Recent Research Projects

Project 1: Demand, Access, and Equity in Shared Micro-mobility Networks
In bike-share or scooter-share networks, the distribution of vehicles affects the observed trips. In areas with little or inconsistent access, we will observe few trips even if there exists potential demand. Previous work on this project has focused on estimating demand across the city and across time given observed trips and availability and the resulting algorithm is available to use through a public website. The next piece to this project is focusing on using those results to understand how to update the availability to better meet demand and provide equitable access. Methods will include mixed integer linear optimization and simulation optimization. Additionally, the goal is to incorporate these algorithmic tools into our website.

Project 2: Optimizing Risk Score Models
A risk score model maps an integer linear combination of data features to a probability of the outcome as a way for clinicians to quickly determine whether patients are at high risk for some potential outcome. For example, a risk score model may indicate that if a patient meets three out of five given characteristics they are at high risk. In developing these models, we need to balance the interpretability of the end model with the accuracy and usefulness of the predictions. Finding optimal and interpretable models is an interesting integer convex optimization problem. This project focuses on improving the underlying algorithms to solve these problems and developing corresponding code packages for clinicians.

Project 3: Reinforcement Learning for Variable Selection
Best subset selection for linear regression is a machine learning problem that has received renewed attention following a new approach to directly solve this problem using mixed integer quadratic optimization. This approach has been extended to more efficient algorithms relying on cyclical coordinate descent integrated into branch-and-bound with impressive results. Another thread of research has focused on learning how to branch in combinatorial optimization problems. This project brings these two threads together by looking at using machine learning to learn from and improve the optimization for variable selection.