NYU CUSP 2019

IMPACT OF MANHATTAN CONGESTION SURCHARGE ON FOR-HIRE-VEHICLES

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Abstract

Comprehensive understanding of anticipated impacts of transportation pricing policies on urban system is crucial for both decision makers and stakeholders. This paper aims to provide a data-driven framework for quantitative evaluation of such impacts, having Manhattan congestion surcharge as a use case. To do so we will use open data to develop a predictive model to estimate the impact of pricing changes on public transportation and for-hire-vehicles. Anticipated results as developing a web-based tool to enable voters and policy makers to quantitatively evaluate the impact of proposed congestion pricing changes on transportation modal shift and related urban impacts and stakeholder value.

Problem Statement & Objectives

Estimate modal shift in transportation and quantify the impacts of current and proposed policies by:

- Developing a model to predict the reaction in consumer transportation mode choice (private vehicle, for-hire vehicle, public transportation) to pricing changes
- Using the model to evaluate the impact on social and economic aspects such as job demand, traffic reduction, commute cost and time, and tax revenue, under three policy scenarios: 1. the status quo 2. a 30% MTA fare increase, and 3. a more aggressive congestion pricing plan (proposed by governor Cuomo)

INTRODUCTION & MOTIVATION

Traffic in Midtown Manhattan now crawls at an average of 4.7 miles an hour as Ubers and other ride-app cars have flooded streets, truck deliveries have expanded and construction has blocked or narrowed car lanes. Beginning on February 2, 2019 a congestion surcharge has been applied to for-hire-vehicles (FHV) whenever those vehicles pass through the area of Manhattan south of and excluding 96th Street. In additional to reducing congestion, the surcharge is estimated to bring upwards of $1 million a day in revenue earmarked for MTA subway repairs, which is crucial to improve commutes. However, this plan has encountered fierce opposition from taxi and FHV drivers, and many state legislators also suggest that it's unfair to communities in the outer boroughs and suburbs where access to transit is not as easy. Governor Andrew Cuomo has proposed a plan to expand congestion pricing to include an $11.25 toll on all vehicles entering Manhattan below 60th Street, including private vehicles (1).

This project aims to evaluate the impact of the new FHV surcharge policy as well as predict the impact of other congestion policy proposals. We will use open data to develop a predictive model to estimate the impact of pricing changes for public transportation, private vehicles and for-hire-vehicles on consumer transportation mode choice. We will then compare the current pattern with the scenarios of increasing MTA fares and of imposing the more significant surcharges proposed by Governor Cuomo.

Understanding and modeling transportation networks is extremely complex and requires understanding and making assumptions regarding disciplines spanning from economics and human behavior to urban planning and environmental studies. An extensive body of research exists on modeling transportation networks (2)(3) and we intend to leverage this, including the outcomes of studies conducted by other CUSP research groups (4). We intend to build upon the work of last year's Capstone group, applying their insights regarding mode shift in New York City to our focus on Manhattan congestion pricing (5).

Finally, we will explore the potential use our model findings to better understand the real social impact of these policy choices beyond mode shift. Outcomes of congestion pricing schemes in other localities, including London and Singapore, have been studied and may provide valuable insight. Studies have simulated the welfare effects of congestion pricing (6), and others estimate the environmental impacts. With careful consideration paid to confounding variables, we would like to explore a method to quantify the social impact of each policy scenario by simulating outcomes based on relationships established in prior research.

