Exploratory Data Analysis

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01
Introduction

About Capital Bikeshare (CaBi)

PPP

Public-private partnership between municipal owners and Motivate (Lyft)

Broad goals

Transportation
Community
Quality of Life
System Sustainability*

Docked bikes

Classic bikes & docks
New: e-bikes
Data on rides

*Source: District Department of Transportation (DDOT), Development Plan

1) Motivate is operator. Plays important role in maintaining system health and availability. Each jurisdiction contracts out with Motivate to run the system in exchange for **a fixed fee per dock**. M was acquired by Lyft in 2018. Since that time Lyft has integrated CaBi into the Lyft app.
2) More than just mobility, and certainly more than just generating profit. 4 Themes:
3) As opposed to more recent dockless mobility options such as scooters and other bikes. E-bikes owned by Lyft.

02

Goal: system balance

User experience: getting dock-blocked

M.V. Jantzen   + Follow

Dock Blocked

PRO The "Columbus Circle / Union Station" Capital Bikeshare station. It was completely full, preventing me from returning my bike here. Washington, DC.

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I feel I have to share this with you: I too have been dock-blocked. It happened to me many years ago in Lyon, in France. So I know the feeling! And the worst thing about getting dock-blocked is, you think you've reached where you want to be. You found your vehicle, you've navigated your way around the city, you're just in time to arrive, you reach the station – and – all the docks are blocked. There is nothing more frustrating, especially if the next station is some distance away.

"Fifty-five percent of respondents said they would ride more often if more docks/bikes were added to existing stations."

—CaBi User Survey 2016
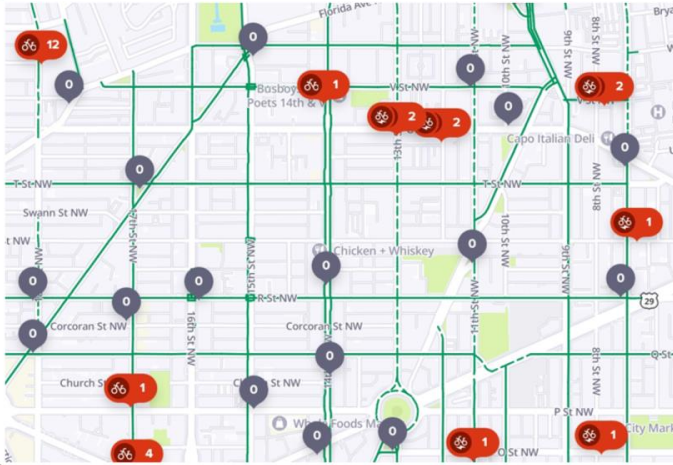
Empty stations – still a thing in 2023!

Live view, 10:30am Tuesday, near Logan Circle

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It's not part of the data made publicly available, but CaBi clearly knows when stations are empty or full.

A balanced bikeshare system

For a convenient ride experience, users need:

- Functioning bikes available nearby
- Free docks at the destination

So we need to maintain balance in how bikes are distributed around the city.

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Let's talk about balance [Slide]
What might cause a bikeshare system to lose its balance? There are numerous answers to this question, but here are two really big ones:
- Many people wanting to ride at the same **time**
- Many people wanting to start or end their ride at the same **place**
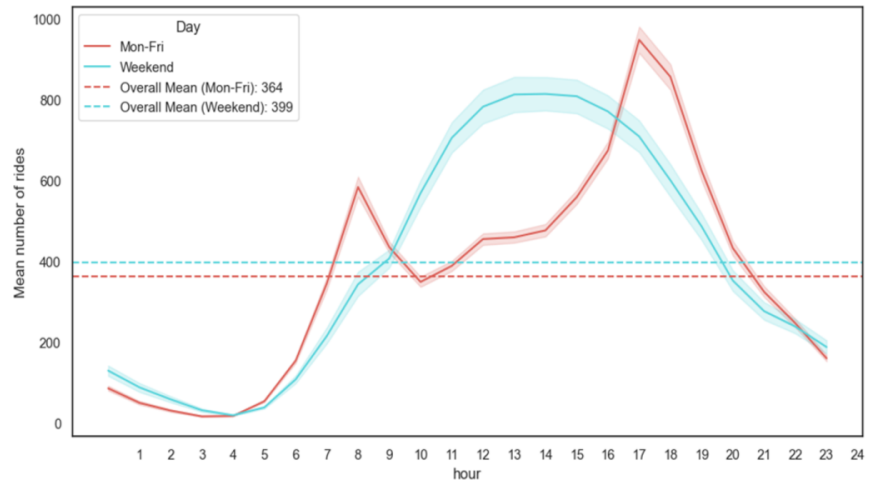
03

