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The House Apportionment Formula in Theory and Practice

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The House Apportionment Formula in Theory and Practice

Summary

The Constitution requires that states be represented in the House in accord with their population. It also requires that each state have at least one Representative, and that there be no more than one Representative for every 30,000 persons.

Apportioning seats in the House of Representatives among the states in proportion to state population as required by the Constitution appears on the surface to be a simple task. In fact, however, the Constitution presented Congress with issues that provoked extended and recurring debate. How may Representatives should the House comprise? How populous should congressional districts be? What is to be done with the practically inevitable fractional entitlement to a House seat that results when the calculations of proportionality are made? How is fairness of apportionment to be best preserved?

Over the years since the ratification of the Constitution the number of Representatives has varied, but in 1941 Congress resolved the issue by fixing the size of the House at 435 Members. How to apportion those 435 seats, however, continued to be an issue because of disagreement over how to handle fractional entitlements to a House seat in a way that both met constitutional and statutory requirements and minimized unfairness.

The intuitive method of apportionment is to divide the United States population by 435 to obtain an average number of persons represented by a Member of the House. This is sometimes called the *ideal size* congressional district. Then a state's population is divided by the ideal size to determine the number of Representatives to be allocated to that state. The quotient will be a whole number plus a remainder–say 14.489326. What is Congress to do with the 0.489326 fractional entitlement? Does the state get 14 or 15 seats in the House? Does one discard the fractional entitlement? Does one round up at the arithmetic mean of the two whole numbers? At the geometric mean? At the harmonic mean? Congress has used or at least considered several methods over the years–e.g., Jefferson's discarded fractions method, Webster's major fractions method, the equal proportions method, smallest divisors method, greatest divisors, the Vinton method, and the Hamilton-Vinton method. The methodological issues have been problematic for Congress because of the unfamiliarity and difficulty of some of the mathematical concepts used in the process.

Every method Congress has used or considered has its advantages and disadvantages, and none has been exempt from criticism. Under current law, however, seats are apportioned using the equal proportions method, which is not without its critics. Some charge that the equal proportions method is biased toward small states. They urge that either the major fractions or the Hamilton-Vinton method be adopted by Congress as an alternative. A strong case can be made for either equal proportions or major fractions. Deciding between them is a policy matter based on whether minimizing the differences in district sizes in absolute terms (through major fractions) or proportional terms (through equal proportions) is most preferred by Congress.

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The House Apportionment Formula in Theory and Practice

Introduction

One of the fundamental issues before the framers at the Constitutional Convention in 1787 was how power was to be allocated in the Congress among the smaller and larger states. The solution ultimately adopted, known as the Great (or Connecticut) Compromise, resolved the controversy by creating a bicameral Congress with states represented equally in the Senate, but in proportion to population in the House. The Constitution provided the first apportionment of House seats: 65 Representatives were allocated to the states based on the framers' estimates of how seats might be apportioned after a census. House apportionments thereafter were to be based on Article 1, section 2, as modified by the Fourteenth Amendment:

> *Amendment XIV, section 2.* Representatives shall be apportioned among the several States ... according to their respective numbers....
>
> *Article 1, section 2.* The number of Representatives shall not exceed one for every thirty Thousand, but each State shall have at least one Representative....

From its beginning in 1789, Congress was faced with questions about how to apportion the House of Representatives–questions that the Constitution did not answer. How populous should a congressional district be on average? How many Representatives should the House comprise? Moreover, no matter how one specified the ideal population of a congressional district or the number of Representatives in the House, a state's ideal apportionment would, as a practical matter, always be either a fraction, or a whole number and a fraction–say, 14.489326. Thus, another question was whether that state would be apportioned 14 or 15 representatives? Consequently, these two major issues dominated the apportionment debate: how populous a congressional district ought to be (later re-cast as how large the House ought to be), and how to treat fractional entitlements to Representatives.[1]

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[1] Thomas Jefferson recommended discarding the fractions. Daniel Webster and others argued that Jefferson's method was unconstitutional because it discriminated against small states. Webster argued that an additional Representative should be awarded to a state if the fractional entitlement was 0.5 or greater–a method that decreased the size of the house by 17 Members in 1832. Congress subsequently used a "fixed ratio" method proposed by Rep. Samuel Vinton following the census of 1850 through 1900, but this method led to the paradox that Alabama lost a seat even though the size of the House was increased in 1880. Subsequently, mathematician W.F. Willcox proposed the "major fractions" method, which was used

(continued...)

The questions of how populous a congressional district should be and how many Representatives should constitute the House have received little attention since the number of Representatives was last increased to 435 after the 1910 Census.[2] The problem of fractional entitlement to Representatives, however, continued to be troublesome. Various methods were considered and some were tried, each raising questions of fundamental fairness. The issue of fairness could not be perfectly resolved: inevitable fractional entitlements and the requirement that each state have at least one representative lead to inevitable disparities among the states' average congressional district populations. The congressional debate, which sought an apportionment method that would minimize those disparities, continued until 1941, when Congress enacted the "equal proportions" method–the apportionment method still in use today.

In light of the lengthy debate on apportionment, this report has four major purposes:

1. to summarize the constitutional and statutory requirements governing apportionment;
2. to explain how the current apportionment formula works in theory and in practice;
3. to summarize recent challenges to it on grounds of unfairness; and
4. to explain the reasoning underlying the choice of the equal proportions method over its chief alternative, major fractions.

Constitutional and Statutory Requirements

The process of apportioning seats in the House is constrained both constitutionally and statutorily. As noted previously, the Constitution defines both the maximum and minimum size of the House. There can be no fewer than one Representative per state, and no more than one for every 30,000 persons.[3]

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[1] (...continued)
following the census of 1910. This method, too, had its critics; and in 1921 Harvard mathematician E.V. Huntington proposed the "equal proportions" method and developed formulas and computational tables for all of the other known, mathematically valid apportionment methods. A committee of the National Academy of Sciences conducted an analysis of each of those methods–smallest divisors, harmonic mean, equal proportions, major fractions, and greatest divisors–and recommended that Congress adopt Huntington's equal proportions method. For a review of this history, see U.S. Congress, House, Committee on Post Office and Civil Service, Subcommittee on Census and Statistics, *The Decennial Population Census and Congressional Apportionment*, 91st Cong., 2nd sess. H. Rept. 91-1314 (Washington: GPO, 1970), Appendix B, pp. 15-18.

[2] Article I, Section 2 defines both the maximum and minimum size of the House, but the actual House size is set by law. There can be no fewer than one Representative per state, and no more than one for every 30,000 persons. Thus, the House after 1990 could have been as small as 50 and as large as 8,301 Representatives.

[3] The actual language in of Article 1, section 2 pertaining to this minimum size reads as (continued...)

