

Problem 1 (10 points): [GH 2.3.7] *Suppose a hypothetical state legislature is to have 79 members apportioned among the eight counties in Connecticut based on the 1990 census data shown in the table.*

County	Fairfield	Hartford	Litchfield	Middlesex	New Haven	New London	Tolland	Windham
Population	827,645	851,783	174,092	143,196	804,219	254,957	128,699	102,525

Determine the apportionment given by the Hill-Huntington Method by completing the following table. Be sure to specify your final divisor; note that the natural divisor is approximately 41609.06.

Solution: We note that the total population is the sum of the eight counties populations. The natural divisor is the total population divided by the number of legislature members, i.e., $3,287,116/79 \approx 41609.06$. The natural quotas are obtained by dividing the counties population by the natural divisor.

Location	Population	Natural Quota	Rounding Cutoff	Initial Allocation	Modified Quota	Final Allocation
Fairfield	827,645	19.89	19.4936	20	19.92	20
Hartford	851,783	20.47	20.4939	20	20.50	21
Litchfield	174,092	4.18	4.4721	4	4.19	4
Middlesex	143,196	3.44	3.4641	3	3.45	3
New Haven	804,219	19.33	19.4936	19	19.36	19
New London	254,957	6.13	6.4807	6	6.14	6
Tolland	128,699	3.09	3.4641	3	3.10	3
Windham	102,525	2.46	2.4495	3	2.47	3
Total	3,287,116			78		79

The rounding cutoff between $n - 1$ and n is found by taking the geometric mean $\sqrt{(n - 1)n}$. So, for example, the rounding cutoff for Fairfield is $\sqrt{19 \cdot 20} = \sqrt{380} \approx 19.49$.

Summing the initial allocations, we find 78 seats were allocated. We thus want to decrease the divisor so that either Hartford or Middlesex gets allocated another seat. In order for Hartford to be allocated another seat, the divisor would need to be smaller than $851,783/20.4939 \approx 41562.76$; in order for Middlesex to be allocated another seat, the divisor would need to be smaller than $143,196/3.4641 \approx 41337.14$.

As we wish to allocate only one more seat, we try using the divisor 41550. Using it, we complete the modified quota column.

Using the rounding cutoffs already computed, we determine the modified allocations. As these values give 79 seats allocated, they are the final allocations.