	Fractional Remainder	Appropriated Representatives per State
Alaska	0.977	0.977	1
New Hampshire	1.951	0.951	2
Kansas	3.950	0.950	4
Vermont	0.919	0.919	1
Maine	1.911	0.911	2
North Dakota	0.896	0.896	1
Hawaii	1.888	0.888	2
Colorado	6.803	0.803	7
Nevada	3.788	0.788	4
New Mexico	2.788	0.788	3
Tennessee	8.773	0.773	9
District of Columbia	0.746	0.746	1
Wyoming	0.732	0.732	1

Pennsylvania	17.720	0.720	18
Texas	34.707	0.707	35
New Jersey	12.698	0.698	13
Michigan	14.684	0.684	15
Utah	3.654	0.654	4
Minnesota	7.633	0.633	8
California	53.601	0.601	54
West Virginia	2.576	0.576	3
Rhode Island	1.572	0.572	2
Georgia	13.502	0.502	14
Louisiana	6.495	0.495	7
Nebraska	2.491	0.491	2
Alabama	6.472	0.472	6
New York	27.378	0.378	27
Montana	1.364	0.364	1
Massachusetts	9.363	0.363	9
Arizona	9.346	0.346	9
Missouri	8.339	0.339	8
Oregon	5.338	0.338	5
Maryland	8.315	0.315	8
Ohio	16.300	0.300	16
Virginia	11.279	0.279	11
South Carolina	6.261	0.261	6
Delaware	1.245	0.245	1
Iowa	4.238	0.238	4
Washington	9.211	0.211	9
Illinois	18.188	0.188	18
Mississippi	4.184	0.184	4
North Carolina	13.159	0.159	13
Idaho	2.136	0.136	2
Florida	27.108	0.108	27
South Dakota	1.107	0.107	1
Wisconsin	8.065	0.065	8
Oklahoma	5.057	0.057	5
Arkansas	4.048	0.048	4
Connecticut	5.037	0.037	5
Kentucky	6.006	0.006	6
Indiana	9.001	0.001	9
		TOTAL:	**435**

6. Drawing Congressional Districts

6.1 Description of Methods for Determining Districts

Every ten years, congressional districts are redrawn according to the results of the decennial census. Although each state has its own laws prohibiting certain factors from being considered during redistricting, certain principles should be abided by in all states. These three main principles are compactness, contiguity, and respect for communities of interests. Compactness calls for minimal size of districts, while contiguity stresses the connectivity in a single section, so that one may walk throughout an entire district without leaving it. Respect for communities of interest calls for the consideration of both natural and governmental units, such as counties and neighborhoods with similar economic and racial demographics. [8]

The redistricting following the 2000 census was executed according to Public Law (P.L) 94-171, which instructs Congress to provide redistricting data required by all 50 states. The Census 2000 Redistricting Data Program, an optional and nonpartisan program, consisted of three phases. The first phase consisted of state officials viewing maps and suggesting visible landmarks to help form district boundaries, such as roads, streams, and preexisting legal boundaries. During the second phase, state officials mapped out boundaries corresponding with physical features and preexisting voting district boundaries. Congress then sent states data required for redistricting. In accordance with P.L. 94-171, these statistics include population totals and summaries by race, Hispanic or Latino, and voting age for all appropriate geographic areas delimited on the maps: state, counties or equivalent areas, voting districts, county subdivisions, places, American Indian/Alaska Native/Native Hawaiian areas, census tracts, block groups, and blocks. [9]