The 1941 apportionment act, in addition to specifying the apportionment method, sets the House size at 435 and mandates administrative procedures for apportionment. The President is required to transmit to Congress "a statement showing the whole number of persons in each state" and the resulting seat allocation within one week after the opening of the first regular session of Congress following the census.[4]

The Census Bureau has been assigned the responsibility of computing the apportionment. As matter of practice, the Director of the Bureau reports the results of the apportionment on December 31st of the census year. Once received by Congress, the Clerk of the House is charged with the duty of sending to the Governor of each state a "certificate of the number of Representatives to which such state is entitled" within 15 days of receiving notice from the President.[5]

The Apportionment Formula

The Formula In Theory. An intuitive way to apportion the House is through simple rounding (a method never adopted by Congress). First, the U.S. apportionment population[6] is divided by the total number of seats in the House (e.g., in 1990, 249,022,783 divided by 435) to identify the "ideal" sized congressional district (572,466 in 1990). Then, each state's population is divided by the "ideal" district population. In most cases this will result in a whole number and a fractional remainder, as noted earlier. Each state will definitely receive seats equal to the whole number, and the fractional remainders will either be rounded up or down (at the .5 "rounding point").

There are two fundamental problems with using simple rounding for apportionment, given a House of fixed size. First, it is possible that some state populations might be so small that they would be "entitled" to less than half a seat. Yet, the Constitution requires that every state must have at least one seat in the House. Thus, a method which relies entirely on rounding will not comply with the Constitution if there are states with very small populations. Second, even a method that assigns each state its constitutional minimum of one seat and otherwise relies on rounding at the .5 rounding point might require a "floating" House size because rounding at .5 could result in either fewer or more than 435 seats. Thus, this intuitive way to apportion fails because, by definition, it does not take into account the

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[3] (...continued)
follows: "The number of Representatives shall not exceed one for every thirty Thousand, but each State shall have at least one Representative." This clause is sometime mis-read to be a requirement that districts can be no larger than 30,000 persons, rather than as it should be read, as a minimum-size population requirement.

[4] 55 Stat. 761. (1941) Sec. 22 (a). [Codified in 2 U.S.C. 2(a).] In other words, after the 2000 Census, this report is due in January 2001.

[5] *Ibid.,* Sec. 22 (b).

[6] The apportionment population is the population of the 50 states. It excludes the population of the District of Columbia and U.S. territories and possessions.

constitutional requirement that every state have at least one seat in the House and the statutory requirement that the House size be fixed at 435.

The current apportionment method (the method of equal proportions established by the 1941 act) satisfies the constitutional and statutory requirements. Although an equal proportions apportionment is not normally computed in the theoretical way described below, the method can be understood as a modification of the rounding scheme described above.

First, the "ideal" sized district is found (by dividing the apportionment population by 435) to serve as a "trial" divisor.

Then each state's apportionment population is divided by the "ideal" district size to determine its number of seats. Rather than rounding up any remainder of .5 or more, and down for less than .5, however, equal proportions rounds at the geometric mean of any two successive numbers. A geometric mean of two numbers is the square root of the product of the two numbers.[7] If using the "ideal" sized district population as a divisor does not yield 435 seats, the divisor is adjusted upward or downward until rounding at the geometric mean will result in 435 seats. In 1990, the "ideal" size district of 572,466 had to be adjusted upward to between 573,555 and 573,643[8] to produce a 435-Member House. Because the divisor is adjusted so that the total number of seats will equal 435, the problem of the "floating" House size is solved. The constitutional requirement of at least one seat for each state is met by assigning each state one seat automatically regardless of its population size.

The Formula in Practice: Deriving the Apportionment From a Table of "Priority Values." Although the process of determining an apportionment through a series of trials using divisions near the "ideal" sized district as described above works, it is inefficient because it requires a series of calculations using different divisors until the 435 total is reached. Accordingly, the Census Bureau determines apportionment by computing a "priority" list of state claims to each seat in the House.

During the early twentieth century, Walter F. Willcox, a Cornell University mathematician, discovered that if the rounding points used in an apportionment method are divided into each state's population (the mathematical equivalent of

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[7] The geometric mean of 1 and 2 is the square root of 2, which is 1.4142. The geometric mean of 2 and 3 is the square root of 6, which is 2.4495. Geometric means are computed for determining the rounding points for the size of any state's delegation size. Equal proportions rounds at the geometric mean (which varies) rather than the arithmetic mean (which is always halfway between any pair of numbers). Thus, a state which would be entitled to 10.4871 seats before rounding will be rounded down to 10 because the geometric mean of 10 and 11 is 10.4881. The rationale for choosing the geometric mean rather than the arithmetic mean as the rounding point is discussed in the section analyzing the equal proportions and major fractions formulas.

[8] Any number in this range divided into each state's population and rounded at the geometric mean will produce a 435-seat House.

multiplying the population by the reciprocal of the rounding point), the resulting numbers can be ranked in a priority list for assigning seats in the House.[9]

Such a priority list does not assume a fixed House size because it ranks each of the states' claims to seats in the House so that any size House can be chosen easily without the necessity of extensive recomputations.[10]

The traditional method of constructing a priority list to apportion seats by the equal proportions method involves first computing the reciprocals[11] of the geometric means between every pair of consecutive whole numbers (the "rounding points") so that it is possible to multiply by decimals rather than divide by fractions (the former being a considerably easier task). For example, the reciprocal of the geometric mean between 1 and 2 (1.41452) is 1/1.414452 or .70710678. These reciprocals are computed for each "rounding point." They are then used as multipliers to construct the "priority list." Table 1 provides a list of multipliers used to calculate the "priority values" for each state in an equal proportions apportionment.

To construct the "priority list," each state's apportionment population is multiplied by each of the multipliers. The resulting products are ranked in order to show each state's claim to seats in the House. For example, assume that there are three states in the Union (California, New York, and Florida) and that the House size is set at 30 Representatives. The first seat for each state is assigned by the Constitution; so the remaining twenty-seven seats must be apportioned using the equal proportions formula. The 1990 apportionment populations for these states were 29,839,250 for California, 18,044,505 for New York, and 13,003,362 for Florida. Table 2 (p. 6) illustrates how the priority values are computed for each state.

Once the priority values are computed, they are ranked with the highest value first. The resulting ranking is numbered and seats are assigned until the total is reached. By using the priority rankings instead of the rounding procedures described above, it is possible to see how an increase or decrease in the House size will affect the allocation of seats without the necessity of doing new calculations. Table 3 (p. 7) ranks the priority values of the three states in this example, showing how the 27 seats are assigned.

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[9] U.S. Congress, House Committee on Post Office and Civil Service, Subcommittee on the Census and Statistics, *The Decennial Population Census and Congressional Apportionment*, 91st Cong., 2nd sess., H. Rept. 91-1814, (Washington: GPO, 1970), p. 16.

