Capstone 3 Proposal: Impartial and Unbiassed Apportionment: Meeting the Ideal of One Person, One Vote

Data Source: https://www.census.gov/data/tables/2020/dec/2020-apportionment-data.html, https://www2.census.gov/programs-surveys/decennial/2020/data/apportionment/apportionment-2020-tableC2.xlsx

The need to round fractions that occur when apportioning Congressional seats among states has led to two centuries of debate over what rounding method is fairest. Using an “apportionment slide rule,” we develop two new classes of arguably fair apportionment methods that we call ``impartial methods'' and ``unbiased methods.'' Both classes group states into ``families,'' sets of states with “divisor-method” quotas that round down to the same integer. Impartial methods apportion the same number of seats to families of states containing the same total population, whether a family consists of a large number of small-population states or a small number of large-population states. Unbiased methods apportion seats so that if states are drawn repeatedly from the same distribution, the expected number of seats apportioned to each family equals the expected divisor-method quota for that family. Balinski and Young showed that divisor methods are the only apportionment methods that are “homogeneous” and immune to the "Alabama paradox" and the "New States paradox." We show that it is generally impossible for divisor methods to be either impartial or unbiased. While a subset of impartial methods are immune to the Alabama paradox, they are all susceptible to the New States paradox and therefore not divisor methods. All unbiased methods are immune to the Alabama paradox and the New States paradox. Unbiased methods derived from power law distributions are homogeneous and therefore divisor methods. Unbiased methods derived from other distributions are not homogeneous and therefore not divisor methods.