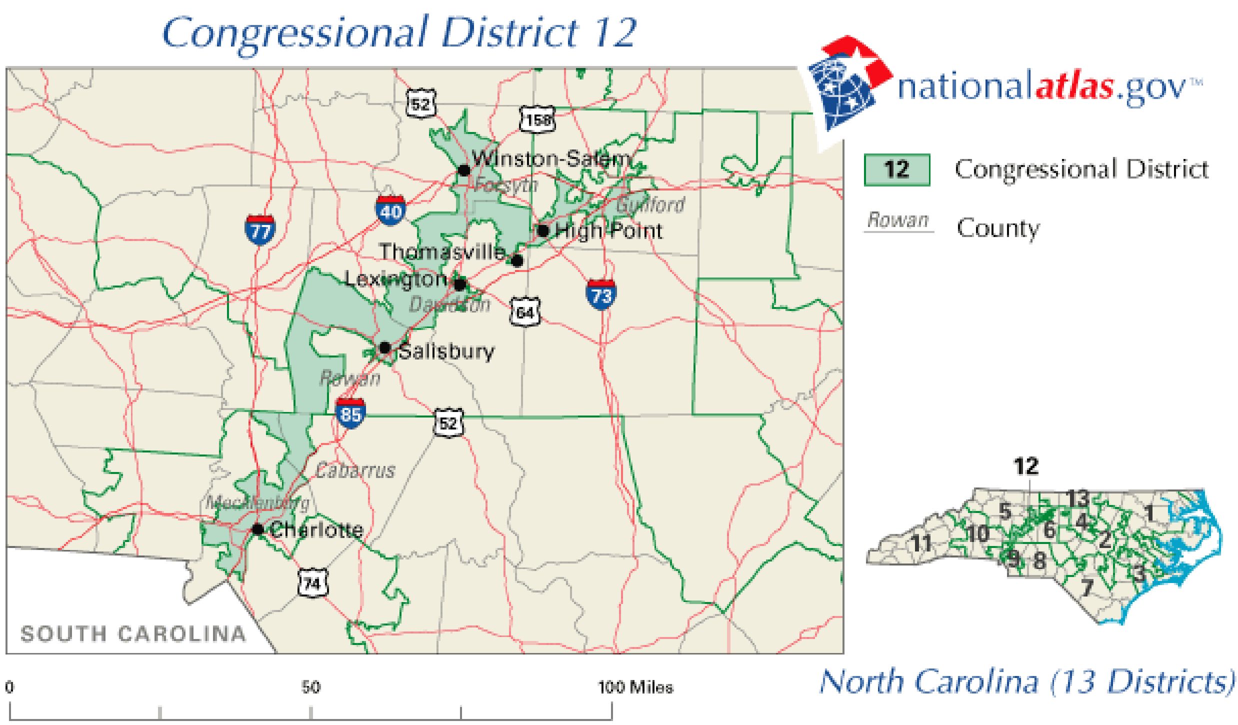
Traditionally, state legislatures created new district lines, but it has become increasingly popular for states to assign unbiased commissions to determine redistricting. Following the 2000 census, four states used commissions and seven states employed court plans to form districts. While the benefits and disadvantages to having commission-based redistricting are not well known, the system does eliminate, at least partially, the conflicts of issues for political officials. [8]

6.2 Issues Raised when Determining Districts

In past years, the reestablishment of congressional districts has been tainted with political motives. Many political experts argue that by gathering voters with similar views in the same congressional districts, the outcome of future elections may be predestined, virtually guaranteeing either the victory or defeat of certain politicians. This gerrymandering of congressional districts may also benefit incumbents by concentrating voters of their party in one or more districts, thereby eliminating supporters of their opponents. Such tactics prevent citizens from hearing debates from both parties and becoming well-informed voters.

Another political issue with redistricting involves creating districts with the intent of bolstering racial representation. By establishing districts to form racial-majorities, political candidates of that race receive an unfair advantage in elections. [12] After the 1990 census, for instance, North Carolina drew two black-majority districts, where two black candidates were elected in 1992. One such district was winding and snakelike, clearly segregating the majority race from the minority race. [7] When voters from the two districts appealed to the Supreme Court in Shaw v. Reno, the Court concluded that the irregularly shaped district was a blatant, unconstitutional effort to separate races and thus manipulate the election process. The Court upheld that states may not design districts with the intent of creating racial majorities. [2] One example of an irregularly shaped district can be seen below (Figure 1).

Figure 1: Example of Irregularly-shaped District in South Carolina. [11]



In the 1964 case of Reynolds v. Sims, the Court ruled that state legislative districts must be “as nearly of equal population as is practicable,” citing the “one person, one vote” principal of equality. This ruling reestablished the predominance of population-equality between congressional districts. Following this case, the Voting Rights Act (VRA) was passed by Congress in 1965, a piece of legislation prohibiting the diminished opportunity for minorities to vote. While the VRA requires states to consider race when forming districts, the Shaw v. Reno case explicitly prohibited states from making race a leading factor. [13]