[10] The 435 limit on the size of the House is a statutory requirement. The House size was first fixed at 435 by the Apportionment Act of 1911 (37 Stat. 13). The Apportionment Act of 1929 (46 Stat. 26), as amended by the Apportionment Act of 1941 (54 Stat. 162), provided for "automatic reapportionment" rather than requiring the Congress to pass a new apportionment law each decade. By authority of section 9 of PL 85-508 (72 Stat. 345) and section 8 of PL 86-3 (73 Stat. 8), which admitted Alaska and Hawaii to statehood, the House size was temporarily increased to 437 until the reapportionment resulting from the 1960 Census when it returned to 435.

[11] A reciprocal of a number is that number divided into one.

Table 1. Multipliers for Determining Priority Values for Apportioning the House by the Equal Proportions Method

Size of delegation	Multiplier*	Size of delegation	Multiplier*	Size of delegation	Multiplier*
1	Constitution	21	0.04879500	41	0.02469324
2	0.70710678	22	0.04652421	42	0.02409813
3	0.40824829	23	0.04445542	43	0.02353104
4	0.28867513	24	0.04256283	44	0.02299002
5	0.22360680	25	0.04082483	45	0.02247333
6	0.18257419	26	0.03922323	46	0.02197935
7	0.15430335	27	0.03774257	47	0.02150662
8	0.13363062	28	0.03636965	48	0.02105380
9	0.11785113	29	0.03509312	49	0.02061965
10	0.10540926	30	0.03390318	50	0.02020305
11	0.09534626	31	0.03279129	51	0.01980295
12	0.08703883	32	0.03175003	52	0.01941839
13	0.08006408	33	0.03077287	53	0.01904848
14	0.07412493	34	0.02985407	54	0.01869241
15	0.06900656	35	0.02898855	55	0.01834940
16	0.06454972	36	0.02817181	56	0.01801875
17	0.06063391	37	0.02739983	57	0.01769981
18	0.05716620	38	0.02666904	58	0.01739196
19	0.05407381	39	0.02597622	59	0.01709464
20	0.05129892	40	0.02531848	60	0.01680732

*Table by CRS, calculated by determining the reciprocals of the geometric means of successive numbers: $1/\sqrt{n(n-1)}$, where "n" is the number of seats to be allocated to the state.

Table 2. Calculating Priority Values for a Hypothetical Three State House of 30 Seats Using the Method of Equal Proportions

State	State's priority value claim to a delegation size			
	Size of delegation	Calculation		
		Multiplier (M)	Population (P)	Priority value (PxM)
CA	2	0.70710678	29,839,250	21,099,536.02
CA	3	0.40824829	29,839,250	12,181,822.80
CA	4	0.28867513	29,839,250	8,613,849.51
CA	5	0.22360680	29,839,250	6,672,259.14
CA	6	0.18257419	29,839,250	5,447,876.77
CA	7	0.15430335	29,839,250	4,604,296.24
CA	8	0.13363062	29,839,250	3,987,437.51
CA	9	0.11785113	29,839,250	3,516,589.34
CA	10	0.10540926	29,839,250	3,145,333.12
CA	11	0.09534626	29,839,250	2,845,060.86
CA	12	0.08703883	29,839,250	2,597,173.35
CA	13	0.08006408	29,839,250	2,389,052.01
CA	14	0.07412493	29,839,250	2,211,832.37
CA	15	0.06900656	29,839,250	2,059,103.87
CA	16	0.06454972	29,839,250	1,926,115.31
CA	17	0.06063391	29,839,250	1,809,270.29
CA	18	0.05716620	29,839,250	1,705,796.39
NY	2	0.70710678	18,044,505	12,759,391.85
NY	3	0.40824829	18,044,505	7,366,638.32
NY	4	0.28867513	18,044,505	5,208,999.91
NY	5	0.22360680	18,044,505	4,034,873.98
NY	6	0.18257419	18,044,505	3,294,460.81
NY	7	0.15430335	18,044,505	2,784,327.57

State	State's priority value claim to a delegation size			
	Size of delegation	Calculation		
		Multiplier (M)	Population (P)	Priority value (PxM)
NY	8	0.13363062	18,044,505	2,411,298.41
NY	9	0.11785113	18,044,505	2,126,565.31
NY	10	0.10540926	18,044,505	1,902,057.84
NY	11	0.09534626	18,044,505	1,720,476.05
NY	12	0.08703883	18,044,505	1,570,572.57
FL	2	0.70710678	13,003,362	9,194,765.45
FL	3	0.40824829	13,003,362	5,308,600.31
FL	4	0.28867513	13,003,362	3,753,747.28
FL	5	0.22360680	13,003,362	2,907,640.14
FL	6	0.18257419	13,003,362	2,374,078.23
FL	7	0.15430335	13,003,362	2,006,462.32
FL	8	0.13363062	13,003,362	1,737,647.34

*The "priority values" are the product of the multiplier times the state population. These values can be computed for any size state delegation, but only those values necessary for this example have been computed for this table. The population figures are those from the 1990 Census. Table by CRS.

Table 3. Priority Rankings for Assigning Thirty Seats in a Hypothetical Three-State House Delegation

House size	State's priority value claim to a delegation size				
	State	Size of delegation	Calculation		
			Multiplier (M)	Population (P)	Priority value (PxM)
4	CA	2	0.70710678	29,839,250	21,099,536.02
5	NY	2	0.70710678	18,044,505	12,759,391.85
6	CA	3	0.40824829	29,839,250	12,181,822.80
7	FL	2	0.70710678	13,003,362	9,194,765.45
8	CA	4	0.28867513	29,839,250	8,613,849.51
9	NY	3	0.40824829	18,044,505	7,366,638.32
10	CA	5	0.22360680	29,839,250	6,672,259.14
11	CA	6	0.18257419	29,839,250	5,447,876.77
12	FL	3	0.40824829	13,003,362	5,308,600.31
13	NY	4	0.28867513	18,044,505	5,208,999.91
14	CA	7	0.15430335	29,839,250	4,604,296.24
15	NY	5	0.22360680	18,044,505	4,034,873.98
16	CA	8	0.13363062	29,839,250	3,987,437.51
17	FL	4	0.28867513	13,003,362	3,753,747.28
18	CA	9	0.11785113	29,839,250	3,516,589.34
19	NY	6	0.18257419	18,044,505	3,294,460.81
20	CA	10	0.10540926	29,839,250	3,145,333.12
21	FL	5	0.22360680	13,003,362	2,907,640.14
22	CA	11	0.09534626	29,839,250	2,845,060.86
23	NY	7	0.15430335	18,044,505	2,784,327.57
24	CA	12	0.08703883	29,839,250	2,597,173.35
25	NY	8	0.13363062	18,044,505	2,411,298.41
26	CA	13	0.08006408	29,839,250	2,389,052.01
27	FL	6	0.18257419	13,003,362	2,374,078.23
28	CA	14	0.07412493	29,839,250	2,211,832.37
29	NY	9	0.11785113	18,044,505	2,126,565.31
30	CA	15	0.06900656	29,839,250	2,059,103.87

*The Constitution requires that each state have least one seat. Table by CRS.

