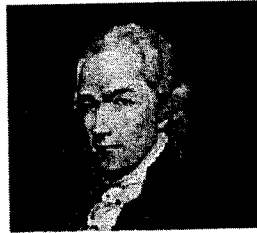


## Apportionment Methods

### Hamilton's Method

1. Calculate SD.
2. Calculate SQ.
3. Assign LQ to each state.
4. Surplus seats go to the state(s) with the largest fractional parts.



Alexander Hamilton

### Jefferson's Method

1. Do steps 1-3 of Hamilton's Method
2. if # seats = total LQ, you're finished
3. if not: find a modified divisor (MD) to use in place of SD so that the modified quotas (MQ) when rounded down and totaled equal the # of seats which need to be assigned



Thomas Jefferson

### Webster's Method

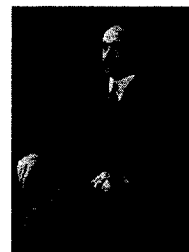
1. Calculate SD.
2. Calculate SQ.
3. Assign either the LQ or UQ to each state using conventional rounding.
4. if # seats = total assigned, you're finished
5. if not: find a modified divisor (MD) to use in place of SD so that the modified quotas (MQ) when rounded conventionally and totaled equal the # of seats which need to be assigned



Daniel Webster

Huntington-Hill Method

also called the "method of equal proportions"



1. Calculate SD.
2. Calculate SQ.
3. Round according to geometric means.  $\sqrt{LQ \cdot UQ}$   $SQ < GM \rightarrow LQ$   
 $SQ > GM \rightarrow UQ$
4. if # seats = total assigned, you're finished
5. if not: find a modified divisor (MD) to use in place of SD so that the modified quotas (MQ) when rounded according to the geometric means and totaled equal the # of seats which need to be assigned

Example 1

(The Can Problem) Ms. Powell's ICM class is having a canned food drive to help support 3 local agencies. At the end of the week they must deliver all of the cans collected. Suppose that they collected 100 cans. Apportion the cans to each agency using each method.

$SD = \frac{1300}{100} = 13$

13 → 98  
10 → 130  
12 → 107  
12.5 → 104  
12.75 → 100

agency	# served	SQ	LQ	Hamilton Apportionment	MQ	Jefferson Apportionment
#1	1000	76.923	76 +1	77	78.431	78
#2	200	15.385	15	15	15.686	15
#3	100	7.692	7 +1	8	7.843	7
TOTAL	1300	100	98	100		100

agency	UQ	<del>MQ</del>	Webster Apportionment	GM	<del>MQ</del>	Huntington-Hill Apportionment
#1	77		77	$\sqrt{76 \cdot 77} = 76.498$		77
#2	16		15	$\sqrt{15 \cdot 16} = 15.492$		15
#3	8		8	$\sqrt{7 \cdot 8} = 7.483$		8
TOTAL	101		100	77+15+8 100		100

**Example 2**

Planet Powell is a new republic located in the Milky Way. It is made up of six states: Airhead, Butterfinger, Chiclets, DumDums, Eclipse, and FunDip. According to the constitution of Planet Powell, the Congress will have 250 seats, divided among the 6 states according to their populations. Use each method to apportion the seats to each state.

$$SD = \frac{12,500,000}{250} = 50,000$$

$$\begin{aligned} 50,000 &\rightarrow 246 \\ 49,000 &\rightarrow 252 \\ 49,500 &\rightarrow 250 \end{aligned}$$

states	population	SD = 50000 SQ	LQ	Hamilton Apportionment	MD = 49500 MQ	Jefferson Apportionment
A	1,646,000	32.92	32 +1	33	33.2	33
B	6,936,000	138.72	138 +1	139	140.1	140
C	154,000	3.08	3	3	3.1	3
D	2,091,000	41.82	41 +1	42	42.2	42
E	685,000	13.7	13	13	13.8	13
F	988,000	19.76	19 +1	20	19.9	19
TOTAL	12,500,000	250	246	250		250

$$\begin{aligned} 50,000 &\rightarrow 251 \\ 50,500 &\rightarrow 248 \\ 50,250 &\rightarrow 250 \end{aligned}$$

$$\begin{aligned} 50,000 &\rightarrow 251 \\ 50,250 &\rightarrow 33+138+3+42+14+20 = 250 \end{aligned}$$

states	UQ	MD = 50250 MQ	Webster Apportionment	GM	MD = 50250 MQ	Huntington-Hill Apportionment
A	33	32.7	33	32.496	32.7	33
B	139	138.0	138	138.499	138.0	138
C	4	3.06	3	3.464	3.06	3
D	42	41.6	42	41.497	41.6	42
E	14	13.6	14	13.491	13.6	14
F	20	19.6	20	19.494	19.6	20
TOTAL	252		250			250

$$\begin{aligned} &33+139+3 \\ &+42+14+20 \\ &= 251 \end{aligned}$$