Equitable and Effective Bike Share Operation: A Comparative Study of Dock Rebalancing

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Kiosk Performance



“Capital Bikeshare Empty Station” by Mr.TinMD, CC BY-ND 2.0

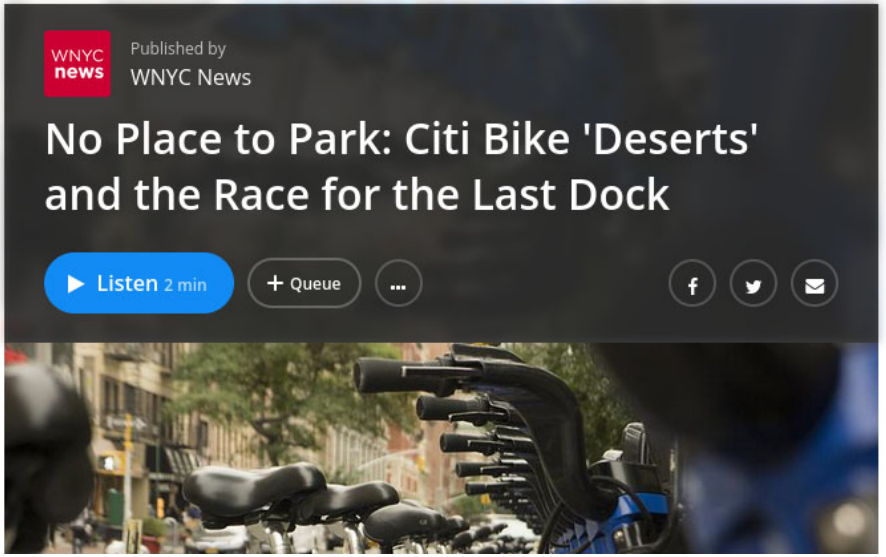
Kiosk Performance



Divvy Station, Chicago

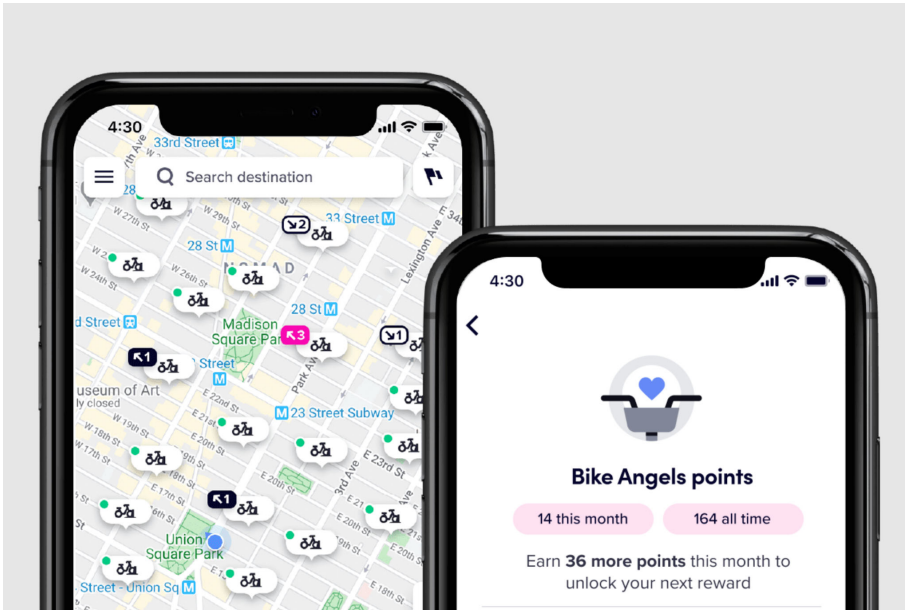
Kiosk Performance

- Bike share kiosks are an understudied phenomenon
- Kiosks are fundamental for system performance
- They add predictability for users
- They act as a public marker for the system