From the example in Table 3, we see that if the United States were made up of three states and the House size were to be set at 30 Members, California would have 15 seats, New York would have nine, and Florida would have six. Any other size House can be determined by picking points in the priority list and observing what the maximum size state delegation size would be for each state.

A priority listing for all 50 states based on the 1990 Census is appended to this report. It shows priority rankings for the assignment of seats in a House ranging in size from 51 to 500 seats.

Challenges to the Current Formula

The equal proportions rule of rounding at the geometric mean results in differing rounding points, depending on which numbers are chosen. For example, the geometric mean between 1 and 2 is 1.4142, and the geometric mean between 49 and 50 is 49.49747. Table 4 on the following page shows the "rounding points" for assignments to the House using the equal proportions method for a state delegation size of up to 60. The rounding points are listed between each delegation size because they are the thresholds which must be passed in order for a state to be entitled to another seat. The table illustrates that, as the delegation size of a state increases, larger fractions are necessary to entitle the state to additional seats.

The increasingly higher rounding points necessary to obtain additional seats has led to charges that the equal proportions formula favors small states at the expense of large states. In a 1982 book about congressional apportionment entitled *Fair Representation*, the authors (M.L. Balinski and H.P. Young) concluded that if "the intent is to eliminate any systematic advantage to either the small or the large, then only one method, first proposed by Daniel Webster in 1832, will do."[12] This method, called the Webster method in *Fair Representation*, is also referred to as the major fractions method. (Major fractions uses the concept of the adjustable divisor as does equal proportions, but rounds at the arithmetic mean [.5] rather than the geometric mean.) Balinski and Young's conclusion in favor of major fractions, however, contradicts a report of the National Academy of Sciences (NAS) prepared at the request of Speaker Longworth in 1929. The NAS concluded that "the method of equal proportions is preferred by the committee because it satisfies ... [certain tests], and because it occupies mathematically a neutral position with respect to emphasis on larger and smaller states".[13]

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[12] M.L. Balinski and H.P. Young, *Fair Representation*, (New Haven and London: Yale University Press, 1982), p. 4. (An earlier major work in this field was written by Laurence F. Schmeckebier, *Congressional Apportionment.* (Washington: The Brookings Institution, 1941). Daniel Webster proposed this method to overcome the large-state bias in Jefferson's *discarded fractions* method. Webster's method was used three times, in the reapportionments following the 1840, 1910, and 1930 Censuses.

[13] "Report of the National Academy of Sciences Committee on Apportionment" in *The Decennial Population Census and Congressional Apportionment*, Appendix C, p. 21.

Table 4. Rounding Points for Assigning Seats Using the Equal Proportions Method of Apportionment*

Size of delegation	Round up at	Size of delegation	Round up at	Size of delegation	Round up at	Size of delegation	Round up at
1		**16**		**31**		**46**	
	1.41421		16.49242		31.49603		46.49731
2		**17**		**32**		**47**	
	2.44949		17.49286		32.49615		47.49737
3		**18**		**33**		**48**	
	3.46410		18.49324		33.49627		48.49742
4		**19**		**34**		**49**	
	4.47214		19.49359		34.49638		49.49747
5		**20**		**35**		**50**	
	5.47723		20.49390		35.49648		50.49752
6		**21**		**36**		**51**	
	6.48074		21.49419		36.49658		51.49757
7		**22**		**37**		**52**	
	7.48331		22.49444		37.49667		52.49762
8		**23**		**38**		**53**	
	8.48528		23.49468		38.49675		53.49766
9		**24**		**39**		**54**	
	9.48683		24.49490		39.49684		54.49771
10		**25**		**40**		**55**	
	10.48809		25.49510		40.49691		55.49775
11		**26**		**41**		**56**	
	11.48913		26.49528		41.49699		56.49779
12		**27**		**42**		**57**	
	12.49000		27.49545		42.49706		57.49783
13		**28**		**43**		**58**	
	13.49074		28.49561		43.49713		58.49786
14		**29**		**44**		**59**	
	14.49138		29.49576		44.49719		59.49790
15		**30**		**45**		**60**	
	15.49193		30.49590		45.49725		60.49793

*Any number between 574,847 and 576,049 divided into each state's 1990 apportionment population will produce a House size of 435 if rounded at these points, which are the geometric means of each pair of successive numbers. Table by CRS.

A bill that would have changed the apportionment method to another formula called the "Hamilton-Vinton" method was introduced in 1981.[14] The fundamental principle of the Hamilton-Vinton method is that it ranks fractional remainders. To reapportion the House using Hamilton-Vinton, each state's population would be divided by the "ideal" sized congressional district (in 1990, 249,022,783 divided by 435 or 572,466). Any state with fewer residents than the "ideal"sized district would receive a seat because the Constitution requires each state to have at least one House

[14] H.R. 1990 was introduced by Representative Floyd Fithian and was cosponsored by 10 other Members of the Indiana delegation. Hearings were held, but no further action was taken on the measure. U.S. Congress, House Committee on Post Office and Civil Service, Subcommittee on Census and Population, *Census Activities and the Decennial Census*, hearing, 97th Cong., 1st sess., June 11, 1981, (Washington: GPO, 1981).

seat. The remaining states in most cases have a claim to a whole number and a fraction of a Representative. Each such state receives the whole number of seats it is entitled to. The fractional remainders are rank-ordered from highest to lowest until 435 seats are assigned. For the purpose of this analysis, we will concentrate on the differences between the equal proportions and major fractions methods because the Hamilton-Vinton method is subject to several mathematical peculiarities.[15]

Equal Proportions or Major Fractions: an Analysis

Each of the major competing methods–equal proportions (currently used) and major fractions–can be supported mathematically. Choosing between them is a policy decision, rather than a matter of conclusively proving that one approach is mathematically better than the other. A major fractions apportionment results in a House in which each citizen's share of his or her Representative is as equal as possible on an absolute basis. In the equal proportions apportionment now used, each citizen's share of his or her Representative is as equal as possible on a proportional basis. The state of Indiana in 1980 would have been assigned 11 seats under the major fractions method, and New Mexico would have received 2 seats. Under this allocation, there would have been 2.004 Representatives per million for Indiana residents and 1.538 Representative per million in New Mexico. The absolute value[16] of the difference between these two numbers is 0.466. Under the equal proportions assignment in 1980, Indiana actually received 10 seats and New Mexico 3. With 10 seats, Indiana got 1.821 Representatives for each million persons, and New Mexico with 3 seats received 2.308 Representatives per million. The absolute value of the difference is 0.487. Because major fractions minimizes the absolute population differences, under it Indiana would have received 11 seats and New Mexico 2, because the absolute value of subtracting the population shares with an 11 and 2 assignment (0.466) is smaller than a 10 and 3 assignment (0.487).

