

# Discrete Convexity with Applications to Maximizing User Satisfaction in Bike Sharing Systems

## Author

Sanelma Heinonen

## Advisor

Pat Devlin

## Description

I grew up without a car, and this experience led to an interest in alternative yet efficient modes of transportation. For my senior essay, I decided to take this interest and turn it into a quantitative research project. I focused on bike sharing systems, more specifically, the question of how bikes should be distributed across stations in bike sharing systems in order to avoid situations where a customer shows up wanting to borrow a bike, but finds none available. To study this problem, I measured the expected number of dissatisfied customers with a "user dissatisfaction function," proved that the user dissatisfaction function was convex, and read a lot of literature on the topic of discrete convex optimization in order to be able to minimize the user dissatisfaction function. My final essay included a description of the bike sharing model I had developed, an in-depth summary of discrete convexity, and the proofs to many theorems which I had found stated but unproven in relevant literature.