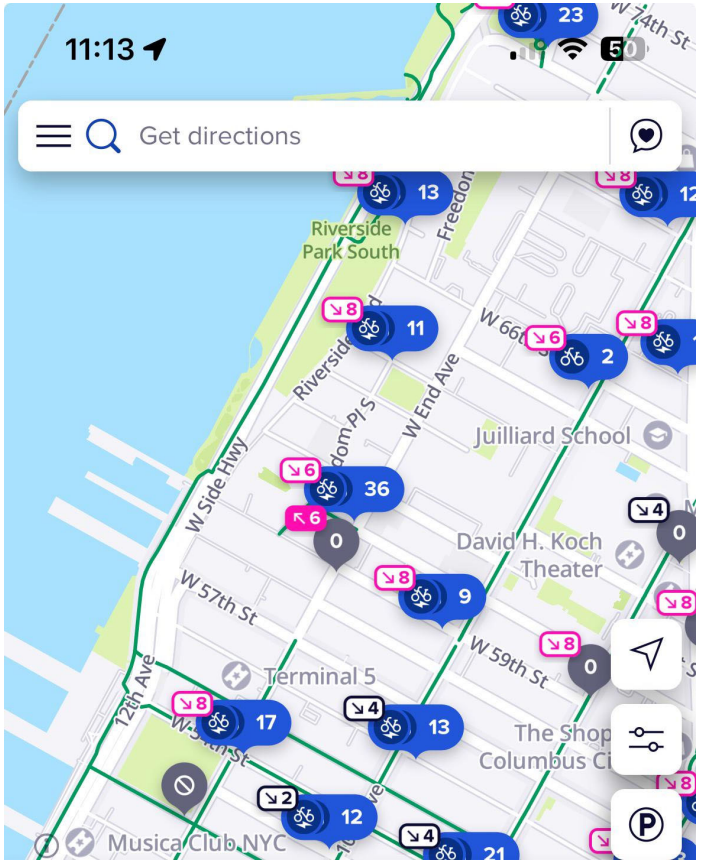


Kiosk Performance

- Operators spend significant time, money, & effort at bike rebalancing
- Even as dockless-capable bikes become more prevalent, kiosks are important
- Differing price schemes for docked v. dockless
- E-bike battery charging



Kiosk Performance



Bike Angels at Work

Research Design

- Objective is to look at the factors that may influence the likelihood that a bike share station may be inaccessible for users.
- Are there comparative patterns across cities in dock accessibility?

Data

- Automated script downloaded dock vacancy status at 15 minute increments between April 2024-July 2025 for Chicago, Boston, Washington, DC, Los Angeles, New York, San Francisco, Montreal, Paris
- A count was made for each kiosk any time a station was either filled to capacity or had no bikes available.

Methodology

- Dependent variable is the percentage times the kiosk is unavailable for bike return or check out.
- Independent variables for US cities at the Census block group level:
  - % African American population
  - % Bachelor’s degree or higher
  - % Households without a car
  - Distance to a transit stop
  - Street intersection density
  - Employment and household mix
  - % low-wage workers
  - Distance to the closest kiosk