An equal proportions apportionment, however, results in a House where the average sizes of all the states' congressional districts are as equal as possible if their differences in size are expressed proportionally–that is, as percentages. The proportional difference between 2.004 and 1.538 (major fractions) is 30%. The proportional difference between 2.308 and 1.821 (equal proportions) is 27%. Based

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[15] The Hamilton-Vinton method (used after the 1850-1900 censuses) is subject to the "Alabama paradox" and various other population paradoxes. The Alabama paradox was so named in 1880 when it was discovered that Alabama would have lost a seat in the House if the size of the House had been increased from 299 to 300. Another paradox, known as the population paradox, has been variously described, but in its modern form (with a fixed size House) it works in this way: two states may gain population from one census to the next. State "A," which is gaining population at a rate faster than state "B," may lose a seat to state "B." There are other paradoxes of this type. Hamilton-Vinton is subject to them, whereas equal proportions and major fractions are not.

[16] The absolute value of a number is its magnitude without regard to its sign. For example, the absolute value of -8 is 8. The absolute value of the expression (4-2) is 2. The absolute value of the expression (2-4) is also 2.

on this comparison, the method of equal proportions gives New Mexico 3 seats and Indiana 10 because the proportional difference is smaller (27%) than if New Mexico gets 2 seats and Indiana 10 (30%). From a policy standpoint, one can make a case for either method by arguing that one measure of fairness is preferable to the other.

The Case for Major Fractions. It can be argued that the major fractions minimization of absolute size differences among districts most closely reflects the "one person, one vote" principle established by the Supreme Court in its series of redistricting cases (*Baker* v. *Carr*, 369 U.S. 186 (1964) through *Karche*r v. *Daggett*, 462 U.S.725 (1983).[17]

Although the "one person, one vote" rules have not been applied by the courts to apportioning seats *among* states, major fractions can reduce the range between the smallest and largest district sizes more than equal proportions–one of the measures which the courts have applied to within-state redistricting cases. Although this range would have not changed in 1990, if major fractions had been used in 1980, the smallest average district size in the country would have been 399,592 (one of Nevada's two districts). With equal proportions it was 393,345 (one of Montana's two districts). In both cases the largest district was 690,178 (South Dakota's single seat).[18] Thus, in 1980, shifting from equal proportions to major fractions as a method would have improved the 296,833 difference between the largest and smallest districts by 6,247 persons. It can be argued, because the equal proportions rounding points ascend as the number of seats increases, rather than staying at .5, that small states may be favored in seat assignments at the expense of large states. It is possible to demonstrate this using simulation techniques.

The House has only been reapportioned 20 times since 1790. The equal proportions method has been used in five apportionments, and major fractions in three. Eight apportionments do not provide enough historical information to enable policy makers to generalize about the impact of using differing methods. Computers, however, can enable reality to be simulated by using random numbers to test many different hypothetical situations. These techniques (such as the "Monte Carlo" simulation method) are a useful way of observing the behavior of systems when experience does not provide enough information to generalize about them.

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[17] Major fractions best conforms to the spirit of these decisions if the population discrepancy is measured on an absolute basis, as the courts have done in the recent past. The Court has never applied its "one person, one vote" rule to apportioning seats–states (as opposed to redistricting within states). Thus, no established rule of law is being violated. Arguably, no apportionment method can meet the "one person, one vote" standard required for districts within states unless the size of the House is increased significantly (thereby making districts smaller).

[18] Nevada had two seats with a population of 799,184. Montana was assigned two seats with a population of 786,690. South Dakota's single seat was required by the Constitution (with a population of 690,178). The vast majority of the districts based on the 1980 census (323 of them) fell within the range of 501,000 to 530,000).

Apportioning the House can be viewed as a system with four main variables: (1) the size of the House; (2) the population of the states; (3) the number of states; and (4) the method of apportionment. A 1984 exercise prepared for the Congressional Research Service (CRS) involving 1,000 simulated apportionments examined the results when two of these variables were changed–the method and the state populations. In order to further approximate reality, the state populations used in the apportionments were based on the Census Bureau's 1990 population projections available at that time. Each method was tested by computing 1,000 apportionments and tabulating the results by state. There was no discernible pattern by size of state in the results of the major fractions apportionment. The equal proportions exercise, however, showed that the smaller states were persistently advantaged.[19]

Another way of evaluating the impact of a possible change in apportionment methods is to determine the odds of an outcome being different than the one produced by the current method–equal proportions. If equal proportions favors small states at the expense of large states, would switching to major fractions, a method that appears not to be influenced by the size of a state, increase the odds of the large states gaining additional representation? Based on the simulation model prepared for CRS, this appears to be true. The odds of any of the 23 largest states gaining an additional seat in any given apportionment range from a maximum of 13.4% of the time (California) to a low of .2% of the time (Alabama). The odds of any of the 21 multi-districted smaller states losing a seat range from a high of 17% (Montana, which then had two seats) to a low of 0% (Colorado), if major fractions were used instead of equal proportions.

In the aggregate, switching from equal proportions to major fractions "could be expected to shift zero seats about 37% of the time, to shift 1 seat about 49% of the time, 2 seats 12% of the time, and 3 seats 2% of the time (and 4 or more seats almost never), and, these shifts will always be from smaller states to larger states."[20]

The Case for Equal Proportions. Support for the equal proportions formula primarily rests on the belief that minimizing the proportional differences among districts is more important than minimizing the absolute differences. Laurence Schmeckebier, a proponent of the equal proportions method, wrote in *Congressional Apportionment* in 1941, that:

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[19] Comparing equal proportions and major fractions using the state populations from the 19 actual censuses taken since 1790, reveals that the small states would have been favored 3.4% of the time if equal proportions had been used for all the apportionments. Major fractions would have also favored small states, in these cases, but only .03 % of the time. See *Fair Representation*, p. 78.

[20] H.P. Young and M.L. Balinski, *Evaluation of Apportionment Methods*, Prepared under a contract for the Congressional Research Service of the Library of Congress. (Contract No. CRS84-15), Sept. 30, 1984, p. 13.