Analysis

When do people ride?

Weekdays

Commuter peaks
6:00 - 9:00 and
16:00 - 19:00

Weekends

More evenly
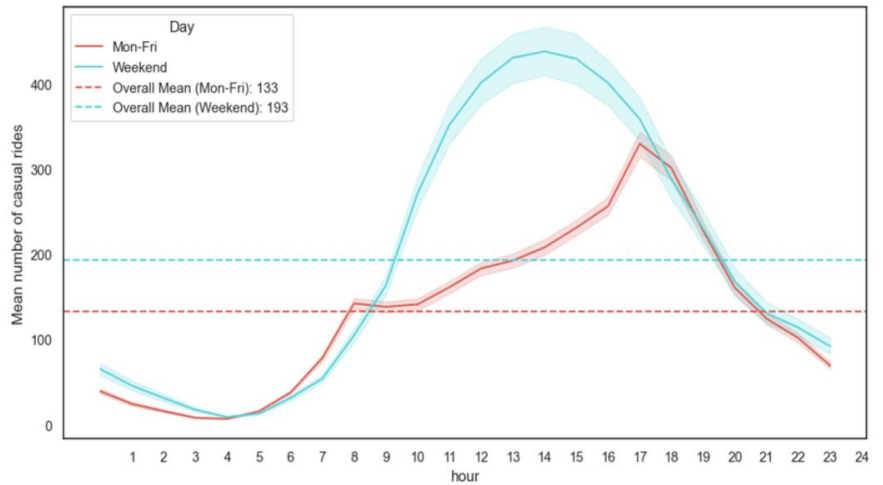throughout the day

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Is is different for casual users?

You bet!
Weekend use is
45% higher than
weekdays

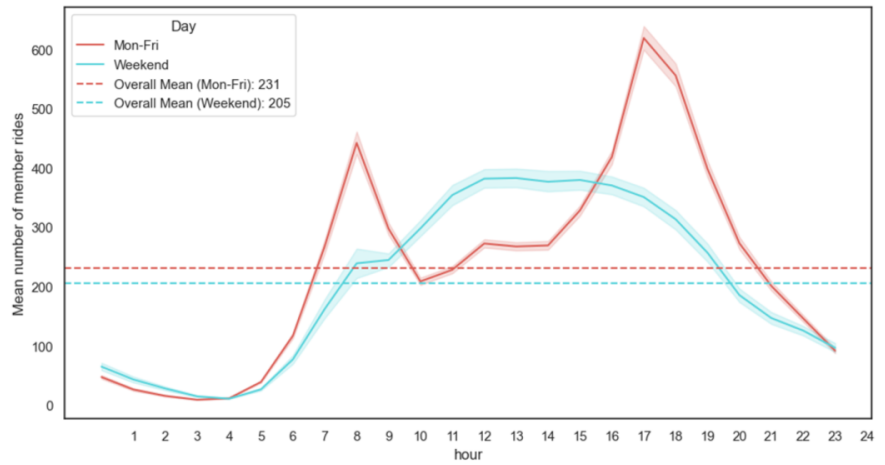## Small peaks
At commuting
times

How about members?