Methodology

Montreal

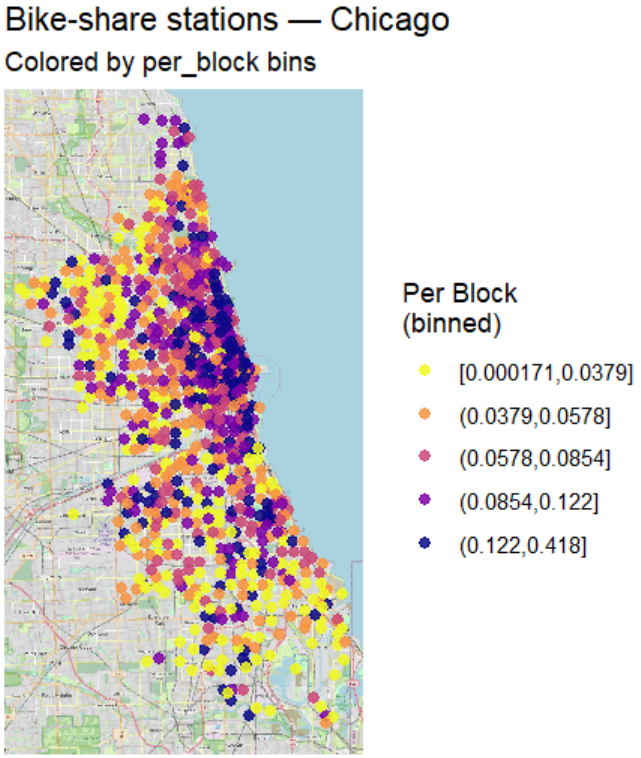
- % Visible minority
- % Bachelor’s degree or higher
- % Cycling to work
- Population per sq km
- Log of median household income
- Distance to nearest kiosk

Paris

- % Immigrant
- % Bachelor’s degree or higher
- % in poverty
- Number of transit stops
- Distance to nearest kiosk

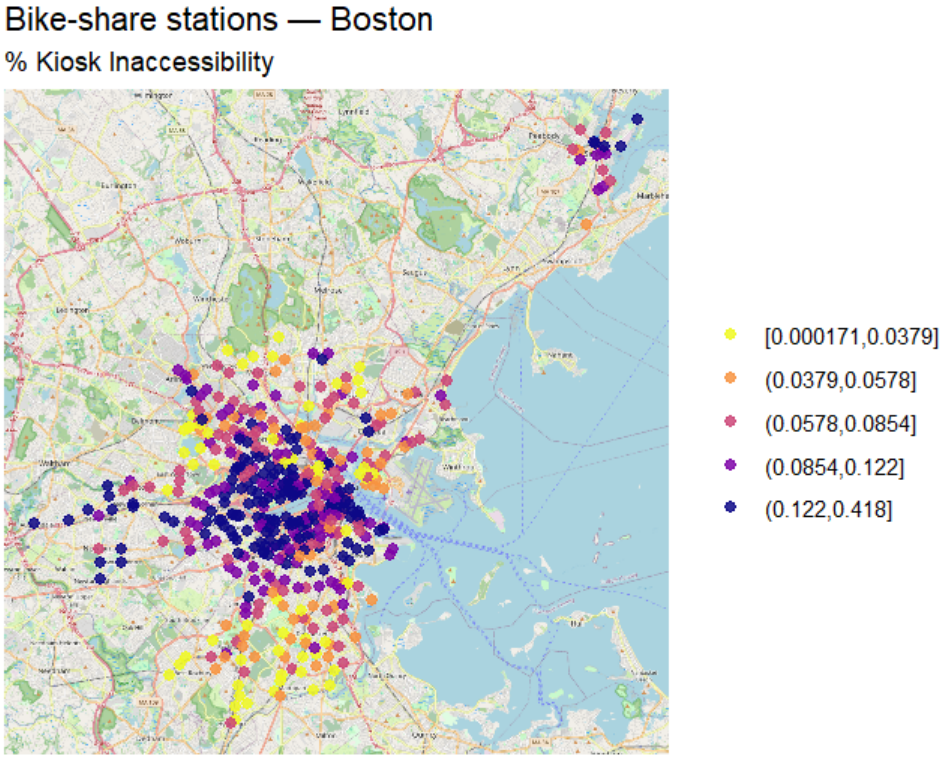
Chicago

Beta Regression Results			
Predictor	Estimate	SE	p-value
Intercept	-2.074***	0.173	0.000
Percent Black	-0.175*	0.083	0.036
Percent Bachelor's	0.394*	0.186	0.034
Percent Non-Car	0.563***	0.142	0.000
Intersection Density	0	0.000	0.151
Distance to Transit Stop	0	0.000	0.801
Employment & Household Mix	-0.14	0.107	0.192
Percent Low-Wage Workers	-0.984*	0.481	0.041
Distance to Nearest Kiosk	-0.001***	0.000	0.000



