



## Introduction to Apportionment



### The situation:

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. How would you divide the cans among the 3 agencies?

# 1 : 33  
# 2 : 33  
# 3 : 34

Now let's suppose that each agency serves a different number of people as indicated in the chart below. Does that change how many cans you would give each agency? How many would each agency receive? Explain your calculations and reasoning.

agency	# served		
#1	1000	$1000/1300$	77
#2	200	$200/1300$	15
#3	100	$100/1300$	8
	1300		

Apportionment Method--a rounding method used to divide items

standard divisor (SD)--the total population divided by the total # of seats/objects

standard quota (SQ)--a state's population divided by the SD

lower quota (LQ)--round down to the nearest whole number

upper quota (UQ)--round up to the nearest whole number

quota rule--a fair apportionment should be either its upper quota or its lower quota

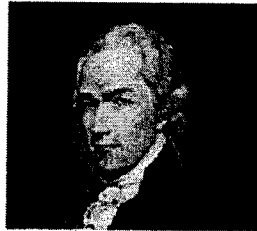
modified divisor (MD)--the number used in place of the standard divisor

modified quota (MQ)--a state's population divided by the MD

## 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

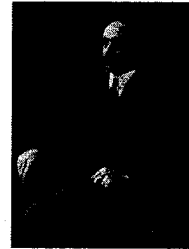


Daniel Webster

**Huntington-Hill Method**

also called the "method of equal proportions"

1. Calculate SD.
2. Calculate SQ.
3. Round according to geometric means.
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.

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

		SD = 13			MD = _____	
agency	# served	SQ	LQ	Hamilton Apportionment	MQ	Jefferson Apportionment
#1	1000	76.923	76 +1	77		
#2	200	15.385	15	15		
#3	100	7.692	7 +1	8		
TOTAL	1300	100	98	100		

		MD = _____			MD = _____	
agency	UQ	MQ	Webster Apportionment	GM	MQ	Huntington-Hill Apportionment
#1						
#2						
#3						
TOTAL						

**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.

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

states	population	SQ	LQ	Hamilton Apportionment	MQ	Jefferson Apportionment
A	1,646,000	32.92	32 r1	33		
B	6,936,000	138.72	138 r1	139		
C	154,000	3.08	3	3		
D	2,091,000	41.82	41 r1	42		
E	685,000	13.7	13	13		
F	988,000	19.76	19 r1	20		
TOTAL	12,500,000	250	246	250		

states	UQ	MQ	Webster Apportionment	GM	MQ	Huntington-Hill Apportionment
A						
B						
C						
D						
E						
F						
TOTAL						