

STATISTICS SEMINAR

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Thursday, December 11, 2014

Dickens Hall, Room 207, 4:00-5:00 pm

Refreshments: Dickens 108, 3:30-4:00 pm



A New Automated Redistricting Simulator Using Markov Chain Monte Carlo

Decennial redistricting is a critical element of American representative democracy. A number of substantive scholars have used simulation methods to sample redistricting plans under various constraints in order to assess their impacts on partisanship and other aspects of representation. However, surprisingly few simulation methods exist in the literature, and the standard algorithm has no theoretical justification. To fulfill this gap, we propose a new automated redistricting simulator using Markov chain Monte Carlo. We formulate redistricting as a graph-cut problem and adopt the Swendsen-Wang algorithm for sampling contiguous districts. We then extend this basic algorithm to incorporate various constraints including equal population and geographical compactness. Finally, we apply simulated tempering and divide-and-conquer approaches to improve the mixing of the resulting Markov chain and scale the algorithm to states with a larger number of districts. The proposed algorithms, therefore, are designed to approximate the population of redistricting plans under various constraints. Through a small-scale validation study, we show that the proposed algorithm outperforms the existing standard algorithm. We also apply the proposed methodology to examine the partisan implications of redistricting under certain conditions in New Hampshire and Mississippi.