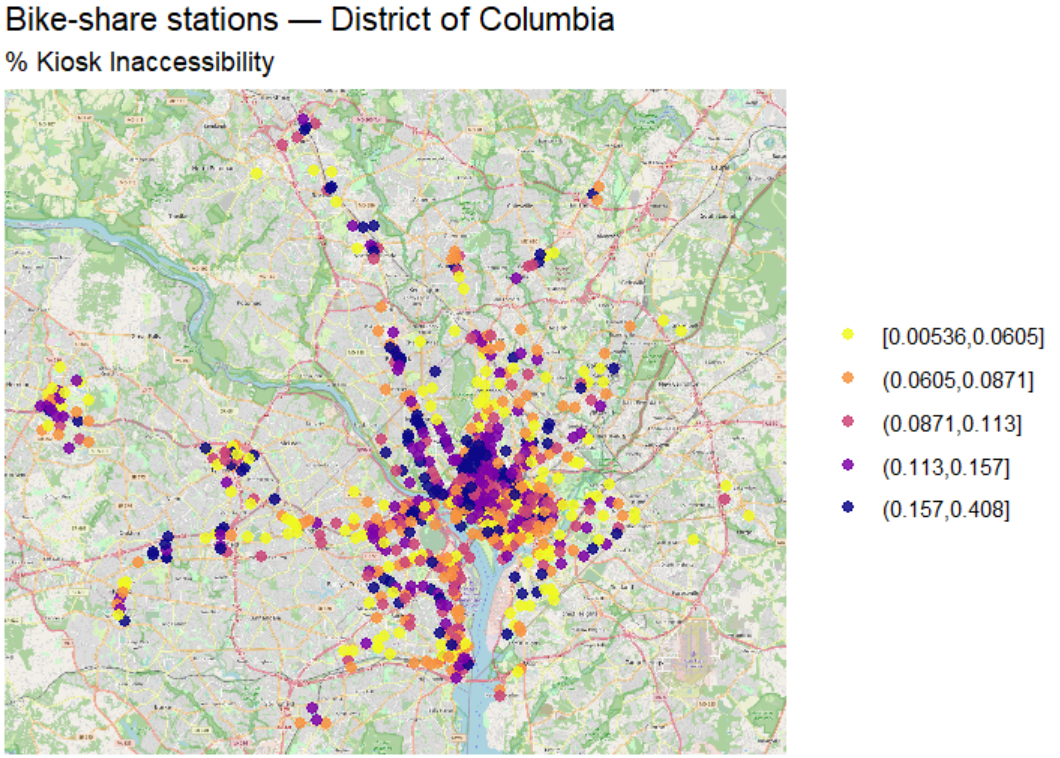
Boston

Beta Regression Results			
Predictor	Estimate	SE	p-value
Intercept	-2.482***	0.310	0.000
Percent Black	-0.772**	0.248	0.002
Percent Bachelor's	0.737*	0.362	0.042
Percent Non-Car	0.478*	0.217	0.028
Intersection Density	0.001*	0.000	0.042
Distance to Transit Stop	0	0.000	0.842
Employment & Household Mix	0.099	0.188	0.599
Percent Low-Wage Workers	1.081	0.808	0.181
Distance to Nearest Kiosk	-0.001**	0.000	0.007