> Mathematicians generally agree that the significant feature of a difference is its relation to the smaller number and not its absolute quantity. Thus the increase of 50 horsepower in the output of two engines would not be of any significance if one engine already yielded 10,000 horsepower, but it would double the efficiency of a plant of only 50 horsepower. It has been shown ... that the relative difference between two apportionments is always least if the method of equal proportions is used. Moreover, the method of equal proportions is the only one that uses relative differences, the methods of harmonic mean and major fraction being based on absolute differences. In addition, the method of equal proportions gives the smallest relative difference for both average population per district and individual share in a representative. No other method takes account of both these factors. Therefore the method of equal proportions gives the most equitable distribution of Representatives among the states.[21]

An example using Massachusetts and Oklahoma 1990 populations, illustrates the argument for proportional differences. The first step in making comparisons between the states is to standardize the figures in some fashion. One way of doing this is to express each state's representation in the House as a number of Representatives per million residents.[22] The equal proportions formula assigned 10 seats to Massachusetts and 6 to Oklahoma in 1990. When 11 seats are assigned to Massachusetts, and five are given to Oklahoma (using major fractions), Massachusetts has 1.824 Representatives per million persons and Oklahoma has 1.583 Representatives per million. The absolute difference between these numbers is .241 and the proportional difference between the two states' Representatives per million is 15.22%. When 10 seats are assigned to Massachusetts and 6 are assigned to Oklahoma (using equal proportions), Massachusetts has 1.659 Representatives per million and Oklahoma has 1.9 Representative per million. The absolute difference between these numbers is .243 and the proportional difference is 14.53%.

Major fractions minimizes absolute differences, so in 1990, if this if this method had been required by law, Massachusetts and Oklahoma would have received 11 and five seats respectively because the absolute difference (0.241 Representatives per million) is smaller at 11 and five than it would be at 10 and 6 (0.243). Equal proportions minimizes differences on a proportional basis, so it assigned 10 seats to Massachusetts and six to Oklahoma because the proportional difference between a 10 and 6 allocation (14.53%) is smaller than would occur with an 11 and 5 assignment (15.22%).

The proportional difference versus absolute difference argument could also be cast in terms of the goal of "one person, one vote." The courts' use of absolute difference measures in state redistricting cases may not necessarily be appropriate when applied to the apportionment of seats among states. The courts already recognize that different rules govern redistricting in state legislatures than in

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[21] Schmeckebier, *Congressional Apportionment*, p. 60.

[22] Representatives per million is computed by dividing the number of Representatives assigned to the state by the state's population (which gives the number of Representatives per person) and then multiplying the resulting dividend by 1,000,000.

congressional districting. If the "one person, one vote" standard were ever to be applied to apportionment of seats among states–a process that differs significantly from redistricting within states–proportional difference measures might be accepted as most appropriate.[23]

If the choice between methods were judged to be a tossup with regard to which mathematical process is fairest, are there other representational goals that equal proportions meets which are perhaps appropriate to consider? One such goal might be the desirability of avoiding geographically large districts, if possible. After the 1990 apportionment, five of the seven states which had only one Representative (Alaska, Delaware, Montana, North Dakota, South Dakota, Vermont, and Wyoming) have relatively large land areas.[24] The five Representatives of the larger states served 1.27% of the U.S. population, but also represented 27% of the U.S. land area.

Arguably, an apportionment method that would potentially reduce the number of very large districts would serve to increase representation in those states. Very large districts limit the opportunities of constituents to see their Representatives, may require more district based offices, and may require toll calls for telephone contact with the Representatives' district offices. Switching from equal proportions to major fractions may increase the number of states represented by only one Member of Congress. Although it is impossible to predict with any certainty, using Census Bureau projections for 2025[25] as an illustration, a major fractions apportionment would result in eight states represented by only one Member, while an equal proportions apportionment would result in six single-district states.

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[23] Montana argued in Federal court in 1991 and 1992 that the equal proportions formula violated the Constitution because it "does not achieve the greatest possible equality in number of individuals per Representative" *Department of Commerce* v. *Montana* 503 U.S. 442 (1992). Writing for a unanimous court, Justice Stevens however, noted that absolute and relative differences in district sizes are identical when considering deviations in district populations *within* states, but they are different when comparing district populations *among* states. Justice Stevens noted, however, "although "common sense" supports a test requiring a "good faith effort to achieve precise mathematical equality" *within* each State ... the constraints imposed by Article I, §2, itself make that goal illusory for the nation as a whole." He concluded "that Congress had ample power to enact the statutory procedure in 1941 and to apply the method of equal proportions after the 1990 census."

[24] The total area of the U.S. is 3,618,770 square miles. The area and (rank) among all states in area for the seven single district states in this scenario are as follows: Alaska–591,004 (1), Delaware–2,045 (49), Montana–147,046 (4), North Dakota–70,762 (17), South Dakota–77,116 (16), Vermont–9,614 (43), Wyoming–97,809 (9). Source: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States 1987,* (Washington: GPO, 1987), Table 316: Area of States, p. 181.

[25] U.S. Census Bureau, *Projections of the Total Population of States: 1995-2025,* Series A, http://www.census.gov/population/projections/stpjpop.txt, visited Aug. 11, 2000.

The appendix which follows is the priority listing used in reapportionment following the 1990 Census. This listing shows where each state ranked in the priority of seat assignments. The priority values listed beyond seat number 435 show which states would have gained additional representations if the House size had been increased.

Appendix: 1990 Priority List

Seq.	State	Seat	Priority
51	CA	2	21,099,535.65
52	NY	2	12,759,391.63
53	CA	3	12,181,821.46
54	TX	2	12,063,103.59
55	FL	2	9,194,765.29
56	CA	4	8,613,849.35
57	PA	2	8,432,043.16
58	IL	2	8,108,168.46
59	OH	2	7,698,501.20
60	NY	3	7,366,637.51
61	TX	3	6,964,635.46
62	CA	5	6,672,258.17
63	MG	2	6,596,446.31
64	NJ	2	5,479,111.55
65	CA	6	5,447,875.79
66	FL	3	5,308,599.72
67	NY	4	5,208,999.81
68	TX	4	4,924,741.41
69	PA	3	4,868,241.93
70	NC	2	4,707,655.23
71	IL	3	4,681,252.81
72	CA	7	4,604,295.11
73	GA	2	4,602,147.13
74	OH	3	4,444,731.33
75	VA	2	4,395,777.31
76	MA	2	4,263,182.77
77	NY	5	4,034,873.39
78	CA	8	3,987,436.09
79	IN	2	3,934,503.28
80	TX	5	3,814,687.81
81	MG	3	3,808,459.70
82	FL	4	3,753,747.20
83	MO	2	3,632,975.98
84	CA	9	3,516,587.79
85	WS	2	3,469,592.60
86	TN	2	3,462,447.99
87	WA	2	3,456,296.16
88	PA	4	3,442,367.20
89	MD	2	3,393,138.09
90	IL	4	3,310,145.91
91	NY	6	3,294,460.21
92	NJ	3	3,163,366.23
93	CA	10	3,145,331.61
94	OH	4	3,142,899.95
95	TX	6	3,114,679.44
96	MN	2	3,102,097.90
97	LA	2	2,996,871.22
98	FL	5	2,907,639.71
99	AL	2	2,872,697.61
100	CA	11	2,845,059.46
101	NY	7	2,784,326.89
102	NC	3	2,717,965.76
103	MG	4	2,692,987.92
104	PA	5	2,666,445.82
105	GA	3	2,657,050.63
106	TX	7	2,632,384.41
107	KY	2	2,615,566.01
108	AZ	2	2,600,728.09
109	CA	12	2,597,172.96
110	IL	5	2,564,027.67
111	VA	3	2,537,902.98
112	SC	2	2,478,909.15
113	MA	3	2,461,349.49
114	OH	5	2,434,479.52
115	NY	8	2,411,297.55
116	CA	13	2,389,051.45
117	FL	6	2,374,077.80
118	CO	2	2,339,046.96
119	CN	2	2,330,389.85
120	TX	8	2,279,711.53
121	IN	3	2,271,586.31
122	NJ	4	2,236,837.92
123	OK	2	2,232,763.16
124	CA	14	2,211,830.60
125	PA	6	2,177,143.82
126	NY	9	2,126,564.37
127	MO	3	2,097,499.46
128	IL	6	2,093,519.75
129	MG	5	2,085,979.21
130	CA	15	2,059,102.28
131	OR	2	2,017,893.92
132	TX	9	2,010,516.41
133	FL	7	2,006,461.82
134	WS	3	2,003,170.03
135	TN	3	1,999,045.09
136	WA	3	1,995,493.33
137	OH	6	1,987,744.13
138	IO	2	1,971,006.37
139	MD	3	1,959,029.01
140	CA	16	1,926,114.17
141	NC	4	1,921,892.20
142	NY	10	1,902,056.92
143	GA	4	1,878,818.69
144	PA	7	1,840,022.25
145	MS	2	1,828,891.35
146	CA	17	1,809,270.25
147	TX	10	1,798,260.48
148	VA	4	1,794,568.57
149	MN	3	1,790,996.89

