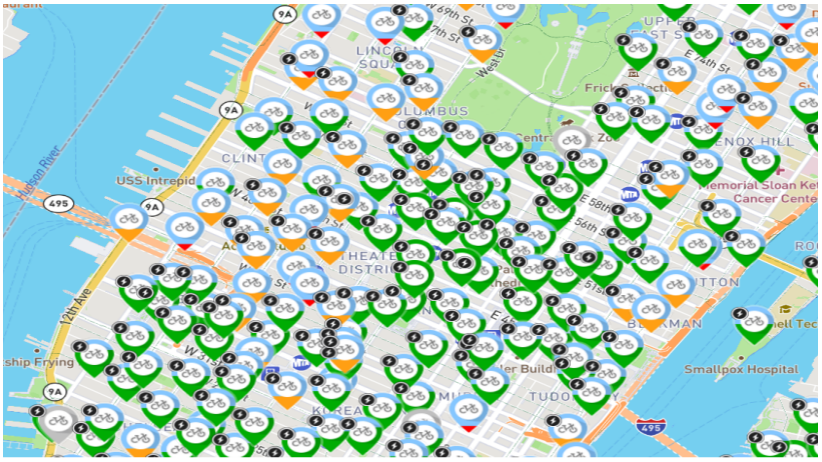
Bilkent University
Department of Industrial Engineering
IE 468 - Pricing and Revenue Optimization

Dynamic Pricing for Citi Bikes

Citi Bike is the exclusive bikeshare program of NYC. Lyft is the owner and operator of the program and Citibank is the title sponsor. The company started its operations in 2013. In 2024, Citi Bike recorded over 45 million rides, with an average of around 120,000 daily rides, and the revenue for the year was approximately 215 million dollars. Citi Bike has a fleet of approximately 33,000 bikes across New York City, with more than 1,915 docking stations. It is the most extensive bike-sharing system in the United States.

Manhattan is a key market for Citi Bike, with some of the busiest locations, including the Midtown Manhattan (MiMA) and Upper East Side (UES) area. People of NYC frequently use Citi Bike to travel between Midtown Manhattan (one of the busiest commercial areas in the city) and the Upper East Side, where they live and can find a great variety of dining and drinking spots there. Below is a picture of Citi Bikes and a map of available Citi Bikes (green icons) in Midtown Manhattan.



Citi Bike charges a two-part price for its bike-sharing service in New York City. The standard price is $5 to unlock a bike, followed by a charge of $0.40 per minute of ride. Additionally, the City of New York also collects a $0.45 tax per ride from Citi Bike. At the core of Citi Bike's strategy is dynamic pricing, where the company adjusts the price (both the unlock fee and the per-minute charge) based on available supply and demand. Users will be notified of the current price level when looking for a bike in either the Citi Bike or Lyft app.

For instance, a price level of 90% means that the customer will be charged $4.50 to unlock and $0.36 per minute of ride. A price level of 110% means that the customer will be charged $5.50 to unlock and $0.44 per minute of ride. The $0.45 tax remains constant regardless of the price level.

In addition to regular customers, Citi Bike has unique discount customers under the Citi Bike EduPass program (in cooperation with the City of New York). Customers in this program include students between 16 and 24 years old, who often seek affordable transportation options for commuting. The (maximum) price for these customers is $2.50 to unlock the bike and $0.25 per minute of ride. Citi Bike can also charge a lower price for these customers. The price level can only be 100% or lower for Citi Bike EduPass.

In addition to the taxes paid to The City of New York, Citi Bike has a cost $0.10 per minute for the bikes.

Citi Bike is now investigating its pricing policy for the area. It collected ride data in June, July, and August 2024 for weekdays between 4:40 pm and 5:20 pm. In particular, the ride data between Midtown Manhattan and Upper East Side is collected.

Question 1: Using the data that you are provided, fit a linear price-response function using regression to describe the number of Regular riders from MiMA to UES for the time bracket 5:00-5:20 pm as a function of the price level. Explain the results of your regression analysis. Do you think there was a good fit? Explain using the results of your regression analysis. Do the same for Citi Bike EduPass riders from MiMA to UES for the time bracket 5:00-5:20 pm.