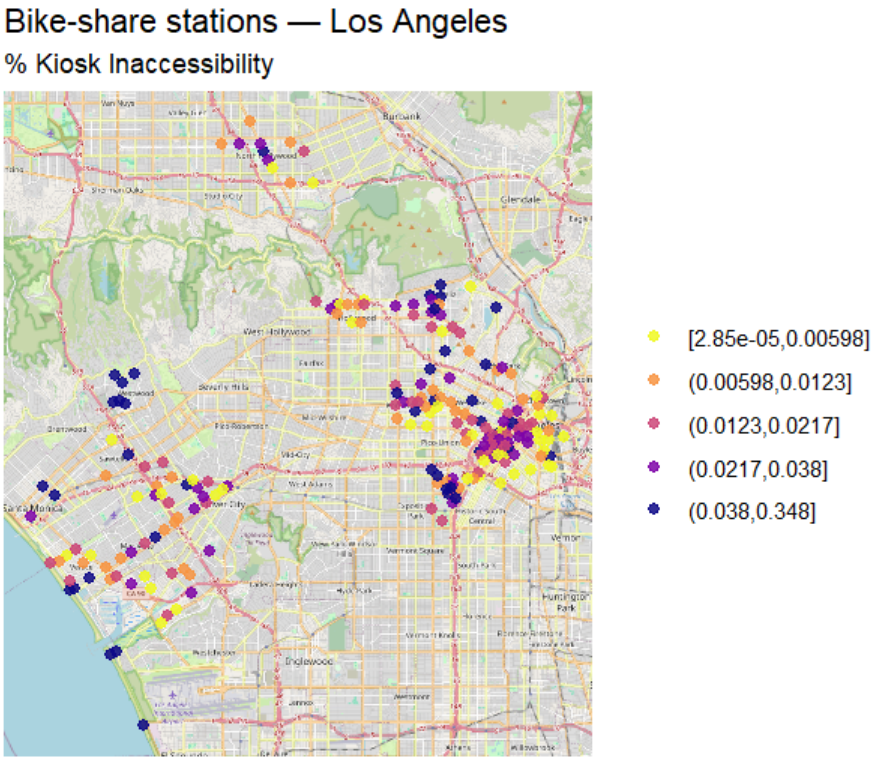
District of Columbia

Beta Regression Results			
Predictor	Estimate	SE	p-value
Intercept	-2.066***	0.217	0.000
Percent Black	-0.546***	0.126	0.000
Percent Bachelor's	0.415	0.280	0.139
Percent Non-Car	0.725***	0.145	0.000
Intersection Density	0	0.000	0.380
Distance to Transit Stop	0	0.000	0.316
Employment & Household Mix	-0.004	0.126	0.975
Percent Low-Wage Workers	0.579	0.801	0.470
Distance to Nearest Kiosk	0***	0.000	0.000



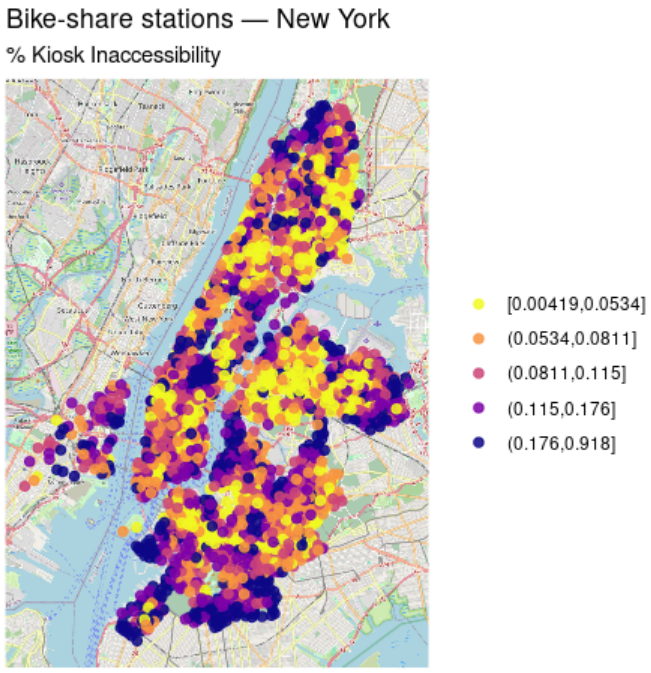
Los Angeles

Beta Regression Results			
Predictor	Estimate	SE	p-value
Intercept	-3.589***	0.550	0.000
Percent Black	-2.683*	1.148	0.019
Percent Bachelor's	0.771	0.538	0.152
Percent Non-Car	-0.038	0.474	0.937
Intersection Density	0.001	0.001	0.271
Distance to Transit Stop	0	0.000	0.704
Employment & Household Mix	-0.858*	0.370	0.020
Percent Low-Wage Workers	0.411	1.566	0.793
Distance to Nearest Kiosk	0	0.000	0.469