150	IL	7	1,769,347.01
151	KA	2	1,757,584.58
152	MA	4	1,740,437.07
153	FL	8	1,737,646.72
154	NJ	5	1,732,646.98
155	LA	3	1,730,244.24
156	NY	11	1,720,475.20
157	CA	18	1,705,796.31
158	MG	6	1,703,194.83
159	OH	7	1,679,950.30
160	AR	2	1,670,355.18
161	AL	3	1,658,552.58
162	TX	11	1,626,587.79
163	CA	19	1,613,521.84
164	IN	4	1,606,254.23
165	PA	8	1,593,505.83
166	NY	12	1,570,572.33
167	FL	9	1,532,460.23
168	IL	8	1,532,299.29
169	CA	20	1,530,721.18
170	KY	3	1,510,097.60
171	AZ	3	1,501,530.92
172	NC	5	1,488,691.10
173	TX	12	1,484,865.21
174	MO	4	1,483,156.23
175	CA	21	1,456,006.30
176	GA	5	1,455,326.51
177	OH	8	1,454,879.48
178	NY	13	1,444,716.30
179	MG	7	1,439,462.27
180	SC	3	1,431,198.73
181	WS	4	1,416,455.24
182	NJ	6	1,414,700.28
183	TN	4	1,413,538.47
184	WA	4	1,411,027.00
185	PA	9	1,405,339.93
186	VA	5	1,390,066.66
187	CA	22	1,388,247.47
188	MD	4	1,385,242.82
189	FL	10	1,370,674.05
190	TX	13	1,365,877.22
191	IL	9	1,351,360.84
192	CO	3	1,350,449.27
193	MA	5	1,348,136.59
194	CN	3	1,345,451.08
195	NY	14	1,337,546.63
196	CA	23	1,326,516.39
197	OK	3	1,289,086.29
198	OH	9	1,283,082.99
199	WV	2	1,273,941.23
200	CA	24	1,270,042.73
201	MN	4	1,266,426.16
202	TX	14	1,264,555.87
203	PA	10	1,256,974.20

204	MG	8	1,246,610.75
205	NY	15	1,245,188.18
206	IN	5	1,244,199.02
207	FL	11	1,239,821.31
208	LA	4	1,223,467.55
209	UT	2	1,221,727.76
210	CA	25	1,218,182.21
211	NC	6	1,215,511.15
212	IL	10	1,208,693.83
213	NJ	7	1,195,639.89
214	GA	6	1,188,269.08
215	TX	15	1,177,237.47
216	AL	4	1,172,773.89
217	CA	26	1,170,391.58
218	OR	3	1,165,031.49
219	NY	16	1,164,767.10
220	MO	5	1,148,847.73
221	OH	10	1,147,624.27
222	IO	3	1,137,960.95
223	PA	11	1,136,975.93
224	VA	6	1,134,984.63
225	FL	12	1,131,797.21
226	CA	27	1,126,209.87
227	NB	2	1,120,493.40
228	TX	16	1,101,205.03
229	MA	6	1,100,748.87
230	MG	9	1,099,407.25
231	WS	5	1,097,181.37
232	TN	5	1,094,922.05
233	NY	17	1,094,108.80
234	IL	11	1,093,304.69
235	WA	5	1,092,976.67
236	CA	28	1,085,243.01
237	NM	2	1,076,060.23
238	MD	5	1,073,004.34
239	KY	4	1,067,800.35
240	AZ	4	1,061,742.79
241	MS	3	1,055,910.81
242	CA	29	1,047,152.30
243	FL	13	1,041,101.93
244	OH	11	1,038,065.20
245	PA	12	1,037,912.62
246	NJ	8	1,035,454.40
247	TX	17	1,034,402.59
248	NY	18	1,031,535.64
249	NC	7	1,027,294.36
250	IN	6	1,015,884.21
251	KA	3	1,014,741.83
252	SC	4	1,012,010.42
253	CA	30	1,011,645.28
254	GA	7	1,004,270.60
255	IL	12	998,046.41
256	MG	10	983,339.70
257	MN	5	980,969.36

