Quantifying Bus Performance

A Comparison Between GPS Bus Trajectories and Schedule Data in NYC

presented to

UTRC Transportation Technology Symposium

presented by

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Impetus Behind This Effort

- Availability of MTA BusTime and GPS Data

- The need to establish a casual relationship between Bus speeds and congestion or other factors

- Fascination with visualization

- The potential of Data Analytics/Data Mining/Machine Learning
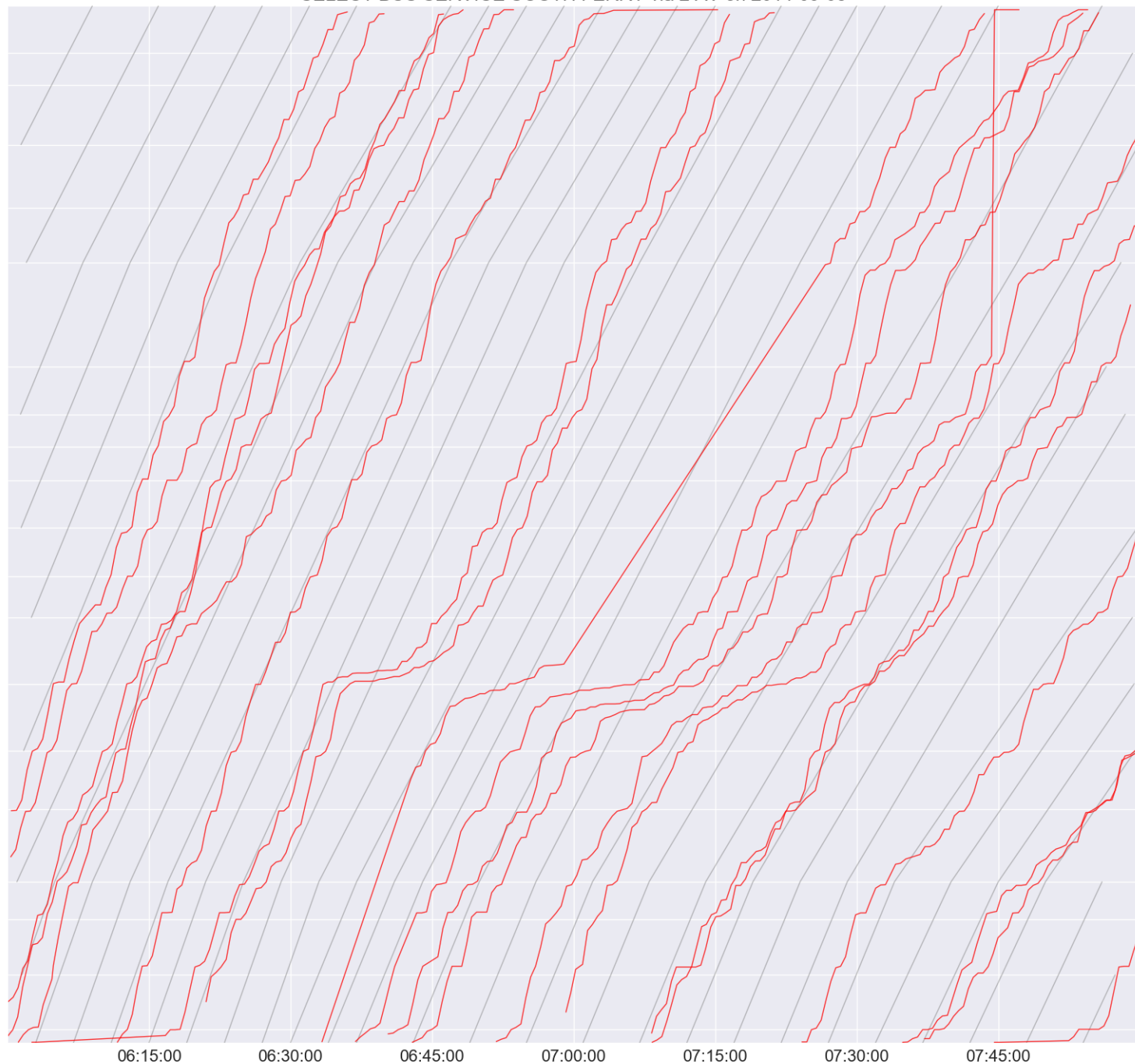
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The Data

