Math 325 Modeling
Apportionment Assignment
Due Friday, Feb. 15.

1. Debate

I will assign each of you one of the six apportionment methods described below. Your task is to prepare and present a two-to-five-minute argument that your method is the one we should use. You should give both mathematical and practical arguments that your method is superb and the other methods are terrible. Try to anticipate and rebut your opponents' arguments, and feel free to bring up sordid episodes (real or imagined) in their pasts. The table on pp. 336-7 of the Edelman paper (available on the assignments webpage or under Course Documents on Blackboard) listing the 2000 apportionments using some of these methods should be useful.

(Note that Edelman's descriptions of some of these methods are different from those given below. For fun, you can try to show that they're equivalent.)

The house has h seats. The population of state i is p_i, so the exact number of seats to which state i is entitled is $q_i = \dfrac{hp_i}{\sum p_i}$.

Hamilton method: Start by giving state i $\lfloor q_i \rfloor$ seats (i.e., round down). Divide the k remaining seats up among the k states with the largest fractional part $q_i - \lfloor q_i \rfloor$.

The next four methods all work in the following way: Begin by giving each state one seat. Then, once n seats have been given out and state i has received $a_{i,n}$ seats so far, give the $(n+1)$st seat to the most deserving state, that is, the state with the lowest value of $f(a_{i,n})$, where f is as follows for the different methods:

Jefferson method: $f(a_{i,n}) = \dfrac{a_{i,n}+1}{q_i}$

Adams method: $f(a_{i,n}) = \dfrac{a_{i,n}}{q_i}$

Webster method: $f(a_{i,n}) = \dfrac{a_{i,n}+1/2}{q_i}$

Equal proportions method, aka Huntington-Hill method: $f(a_{i,n}) = \dfrac{\sqrt{a_{i,n}(a_{i,n}+1)}}{q_i}$ (This is the method that the U.S. currently uses.)

Finally, there's the

Lottery method: Start by giving state i $\lfloor q_i \rfloor$ seats. Give out the remaining k seats by a lottery, where state i's chance of winning is proportional to its fractional part $q_i - \lfloor q_i \rfloor$. (There are different ways of implementing this, but in each case the expected value of the number of seats that state i gets is q_i.)

2. Discuss

Read pp. 298-310 of Paul Edelman's law review article "Getting the Math Right: Why California Has Too Many Seats in the House of Representatives" (if you have time, read the whole thing; it's interesting). Come to class prepared to discuss it. What is the "fairest" apportionment? How have the courts modeled that? What are the mathematical issues in the model? What are the practical/legal issues?