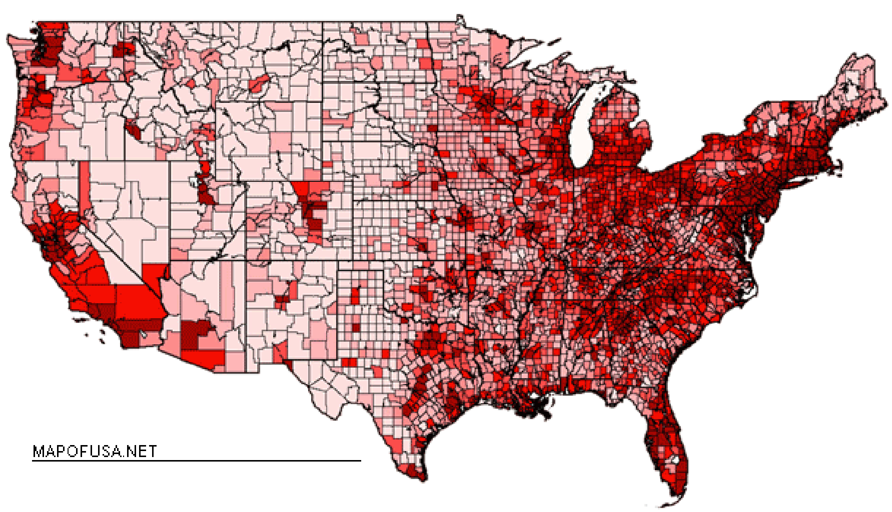
6.3 Proposed Solution

Throughout history, the most significant problems encountered while redistricting states were those of gerrymandering. To prevent instances of corruption of either racial or political nature, we recommend creating districts of relatively equal populations. In accordance with both the VRA and Shaw v. Reno ruling, we also recommend designing districts so that the racial percentages and demographics most closely mirror those of the state as whole. States are advised to comply, at least in part, with the 2010 Census Redistricting Data Program to receive data about the makeup of their populations. Upon receiving data, states should plan to create districts with as equal populations as possible, so as to comply with the 1964 Supreme Court ruling in Reynolds v. Sims. The ideal population of a district (d) can be found by dividing the state’s total population (p) by the number of congressional districts that need to be created (n): $d = p/n$. To avoid the creation of majority-minority concentrated areas, we also suggest that the ratio of the population of any ethnic group in a district area (e) to the total population of the district area (f) be equal to the ratio of the population of that ethnic group in the whole state (g) to the total population of that state (h): $e/f = g/h$. It is also in the best interest of the state to refrain from intentionally creating districts heavily inclined towards a single political party, though due to naturally occurring areas of heavy political inclination, this may be impossible to arrange. We also understand that because of the communities in each state, these suggestions concerning ethnic percentages and political concentrations may be impossible to fully abide by at times. However, because most problems encountered throughout the history of redistricting concerned racial and political gerrymandering, we believe that these first three suggestions should take priority above all other principles. The order in which these suggestions were listed also reflects the weight each one should hold during the redistricting process, with the first suggestion holding the most weight.

Once a state has calculated the ideal population and demographics of a congressional district, they must begin planning the actual shapes and locations of the districts. We agree with the 2000 Census Redistricting Data Program, which encouraged states to incorporate visible features (such as roads, rivers, mountains) in district boundaries, if possible. More important, however, is the principle of contiguity. A district must be contained within a single area, so that one may walk from one end to another without leaving the district. Should part of a district be enclosed by another district (in an arrangement such as Lesotho inside of South Africa), that part of the district will not have the same political issues or environment as the other part. Thus, the two parts of the same district would not be able to vote for a candidate that would represent the needs of each part.

One of the main principles of redistricting is compactness, which stresses small, regularly shaped districts. We disagree with compactness being a leading factor of redistricting. An ideal district would be regularly shaped, so that each district occupies the same amount of land. However, the population density of the United States is very inconsistent across the country, particularly in the Midwest. This presents a problem in creating districts of similar size and shape with equal populations, as can be seen in Figure 2.

