EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

Redistricting, Gerrymandering, and Mixed Integer Nonlinear Programming

ABSTRACT - After the 2020 United States census, each state was tasked with redrawing its district lines to satisfy equal population and contiguity constraints, while also attempting to satisfy a number of other objectives. This is a very tricky subject as it is often easy to redistrict for one political party's gain (i.e., gerrymander), but can be difficult to argue that certain choices are unfair or are neglecting certain populations. Computational tools are becoming increasingly useful in understanding fairness in redistricting and pushing the limits as to what we can do to understand the possibilities in map drawing. These problems are inherently multi-objective and extremely large-scale optimization problems (perhaps with debate on what the objectives are). We work with highly nonlinear objective functions that estimate the expected outcome of representation. On large-scale instances (at the block group level), we generate high-quality solutions for these objectives using heuristic techniques, while on restricted sizes (at the county and tract levels) we solve nearly to optimality using a variety of integer programming approaches. Although optimization is not necessarily the goal, we use our solutions to study the possible outcomes and help justify decisions that can be made. We hope that this work will be relevant in recent and forthcoming litigation with respect to representation in several southern states.

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SPEAKER BIO – Dr. Robert Hildebrand is an Assistant Professor in the Grado Department of Industrial and Systems Engineering (ISE) at Virginia Tech. He obtained his PhD at the University of California, Davis under the supervision of Matthias Köppe. Afterwards, he spent two years in Zurich, Switzerland as a postdoctoral researcher at the Institute for Operations Research in the Department for Mathematics at ETH Zurich. Subsequently, he was a Goldstine Fellow Postdoctoral Researcher at IBM Watson Research Center in Yorktown Heights, New York. He recently participated in the semester-long Simons Institute program on Bridging Continuous and Discrete Optimization at UC Berkeley.

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