+ Weekdays

Member use is 13% higher from Mon-Fri

High peaks

Commuting times are especially busy

Where are people going?

Data needs reorganising:

- 6,157,609 classic bike rides over 911 days
- How are these spread across 818 stations?

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To find out where people tend to ride to and from, I aggregated the ride data by station. That involved creating a new dataframe with stations as the rows, counting up the rides that started and ended there, and adding some extra features to let me know how well balanced each station is.

To give you an example, I'll start by comparing a couple of specific stations.

Balanced: New Hampshire Ave & T St NW

Daily usage
TOP! 159 bikes taken/returned at 22 docks

Work am
-12.9 bikes

Work pm
+12.5 bikes

Bikes added
49.7%

Fun am
-6.3 bikes

Fun pm
+4.2 bikes

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"Work" = Monday-Friday, "Fun" = Saturday & Sunday

Balanced: Columbus Circle/Union Station

Daily usage
146 bikes taken/returned at 50 docks

Work am
+8.59 bikes

Work pm
-5.66 bikes

Bikes added
50.3%

Fun am
+8.4 bikes

Fun pm
-12.17

It's a destination for riders in the morning and a start point for riders in the afternoon. So it appears that people use the main train station to travel outside the city for the day and come back in the afternoon. Both on workdays and weekends.
The figures are somewhat unbalanced during the week, but the weekend figures redress the balance. This is one of my favourite bike stations in DC because, like the diligent workers of the city, it uses weekend activities to balance out the working week.

04

Imbalance

Audience: If people are taking bikes from here to commute to work or have fun at the weekend, why are fewer bikes being returned in the afternoon?

You may be also asking: How is that even possible? It has 26 docks. If it keeps losing bikes at these rates, after 4 days it's empty, there are no more bikes left to take. The answer is: rebalancing. Measures are in place to redistribute bikes around the city. Motivate picks up bikes in trucks to bring them to empty stations. In addition, a Corral Service means staff are on hand at busy stations at peak times to remove bikes when docks are full. Commute destinations & special events.

Why do some stations lose their balance?
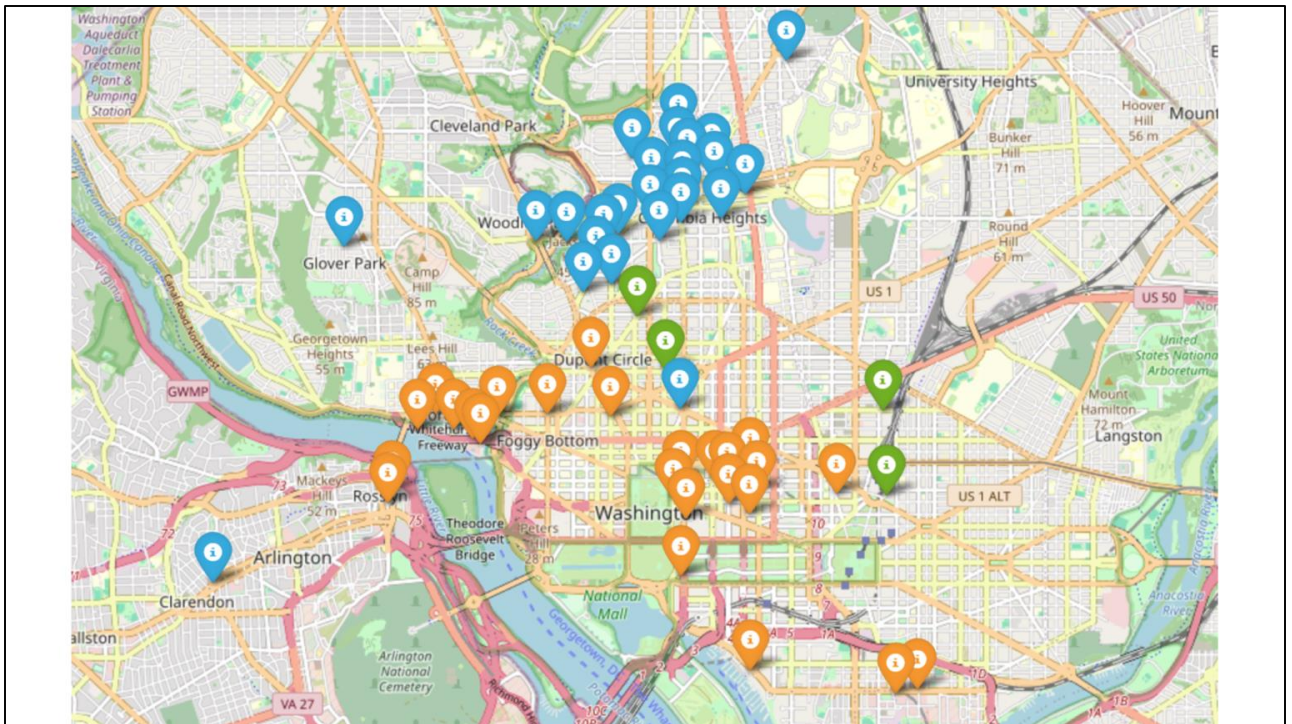
To find out, I plotted the top 40 most unbalanced stations on a map of DC. That means, the stations with the largest net difference between bikes taken and bikes returned. The blue dots on the map are the stations that lose the most bikes over the course of a day. The orange dots are stations that gain the most bikes. The green dots are the small selection of well balanced stations we looked at previously.

