New York City's Bike System

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Short description and reference. Simulation of the flow of bike trips between bike stations in NY City. The optimization problem is the allocation of a constrained number of bikes (6000) to available docks within the city at the start of rush hour, so as to minimize, in simulation, the expected number of potential trips in which the rider could not find an available bike at their preferred origination station, or could not find an available dock at their preferred destination station. We call such trips "negatively affected trips." [1].

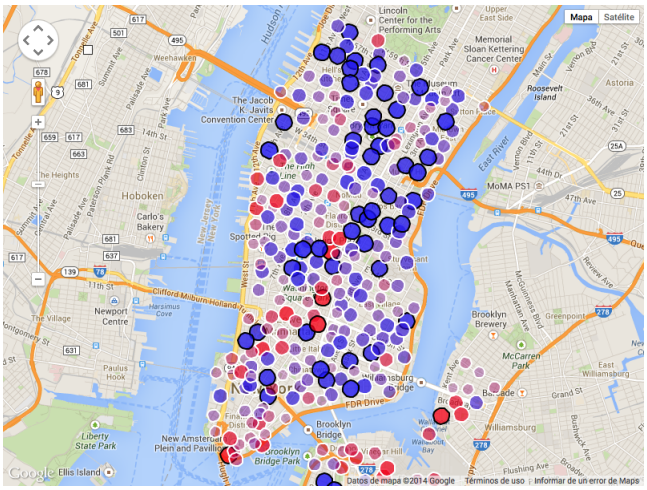

Figure 1: Location of bike stations (circles) in New York City, where size and color represent the ratio of available bikes to available docks.

Problem description

- Deterministic inputs: We divided the bike stations in 4 groups using k-nearest neighbors, and the number of bikes in each group at 7:00 AM is the deterministic input.
- Randomness: We consider a directed graph between the bike stations, where each pair of bike stations has two directed edges, and we divided these edges in 4 groups. One random input is the number of bike trips in each of those groups. The other random inputs are the number of bike trips between each pair of bike stations, and the duration of the trips.
- Output: Number of negatively affected trips.

Objective

- Compare the performance of a new algorithm (Stratified Bayesian Optimization proposed by Peter Frazier and Saul Toscano-Palmerin) with other classical global optimization algorithms of expensive functions on this problem: Expected Improvement, Probability Improvement and Knowledge Gradient.

- Current results:

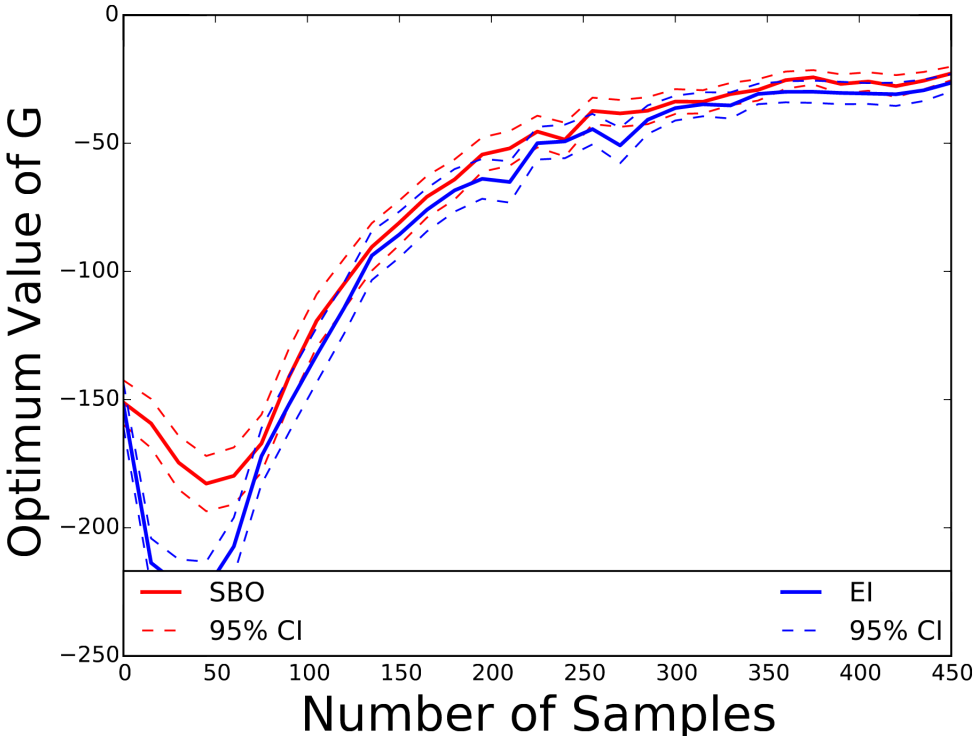

Figure 2: Performance comparison between SBO and Expected Improvement method on the problem of Citibike.

References

[1] Saul Toscano-Palmerin and Peter Frazier. Stratified bayesian optimization. 2015. http://toscanosaul.github.io/saul/.

[2] Citi bike website. https://www.citibikenyc.com/, accessed May 2015.