Figure 2: Population Density Map. [10]



Like the Supreme Court in the 1964 case of Reynolds v. Sims, we believe that equal population in congressional districts is more critical than equal land area. Thus, some district shapes may be more irregular. Unlike the district 12 of North Carolina in 1992, any irregularly shaped districts will be the result of population groupings, not of racial gerrymandering. However, states should attempt to keep districts convex and of similar shape. When forming districts, we advise states to honor the “respect for communities of interests” principle by keeping individual towns within the same district. However, if necessary, counties and townships may be divided into separate districts. For cities of large populations, it is possible that the entire city may be considered its own district because it fulfills the ideal population for a district. Given the history of gerrymandering on the part of state legislative bodies, we advise states to select a politically and racially unbiased commission to handle state redistricting.

7. Conclusions

History has shown that it is apparent that the way the U.S. census is conducted must be improved as soon as possible for the continued productivity of the nation. The sources for error are both numerous and demanding of attention. Undercounting, the error by which the census finds fewer people than in residence, is a serious plague upon the wallets of the nation. Because the estimated number of people is fewer, taxes are raised and funding is decreased, resulting in financial difficulties for the residents. Our proposed plan, while not perfect, will significantly decrease the undercount, thus making life better for all affected by its outcome.

The improved accuracy of the census, and thus of the population count, will in turn provide more accurate data upon which the apportioning of the House of Representatives is based. There are six various methods that are used for apportioning the representatives in Congress to each of the 50 states in the U.S. They are known as the Hamilton–Vinton, Webster, Adams, Jefferson, Dean, and Hill methods. The Hill method is the method currently used in the United States. In the Hamilton–Vinton method, an “ideal-size” district is obtained by dividing the total population of the United States by the total number of representatives in Congress, 435. Each state’s population is then divided into the population of the “ideal-size” district. Each of the states receives the whole number in their quotients, and any remaining seats are assigned to the states with the highest fractional remainders. The other five methods originally follow the Hamilton–Vinton method, but they use a certain rounding point to round the fractional remainders. Three of them use a fixed rounding point while the other two use a varying rounding point.

Our team maintains that the Hamilton–Vinton method is the best method. It is the simplest and fairest because it doesn’t require any rounding, and while certain paradoxes can arise, they can be ignored because their causes (an increase in the number of total representatives and in the number of states) have not occurred in many years and are not predicted to happen in the foreseeable future. The five rounding methods are more complicated and less fair because they often give certain states advantages and other states disadvantages depending on their populations. The fairest method of apportioning will ensure the fairest distribution of the 435 House seats among the 50 states.

Aside from determining the apportioning of the House and from influencing the economics of the nation, the census also determines the redistricting of states’ congressional districts. The redistricting of congressional districts after the decennial census has a long history of political manipulation and gerrymandering. In an attempt to establish fair districts, our team has recommended the following measures and order of priorities: First, states should select unbiased commissions to handle redistricting to avoid previous problems of corruption. The one nonnegotiable concept we have is the concept of contiguity, or having a district connected to all its parts. Other than this, the first priority of redistricting is equal populations in each district, to abide by the "one person, one vote" policy established by the Supreme Court, an idea that insures the equality of all votes. The next factor to consider is the racial demographics within each district, which should mirror the demographics of the state. Due to the sensitive nature and history of this issue, we believe this must be a priority for redistricting. To prevent political corruption, we also recommend that states then refrain from intentionally creating districts that lean heavily towards one political party. When these requirements are met, states must then begin drawing the actual boundaries of the districts, trying to follow the 2000 Census Redistricting Data Program policies of incorporating visible features into boundaries. States should keep individual towns within the same district, and townships and counties, if possible, and large cities may be populated enough to be their own congressional districts. Though districts traditionally have been compact and regularly shaped, we believe that this characteristic should be considered last because the inconsistent population density of the United States may not provide opportunities to create districts of similar size and shape and with equal populations. All steps should be completed as accurately as possible, with the understanding that it may not be possible to meet all expectations. In this scenario, the state should strive for the best "overall" redistricting, considering factors in the order of priorities described above.

This census, which comes about every ten years, will have resounding effects on the nation as a whole and on individual states, effects that will be felt throughout the following years. Inaccurate methods of reacting to undercounts, apportioning House seats, and establishing congressional districts have wreaked havoc upon the nation's economic and political situations and cast doubt upon the integrity of state legislative bodies. Our proposed plan, while fallible and susceptible to errors, will improve the overall accuracy and fairness of the census and all procedures associated with it, thereby ensuring the continued prosperity of the United States of America.

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