Question 2: The company has 150 prepositioned bikes at MiMA to be used explicitly for MiMA-UES rides between 5:00 and 5:20. In addition, any returns from rides from UES to MiMA in the time bracket 4:40-5:00 can also be used for trips from MiMA to UES between 5:00 and 5:20 Historically, the average number of returns from Regular customers is 96, and the average number of returns from Citi Bike EduPass customers is 16. That is, there are altogether 262 bikes that can be used for rides from MiMA to UES. If the company does not use any dynamic pricing (price level=100%) for both types of customers, what is the expected profit for Citi Bike for rides from MiMA to UES for the time bracket 5:00-5:20? What is the service rate for Citi Bike (proportion of riders that can find a bike)? Assume that any rider who cannot find a Citi Bike immediately uses some other service (Lime, Bird, taxi services, or public transportation). (Hint: the average minute spent per ride can be deduced from the total revenue column in the data)

Question 3: The company believes that it can bring additional bikes from Brooklyn to the MiMA area so that the service rate and profit can be increased for rides from MiMA to UES for the time bracket 5:00-5:20. What should be the maximum incentive that should be paid (per bike) for such moves from Brooklyn?

Question 4: If Citi Bike uses dynamic pricing for both types of customers, what should the price levels be (Regular and Citi Bike EduPass price levels can be different) for 5:00-5:20 pm from MiMA to UES on a weekday? Remember that you cannot charge Citi Bike EduPass customers more than 100%. What is the expected revenue for Citi Bike for rides between 5:00 and 5:20 (from MiMA to UES)? What is the maximum amount Citi Bike should pay to move additional bikes from Brooklyn to the MiMA area?

Question 5: If Citi Bike uses dynamic pricing for both types of customers, but price levels for both types of customers must be the same, what should be the price level for 5:00-5:20 pm from MiMA to UES on a weekday? In this case, relax the restriction that Citi Bike EduPass price level should be smaller than or equal to 100%. What is the expected revenue and profit for Citi Bike for rides between 5:00 and 5:20 (from MiMA to UES)? What is the value of bringing an additional bike from Brooklyn to the MiMA area?

Question 6: Do you think implementing different price levels for Citi Bike's regular customers each day of the week is viable? (Different price levels for Monday, Tuesday, Wednesday, Thursday, and Friday). Justify your answer using statistics.

Question 7: Citi Bike realized that the number of available bikes in the MiMA area heavily depends on the returns from earlier rides to this area. In particular, any return for a ride between 4:40 and 5:00 from UES to MiMA area can be used for rides from MiMA to UES between 5:00 and 5:20. Assume now that you can use dynamic pricing for rides from UES to MiMA for Regular customers. For this purpose, estimate a linear price-response function for UES to MiMA Regular rides between 4:40 and 5:00. (Assume that the price level for Citi Bike EduPass customers will not be optimized; only 16 bikes will be returned). Aside from returns, 150 bikes are prepositioned in the MiMA area. Given that the total number of bikes available in the UT area is 166 + the number of returns from UES to MiMA Regular rides,

- Find the optimal price levels for UES to MiMA Regular, MiMA to UES Regular, and MiMA to UES Citi Bike EduPass.
- Find the expected revenue and profit corresponding to these rides.
- Find the value of additional bikes that can be brought to the MiMA area from further away locations.

In doing these, assume that the MiMA to UES Citi Bike EduPass price level cannot be more than 100%. In addition, assume that there are plenty of bikes in the Upper East Side (UES) area that can be used for rides from UES to MiMA.

Question 8: Using the data that you are provided, fit a logit function to describe the number of Regular riders for MiMA to UES rides between 5:00 and 5:20 as a function of the price level. Do you think this is a better fit than what you find in Question 1? Justify your answer. (While fitting the logit function assume that C (market size) is 450).

Question 9: Repeat Question 4 using the logit function that you find in Question 8 for MiMA to UES Regular rides. If you believe that logit fits the data better, what is the potential damage of using the wrong function in Question 4 (Using linear function – incorrect estimate – rather than the logit function – correct estimate –) in optimizing your price levels? Explain your results.

In answering all these questions, assume that the trip durations (and therefore the average base rates – without dynamic pricing) are not affected as price levels change. This should also be evident from the data.