- MTA's General Transit Speed Specification (GTFS)

- MTA's BusTime archived data for three months – 8/1/2014 to 10/31/2014

- Every day 5 million bus location points

- Data size: 800 MB/day

Source: http://blog.openplans.org/2012/08/the-openplans-guide-to-gtfs-data/

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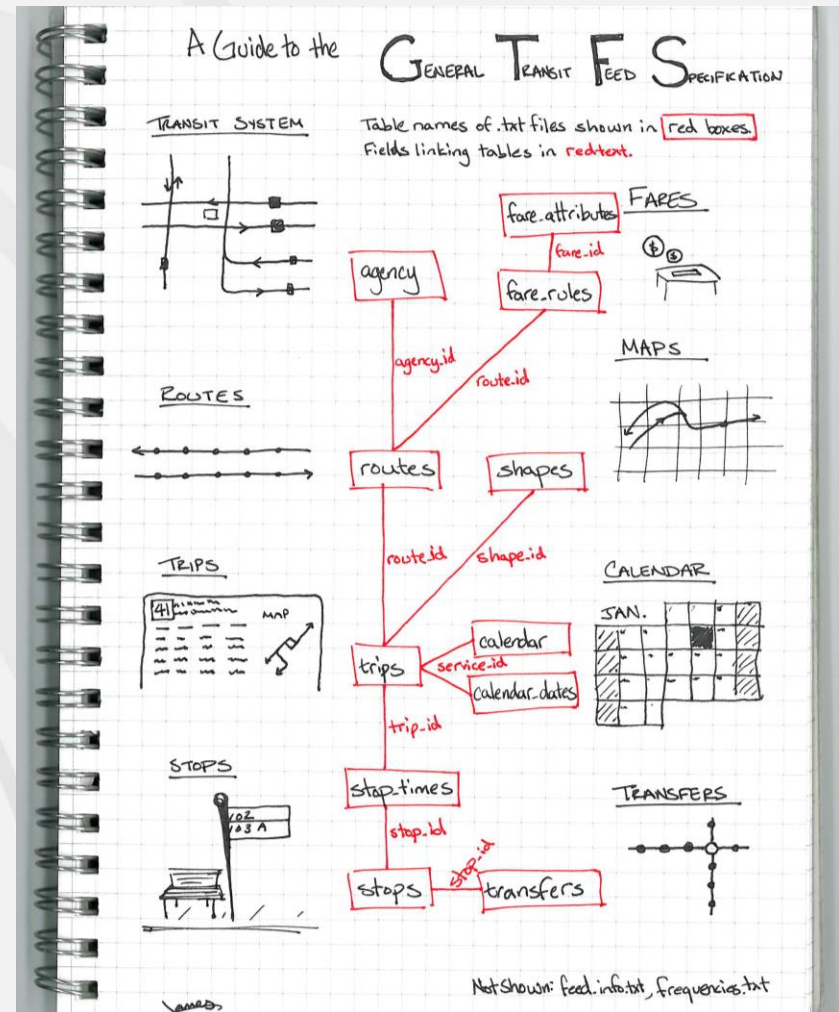
Bus Trajectories

M15+ East Harlem - South Ferry Select Bus Service via 1st Av / 2nd Av
SELECT BUS SERVICE SOUTH FERRY via 2 AV on 2014-09-08