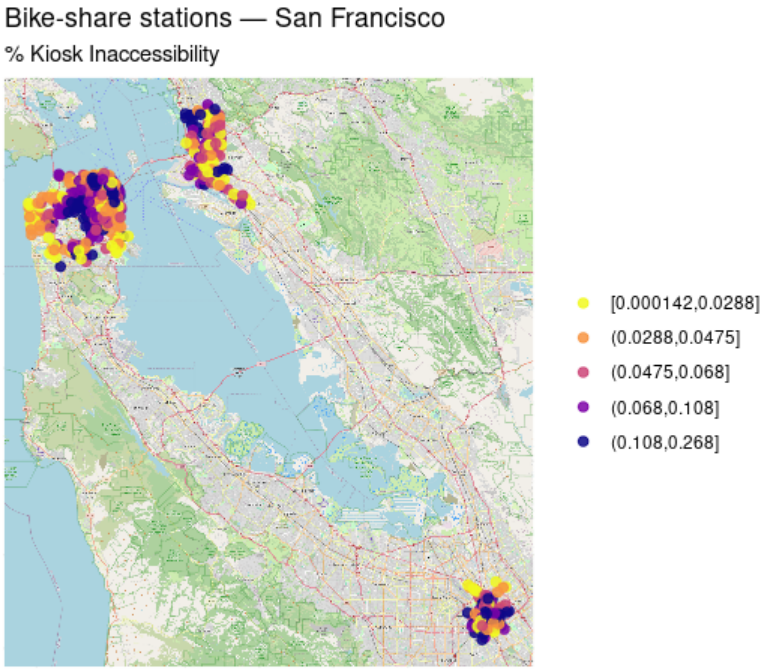
New York

Beta Regression Results			
Predictor	Estimate	SE	p-value
Intercept	-1.747***	0.152	0.000
Percent Black	0.074	0.078	0.342
Percent Bachelor's	0.263*	0.128	0.041
Percent Non-Car	-0.335***	0.094	0.000
Intersection Density	0	0.000	0.364
Distance to Transit Stop	0	0.000	0.923
Employment & Household Mix	-0.067	0.083	0.415
Percent Low-Wage Workers	0.516	0.376	0.170
Distance to Nearest Kiosk	-0.001*	0.000	0.016



