CMMC 2023

Columbia Mathematical Modeling Contest

8:00PM, Thursday, February 2 – 8:00AM, Monday, February 6

Background

With nearly 8.5 million inhabitants, it is no surprise that there is a lot of movement in, around, and about New York City. People travel through the city using all sorts of vehicles – ranging from cars to buses and from subways and trains to ferries. Being the most populous city in the United States, New York City is also a major producer of pollution caused by vehicles burning fuels.

The Problem

The population of New York City is growing. By 2050, it is projected that the population will surpass 9 million people, with the fastest rate of growth in the Bronx and Brooklyn. With increases in population, increases in movement are bound to occur.

One way of decreasing traffic and its harming effects to community health is to encourage commuters to use greener means of transportation such as scooters and bikes. Among the ten most populous cities in the United States, New York City showed the largest increase in the use of bikes over other transportation means in the last decades. The city's Department of Transportation (DOT)'s aggressive expansion of our bicycle lane network, the growth and the expansion of Citi Bike, improved enforcement, and other changes have made the city vastly better for cycling. However, as the cycling population in New York City increases, **more** and **better** infrastructure is needed to protect those growing numbers.

The good news is that last year, the city received a $7.25 million federal grant to plan for a major expansion of the greenway network across the five boroughs, with a focus on historically underserved, lower-income communities that lack access to affordable transportation and job opportunities. The funding is to be used to develop a comprehensive vision plan to fill critical gaps in the city's greenway network, improve cyclist and pedestrian safety with improved infrastructure, and enhance quality of life with green transportation options and greater waterfront access.

Objective

Your team's job is to prepare a plan that uses the $7.25 million federal grant to **improve** and **expand** the current cycling infrastructure in New York City. The city's Department of Transportation (DOT) already maintains a successful and active program, the Green Wave: A Plan for Cycling in New York City, but your team's recommendations might be used to enhance it further.

Here are some focus points for your team while preparing the plan:

1. Identify one area in New York City in which expanding or improving the existing cycling infrastructure would have the greatest socio-economic impact. Prioritize between expanding/improving cycling lanes in areas of high density versus areas housing historically

underserved, lower-income communities that lack access to affordable transportation and job opportunities.

2. Differentiate between conventional versus protected bike lane infrastructure. Evaluate and compare the cost and return of building protected versus conventional bike lanes in New York City. Identify the benefits of protected compared to conventional bike lanes with a focus on public health and equity (look into the demographics of bikers in New York City now and discuss how that can change depending on the availability of protected/conventional bike lanes). Relying on the insights that your team has discovered, determine and propose the best mix of protected versus conventional through cost and return analysis.
3. Assess the overall impact of your team's proposed development of the cycling infrastructure on city traffic: less lanes for engined vehicles (cars, trucks, buses, etc.). Weigh the benefits and drawbacks of allocating more/less road space to cyclists versus pedestrians and engined vehicles.

In addition to your detailed report, please write a one-page executive summary of your results for Mr. Ydanis Rodriguez, the Commissioner of the Department of Transportation. Please be careful in outlining the assumptions and limitations of your model. Remember that policy-makers may not be aware (and often don't need to be aware) of all the technical details, but should have enough information about the amount of uncertainty in the model before using it to make any policy decisions.

Your Submission

Your PDF submission of no more than 25 total pages should include:

- Name page: containing the names of the members of your team. Your names should not appear anywhere else in the document. When sent for review to the CMMC committee, the first page will be removed from the document.
- One-page abstract.
- Table of contents.
- Your solution.
- One-page executive summary to the DOT Commissioner, Ydanis Rodriguez
- References list.

Resources

- NYC.gov: Ridership Statistics and Reports
- NYC.gov: Cycling in the City Cycling - Trends in NYC (May 2019)
- NYC.gov: Green Way - A Plan for Cycling in New York City
- NYC.gov: Green Way Progress Report (April 2021)
- NYC.gov: Protected Bicycle Lanes in NYC

- Citi Bike Systems Data
- NYC Open Data
- Nace, Amanda, and Marianne Fahs. "Cost Analysis of Protected Bike Lanes in NYC." APHA's 2018 Annual Meeting & Expo (Nov. 10-Nov. 14). APHA, 2018.
- Gu, Jing, Babak Mohit, and Peter Alexander Muennig. "The cost-effectiveness of bike lanes in New York City." Injury prevention 23.4 (2017): 239-243.

Deadlines

The contest ends on **Monday morning**.

- **Complete** your report by 8AM on Monday, Feb 6th.
- **Email** your report (pdf) to dragomir@math.columbia.edu by 9AM on Monday, Feb 6th.

Good Luck!