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KPIs

So what can we do to help the system stay in balance? I'd like to answer that question by looking at 2 recommended KPIs for Capital Bikeshare.

Recommended KPIs

1) Reduce station downtime

- Measured by length of time per month that a station is *completely full or empty*.
- CaBi goals: transportation, system sustainability.
- Responsibility of Motivate – corrals and rebalancing trucks
- Use data analysis to target the most popular unbalanced stations.

2) Increase Bike Angel rides

- Measured by number of Bike Angel rides per month compared to prior year.
- Also serves CaBi goals of community, quality of life.
- How? Raise program visibility, offer attractive rewards.
- Target less popular unbalanced stations.

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Motivate: Corrals to cope with peak-time dock demand & moving bikes by truck
Bike Angels is a programme that members can sign up for to receive points and rewards by moving bikes from full to more empty stations.
Community: enhances feeling of belonging, more than just a consumer service.
Quality of life: this an opportunity to get some vigorous exercise, for example by riding the uphill journey home from work.

"Rebalancing laps can be a fun way to earn a few Angel points and get some **multimodal exercise**."

—User on Bike Arlington Forum, 2020

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"I've found Courthouse to be a great spot for it because bikes will often accumulate at some stations just a few blocks from other empty stations. Unsurprisingly, the full stations are always at lower elevations than the empty ones, so you will be jogging downhill and riding uphill."

Bike Angel rewards

Lifetime Rewards

250 points	500 points	1,500 points	2,500 points	5,000 points
Joy Rider	Casual Cruiser	Steady Pedaler	Hustlin' Hero	Power Angel
Ride Credit	Water Bottle	Key Fob	Bike Gloves	Backpack
Pin	Pin	Pin	Pin	Pin

Choosing the right rewards:

- Encourage identification with CaBi
- Further boost visibility & engagement
- Make it worthwhile!

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06
Key
Takeaways

Key Takeaways

Downtime

Means fewer rides and frustrating user experience

Topography

Major driver of station imbalance

Bike Angels

Alongside operator measures to rebalance system & serve broader goals

Thanks

Any more questions?

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Research references

- District Department of Transportation (DDOT),
  Development Plan Update 2020
  - http://bikearlingtonforum.com/