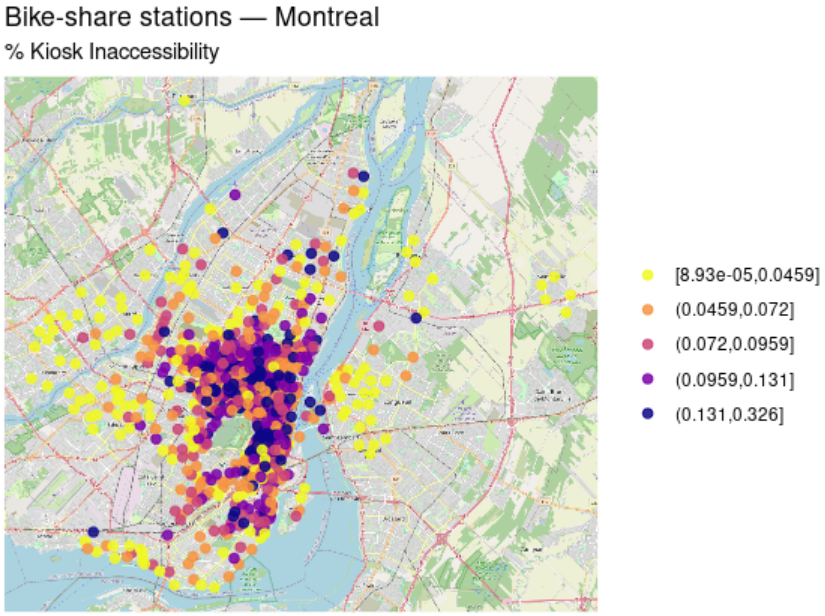
San Francisco

Beta Regression Results			
Predictor	Estimate	SE	p-value
Intercept	-2.409***	0.306	0.000
Percent Black	-0.529	0.312	0.090
Percent Bachelor's	0.11	0.316	0.728
Percent Non-Car	0.199	0.228	0.384
Intersection Density	0.001**	0.000	0.005
Distance to Transit Stop	0	0.000	0.838
Employment & Household Mix	0.059	0.215	0.784
Percent Low-Wage Workers	-2.613**	0.895	0.004
Distance to Nearest Kiosk	0	0.000	0.872



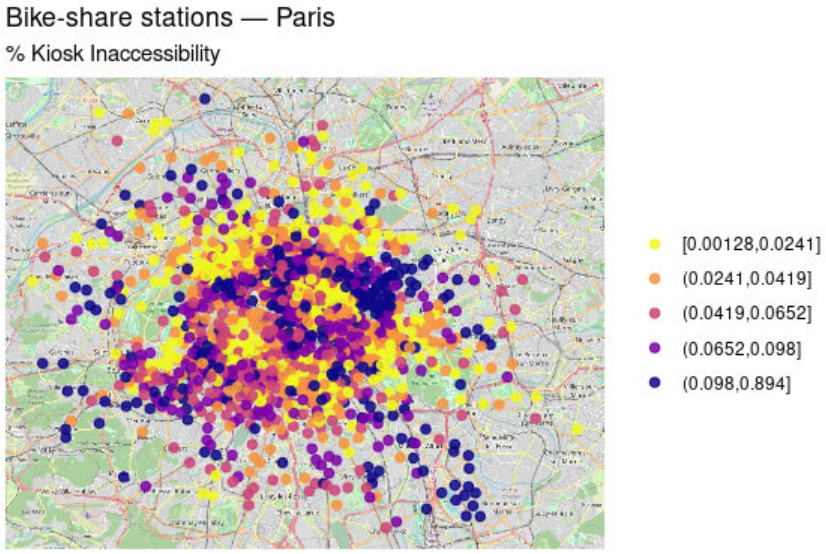
Montreal

Beta Regression Results			
Predictor	Estimate	SE	p-value
Intercept	-0.295	0.732	0.687
Percent Visible Minority	0.047	0.122	0.700
Percent Bachelor's	0.423**	0.138	0.002
Percent Cyclcing to Work	1.202***	0.335	0.000
Population per sq km	0	0.000	0.265
Median Household Income	-0.179**	0.067	0.008
Distance to Nearest Kiosk	-0.001***	0.000	0.000



Paris

Beta Regression Results			
Predictor	Estimate	SE	p-value
Intercept	-1.561***	0.260	0.000
Percent Immigrant	-1.088*	0.556	0.050
Percent Bachelor's	-0.872***	0.271	0.001
Percent in Poverty	-1.125	0.609	0.065
Number Public Transport Stops	0.003	0.003	0.300
Distance to Nearest Kiosk	0	0.000	0.110



Conclusions

- Wide variety of factors are related to kiosk inaccessibility
- Higher percentage of African-Americans, lower odds of inaccessibility
- Higher percentage of college degree population, higher odds of inaccessibility
- Higher percentages of cyclists, higher odds of inaccessibility
- Urban amenities and neighborhood characteristics were less important.

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