258	CA	31	978,467.51
259	NY	19	975,735.07
260	TX	18	975,244.09
261	AR	3	964,379.92
262	FL	14	963,872.55
263	VA	7	959,237.03
264	CO	4	954,911.92
265	PA	13	954,740.67
266	CN	4	951,377.67
267	LA	5	947,693.77
268	OH	12	947,619.86
269	CA	32	947,397.10
270	MO	6	938,030.21
271	MA	7	930,302.53
272	NY	20	925,663.55
273	TX	19	922,488.60
274	CA	33	918,239.42
275	IL	13	918,069.09
276	NJ	9	913,184.87
277	OK	4	911,521.74
278	AL	5	908,426.63
279	FL	15	897,316.53
280	WS	6	895,844.81
281	TN	6	894,000.08
282	WA	6	892,411.68
283	CA	34	890,823.07
284	NC	8	889,662.91
285	MG	11	889,464.22
286	PA	14	883,917.61
287	NY	21	880,481.68
288	MD	6	876,104.34
289	TX	20	875,149.50
290	ME	2	872,020.33
291	OH	13	871,683.42
292	GA	8	869,723.76
293	CA	35	864,996.63
294	IN	7	858,578.81
295	NV	2	852,878.24
296	IL	14	849,966.34
297	CA	36	840,625.60
298	NY	22	839,506.30
299	FL	16	839,362.91
300	TX	21	832,433.24
301	VA	8	830,723.54
302	KY	5	827,114.49
303	OR	4	823,801.74
304	PA	15	822,882.53
305	AZ	5	822,422.32
306	CA	37	817,590.39
307	NJ	10	816,777.34
308	MG	12	811,966.30
309	OH	14	807,021.57
310	MA	8	805,665.54
311	IO	4	804,659.98
312	NY	23	802,176.05
313	MN	6	800,958.10
314	CA	38	795,784.05
315	TX	22	793,693.91
316	MO	7	792,780.17
317	IL	15	791,275.62
318	HA	2	788,617.79
319	FL	17	788,444.61
320	NH	2	787,656.83
321	NC	9	784,608.87
322	SC	5	783,899.80
323	CA	39	775,110.76
324	LA	6	773,788.69
325	PA	16	769,736.26
326	NY	24	768,025.08
327	GA	9	767,024.19
328	TX	23	758,400.80
329	WS	7	757,127.00
330	TN	7	755,567.92
331	CA	40	755,484.48
332	WA	7	754,225.48
333	OH	15	751,296.22
334	MG	13	746,900.30
335	MS	4	746,641.76
336	IN	8	743,550.98
337	FL	18	743,352.69
338	AL	6	741,727.21
339	MD	7	740,443.26
340	IL	16	740,170.70
341	CO	5	739,671.50
342	NJ	11	738,802.90
343	CN	5	736,933.88
344	CA	41	736,827.74
345	NY	25	736,663.79
346	WV	3	735,510.24
347	VA	9	732,629.24
348	TX	24	726,113.47
349	PA	17	723,041.73
350	CA	42	719,070.17
351	KA	4	717,530.90
352	ID	2	715,582.15
353	RI	2	711,338.09
354	MA	9	710,530.16
355	NY	26	707,763.66
356	OK	5	706,061.61
357	UT	3	705,364.78
358	FL	19	703,141.28
359	OH	16	702,773.39
360	CA	43	702,148.53
361	NC	10	701,775.48
362	TX	25	696,463.58
363	IL	17	695,269.70
364	MG	14	691,494.92
365	MO	8	686,567.69

366	GA	10	686,047.27
367	CA	44	686,005.00
368	AR	4	681,919.64
369	PA	18	681,690.26
370	NY	27	681,045.92
371	MN	7	676,933.10
372	KY	6	675,336.13
373	NJ	12	674,431.92
374	AZ	6	671,504.99
375	CA	45	670,587.24
376	TX	26	669,140.55
377	FL	20	667,058.37
378	OH	17	660,141.03
379	NY	28	656,272.29
380	CA	46	655,847.22
381	IN	9	655,750.27
382	WS	8	655,691.14
383	IL	18	655,506.55
384	VA	10	655,283.49
385	TN	8	654,340.94
386	LA	7	653,970.76
387	WA	8	653,178.36
388	NB	3	646,917.11
389	PA	19	644,814.46
390	TX	27	643,880.82
391	MG	15	643,746.75
392	CA	47	641,741.37
393	MD	8	641,242.61
394	SC	6	640,051.48
395	OR	5	638,114.00
396	MA	10	635,517.47
397	NC	11	634,779.80
398	FL	21	634,499.09
399	NY	29	633,237.93
400	CA	48	628,229.44
401	AL	7	626,873.87
402	IO	5	623,286.86
403	OH	18	622,386.91
404	NM	3	621,263.60
405	GA	11	620,553.10
406	TX	28	620,459.09
407	NJ	13	620,387.08
408	IL	19	620,047.14
409	CA	49	615,274.87
410	NY	30	611,765.99
411	PA	20	611,724.70
412	MO	9	605,495.74
413	FL	22	604,971.11
414	CO	6	603,939.23
415	CA	50	602,843.86
416	MG	16	602,170.06
417	CN	6	601,703.97
418	TX	29	598,681.74
419	VA	11	592,726.21
420	NY	31	591,702.60
421	CA	51	590,905.18
422	OH	19	588,719.10
423	IL	20	588,228.36
424	IN	10	586,520.84
425	MN	8	586,241.20
426	PA	21	581,866.26
427	NC	12	579,472.22
428	CA	52	579,430.15
429	TX	30	578,381.53
430	MS	5	578,346.15
431	WS	9	578,265.19
432	FL	23	578,069.92
433	TN	9	577,074.42
434	OK	6	576,496.87
435	WA	9	576,049.11
Last seat assigned by law			
436	MA	11	574,847.17
437	NJ	14	574,366.50
438	NY	32	572,913.58
439	KY	7	570,763.16
440	CA	53	568,392.42
441	MT	2	568,269.89
442	AZ	7	567,525.26
443	GA	12	566,485.07
444	LA	8	566,355.23
445	MG	17	565,640.60
446	MD	9	565,522.77
447	IL	21	559,516.78
448	TX	31	559,413.02
449	OH	20	558,507.97
450	CA	54	557,767.31
451	KA	5	555,796.97
452	NY	33	555,281.24
453	PA	22	554,787.68
454	FL	24	553,459.80
455	CA	55	547,532.16
456	AL	8	542,888.63
457	TX	32	541,649.33
458	MO	10	541,571.83
459	VA	12	541,082.71
460	SC	7	540,942.20
461	NY	34	538,701.92
462	CA	56	537,665.94
463	NJ	15	534,706.13
464	IL	22	533,478.29
465	MG	18	533,291.06
466	NC	13	533,036.87
467	OH	21	531,247.06
468	FL	25	530,860.00
469	IN	11	530,528.06
470	PA	23	530,117.99
471	AR	5	528,212.62
472	CA	57	528,148.99

473	TX	33	524,979.20
474	MA	12	524,761.45
475	NY	35	523,084.05
476	GA	13	521,090.43
477	OR	6	521,017.88
478	WV	4	520,084.33
479	CA	58	518,963.07
480	WS	10	517,216.08
481	MN	9	517,016.09
482	TN	10	516,151.03
483	WA	10	515,233.97
484	CO	7	510,421.77
485	CA	59	510,091.18
486	FL	26	510,033.77
487	IL	23	509,756.16
488	TX	34	509,304.61
489	IO	6	508,911.57
490	CN	7	508,532.64
491	NY	36	508,346.32
492	PA	24	507,549.32
493	OH	22	506,524.17
494	MD	10	505,818.92
495	MG	19	504,442.86
496	ME	3	503,461.12
497	CA	60	501,517.64
498	NJ	16	500,171.88
499	LA	9	499,478.32
500	UT	4	498,768.26