METHODOLOGY

- Develop a model to predict the reaction in consumer transportation mode choice to pricing changes proposed by each each congestion pricing scenario (status quo, 30% MTA increase, more aggressive congestion pricing plan)
- Model consideration will begin with a nested multinomial logit model
- Train model on past data (before Feb. 2nd surcharge tax came into effect) and predict future values. Compare the predicted values with the real data observed after February 2nd and observe the difference
- Estimate stakeholder value (through revenue modeling/congestion modeling)

IMPACTS

Projected impacts on on the following dimensions will be considered when evaluating the “effectiveness” of each policy scenario:

- Mode shift between for-hire vehicles, private vehicles, and public transit
- Job increase or decrease in each sector as a result of mode shift
- Traffic reduction
- Difference in transportation cost to the end user relative to cost
- Commuter convenience and preference
- Difference in average commute time
- Tax Revenue (earmarked for public transit investments)
- Accessibility to differently abled demographics/ other disenfranchised groups
- Economic fairness
- Environmental (i.e. reduction in CO2 emissions)

DATA SOURCES

Data	Link	Notes
Transitland open data	https://transit.land	A community-edited data service, aggregating transit networks
MTA Turnstile Data	http://web.mta.info/developers/turnstile.html https://data.ny.gov/en/browse?q=Turnstile	Weekly Turnstile data from 2010 to 2019 Yearly Turnstile data since 2014 from NYC open data
TLC Ridership Data	https://www1.nyc.gov/site/tlc/about/tlc-trip-record-data.page https://data.cityofnewyork.us/Transportation/CURRENT-BASES/eccv-9dzr	Monthly data 2009-2018 For TLC bases number The yellow and green taxi trip records include fields capturing pick-up and drop-off dates/times, locations, trip distances, fares… The For-Hire Vehicle (“FHV”) trip records include license number and the pick-up date, time, and taxi zone location ID.
LEHD Origin-Destination Employment Statistics (LODES)	https://www.census.gov/ces/dataproducts/lehddata.html	High granularity OD data across modes for more in-depth analysis of traffic patterns
Origin-Destination Data	Arcadis	High granularity OD data across modes for more in-depth analysis of traffic patterns
Bing Maps API		High granularity OD data across modes for more in-depth analysis of traffic patterns
City-Wide Mobility Survey (CMS)	http://www.nyc.gov/html/dot/downloads/pdf/nycdot-citywide-mobility-survey-report-2017.pdf	Assess residents’ sentiment/preference for various transportation modes; potentially engineer feature to encode user preference within transportation network
American Community Survey (ACS)	https://www.census.gov/programs-surveys/acs	Census data for various socioeconomic factors such as income, diversity, education level, etc.

