

## PRACTICE PROBLEMS FOR FINAL EXAM

MATH 19-02, SPRING 2018

For these practice problems, you can use a calculator. On the exam, the problems will be designed so that you don't need a calculator.

- (1) California will have a ballot initiative in the next election about whether to split up into three states, called North California (NorCal), South California (SoCal), and New California (NewCal). Currently California has a population of 39.5 million, and the populations of the new states would be 13.3 million in NorCal, 13.9 million in SoCal, and 12.3 million in NewCal.
  - (a) CA has 53 Congressional representatives. Split them up to the three new states using the Huntington-Hill method.
  - (b) What is the Population Paradox? Explain how you would check if California has been suffering from it in the last few cycles. (Just explain what information you'd need; no need to go look it up.)
- (2) What has a higher Polsby-Popper score ( $4\pi A/P^2$ ), an equilateral triangle or a  $3 \times 1$  rectangle? What about the Reock scores? What does this have to do with redistricting?
- (3) In partisan symmetry scores, why is it considered good if the seats-votes curve goes through or near to the point  $(1/2, 1/2)$ ?

Suppose that a certain election had district-by-district vote shares of  $(.38, .82, .45, .58, .6)$  from the Republican point of view. Assuming equal turnout and uniform partisan swing: what share of the votes and what share of the seats did Republicans receive? Would Democrats have had the same share of the representation if they had had the same share of votes?
- (4) Can you come up with a shape that has...
  - Polsby-Popper score near 0 and Reock score near 1
  - convex hull score near 1 and Reock score near 0
  - skew score near 1 and square-Reock score near 0
- (5) Is it possible for a move to be favorable to one candidate and neutral to another candidate? If so, give an example.
- (6) Give an example of a preference schedule with five candidates so that all of them are involved in a Condorcet cycle.
- (7) Make up an example of a voting system that is unanimity-fair but not Pareto efficient, or explain why this is impossible.