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## Data Science High Frequency Indicators

# NYC Subway Ridership Is Declining

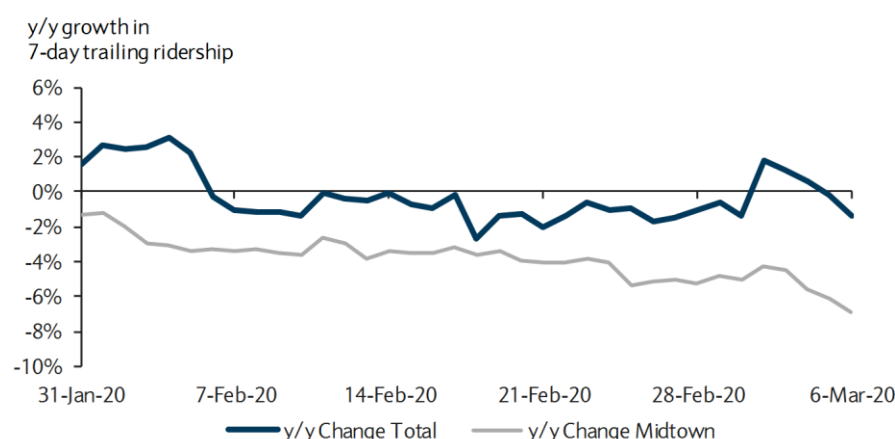
**New York City subway overall ridership has been tracking down year-on-year since early February (Figure 1):** The steepness of the decline appears to have accelerated after the middle of February, albeit with a brief rebound to growth at the beginning of March.

**Traffic to midtown stations has been down more sharply, and accelerated lower starting on March 3<sup>rd</sup>:** We use the stations along 34<sup>th</sup> and 42<sup>nd</sup> streets as a proxy for the traffic connecting to major transit centers (Grand Central Terminal, Penn Station, and the Port Authority Bus Terminal), and the largest concentrations of workplaces. Traffic to these stations has been falling steadily since the third week of January, with distinct accelerations in declines around February 1<sup>st</sup>, Feb 24<sup>th</sup>, and March 3<sup>rd</sup>.

**New York City subway ridership data is released weekly.** We believe the data is useful as a high frequency indicator for tracking economic activity in New York City, in particular as it relates to economic fallout from the COVID-19 outbreak. We detail the source and requirements for processing the data starting on page 2. For the purposes of Figure 1, we look at y/y growth for 7-day periods that are matched on days of the week and week of the year to maximize comparability.

FIGURE 1

**Total Subway Ridership Has Been Down Since Mid-February, But Midtown Ridership Has Declined More Sharply and Accelerated Recently**



Note: Midtown are all the stations along 34<sup>th</sup> and 42<sup>nd</sup> Streets, including those attached to Grand Central Terminal and Penn Station. Source: New York MTA, Barclays Research

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## Using MTA Data

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MTA New York City Transit operates the New York City subway, and local and express New York City buses alongside its sister MTA agencies the Long Island Rail Road and the Metro-North Railroad commuter rail services. The New York City subway system has the highest ridership of any subway in the US and the 7th largest in the world.

Turnstile data tracks the number of entries and exits of passengers in the subway system.

### *Basic Data Description*

The MTA has published turnstile data available back to 2010.<sup>1</sup> The data is published weekly, released on Saturdays. A single datapoint represents the cumulative counter reading at a single turnstile, and is reported every four hours. The dataset has 53,594,158 individual observations and contains the following information:

- C/A – The Control Area is the operator booth in a station. Some stations only have one operator booth. However, larger stations may have more than one.
- UNIT – The Remote Unit, which is the collection of turnstiles. A station may have more than one Remote Unit.
- SCP – The Subunit Channel Position represents the turnstile and the number used may repeat across stations. The UNIT and SCP together is a unique identifier of a turnstile.
- DATE – The Date is the date of the recording with the format MM/DD/YYYY.
- TIME – The Time is the time for a recording, with the format: HH:MM:SS.
- DESC – The DESC is the type of event of the reading. The turnstiles submit “Regular” readings every four hours. They stagger the exact time of the readings across all the turnstiles and stations. Staggering the data submission times avoids having all the turnstiles update simultaneously. “Recover Audit” designates scheduled readings taken after a communication outage. Our analysis uses “Regular” and “Recover Audit” readings. We discard other values such as “DoorClose” and “DoorOpen” which represent unscheduled maintenance readings.
- ENTRIES = The ENTRIES are a cumulative count of turnstile entrances. Note, the ENTRIES do not reset each day or for each recording period. The turnstile entry count continues to increase until it reaches the device limit and then resets to zero.
- EXITS = The EXITS are a cumulative count of the turnstile exits.

### *Data Wrangling/Cleaning:*

We found the difference between each recorded entry per turnstile. In order to do this, we grouped by turnstile, order by date and time, and shifted the data by a lag one. This would give us an extra column in our data of the previous entry recording. Then, we subtracted the current reading with the previous reading. We lost only one reading across all turnstile in the whole dataset.

Once we had the daily entries across all turnstiles, we grouped by date. This gave us the daily entries for the whole systems. To manage the outliers caused by the resets, we set any values greater than 3,000 to 0. Also, some turnstiles counted backwards, so we took the absolute difference when we found the difference. We used Spark to avoid any limitations for the size of the data.

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<sup>1</sup> <http://web.mta.info/developers/turnstile.html>

*Additional Considerations with Data*

The number of times the turnstile records an entrance or exit does not capture the total number of passengers who use the subway. Some passengers bypass the turnstiles to avoid payment on entry. Passengers who use one-way exit turnstiles are not counted. Passengers often use emergency exits instead of the turnstiles during peak hours or if the turnstiles are in an inconvenient location.

Nevertheless, we believe that the turnstile data is representative of the changes in number of passengers, and are a high frequency series that can track total ridership in the city.

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