TIMEFRAME

March

05 First project report due

06 Begin gathering initial data, literature review, and exploring model options

April

17 First iteration of model and data sets due & Evaluate first model

18 Begin second project report & gathering additional data identified by review of first model

May

01 Second progress report due

18 Second iteration of model and data due & Evaluate second model (optimistic date)

27 Summer semester begins

28 Begin gathering additional data identified by review of model

June

10 Second iteration of model and data due & Evaluate second model (hard date) & Begin writing third progress report

20 Third progress report due & Begin work on final report & web/app deliverables

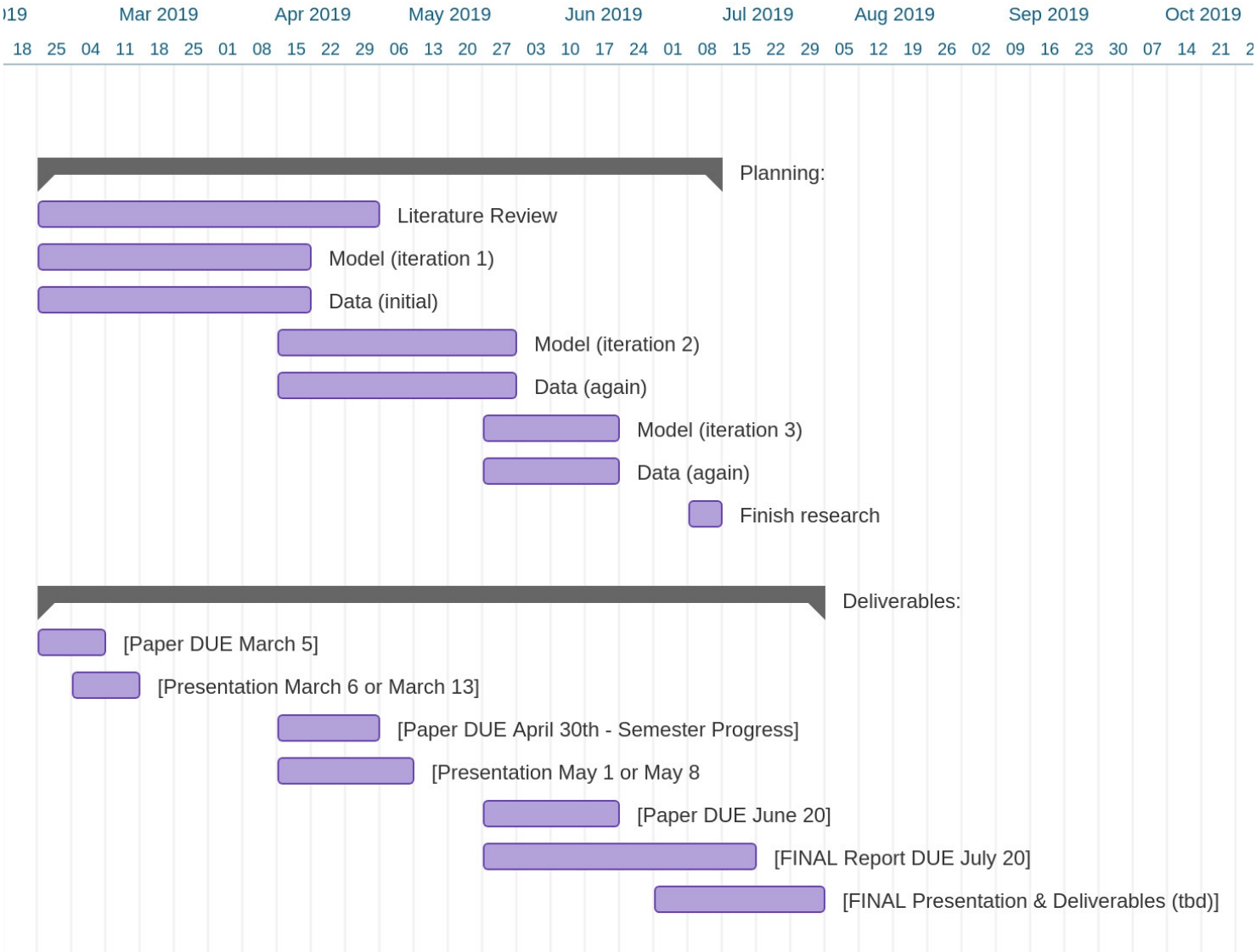
21 Repeat data gathering and modeling process for a third iteration, if needed

July

08 All research and modeling completed

20 Final report & presentations (approximate date)

PROJECT PLAN



RISK	MITIGATION PLAN
Lack of data	• Reevaluate scope of project to focus on the available modes
Model performance issues (lack of generalizability)	• Diagnose model for over/underfitting • Examine features/feature engineering (i.e. elasticity assumptions) • Adjust hyperparameters (including class weights etc) • If necessary, narrow scope of model to modes that perform better • Continue literature review • Different modeling approach
Model fit quality below expectations	• Account for uncertainty in the model predictions and translate it into uncertainty of the model estimates
Uncertainty of model estimates too high/lack of statistical significance of resulting impact	• Consider additional data sources that could provide prior estimates for the model parameters, employ Bayesian inference framework to incorporate this information reducing uncertainty of the posterior estimates

DOMAIN LEADS

Xianing He & Sam Manzi - Data Gathering & Cleaning

Rufei Sheng & Soham Mody - Modeling & Analysis

Katharine Voorhees - Literature Review & Report Writing

REFERENCES

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4.Sobolevsky, S., Levitskaya, E., Chan, H., Postle, M., & Kontokosta, C. (2018). Impact Of Bike Sharing In New York City. arXiv preprint arXiv:1808.06606.

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