M15+ East Harlem - South Ferry Select Bus Service via 1st Av / 2nd Av
SELECT BUS SERVICE SOUTH FERRY via 2 AV on 2014-09-08
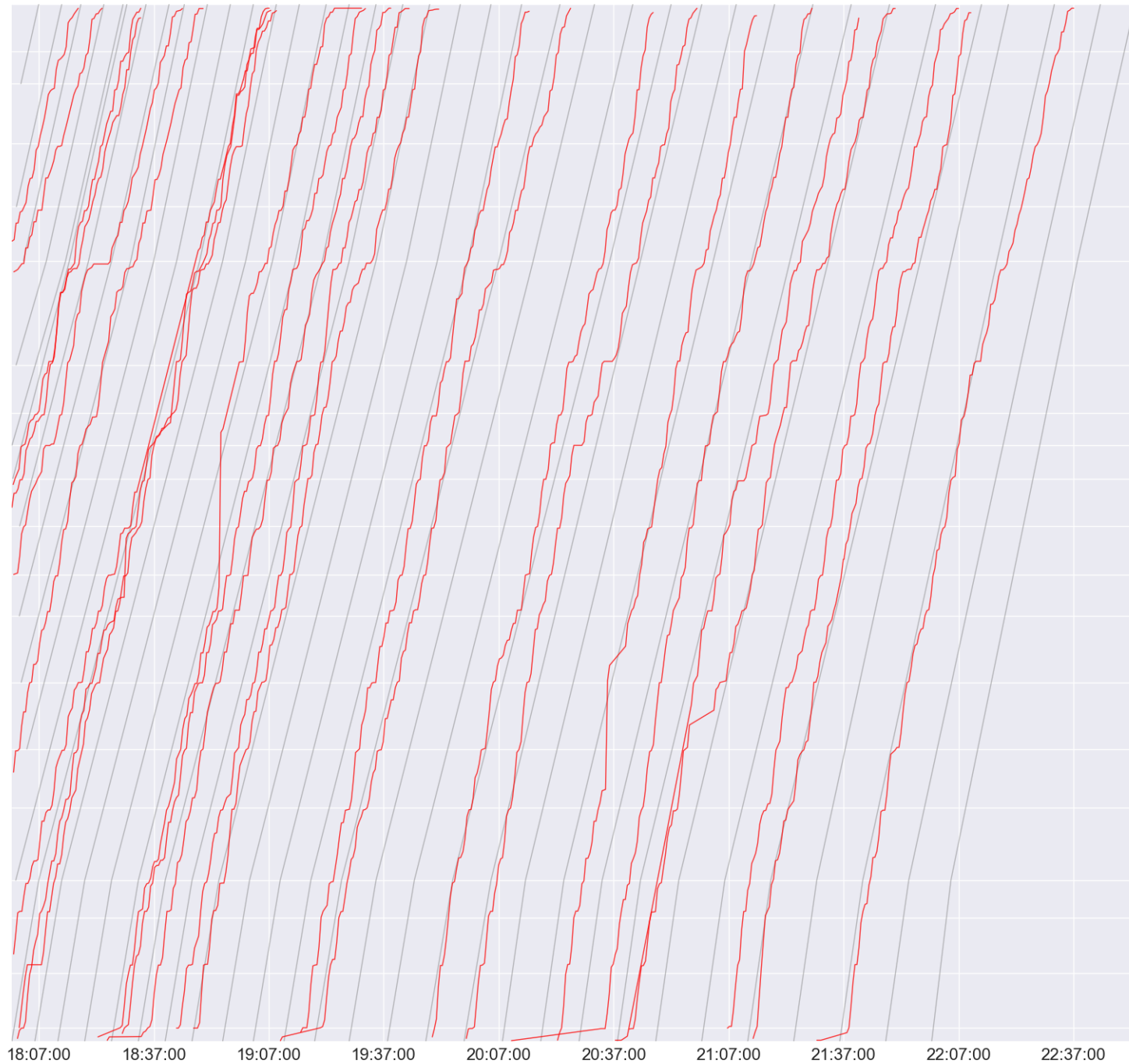
M7 Harlem - 14th Street via Columbus / Amsterdam / 6 & 7 Av / Bway
14 ST via COLUMBUS via 7 AV on 2014-09-08

AV OF THE AMERICAS/W 14 ST
W 14 ST/7 AV
7 AV/WEST 17 STREET
7 AV/W 20 ST
7 AV/W 25 ST
7 AV/W 28 ST
7 AV/W 31 ST
7 AV/W 34 ST
7 AV/W 39 ST
7 AV/W 41 ST
7 AV/W 44 ST
7 AV/W 50 ST
7 AV/W 54 ST
7 AV/WEST 58 ST
COLUMBUS CIR/8 AV
BROADWAY/W 61 ST
COLUMBUS AV/W 66 ST
COLUMBUS AV/W 69 ST
COLUMBUS AV/W 72 ST
COLUMBUS AV/W 75 ST
COLUMBUS AV/W 78 ST
COLUMBUS AV/W 80 ST
COLUMBUS AV/W 86 ST
COLUMBUS AV/W 89 ST
COLUMBUS AV/W 94 ST
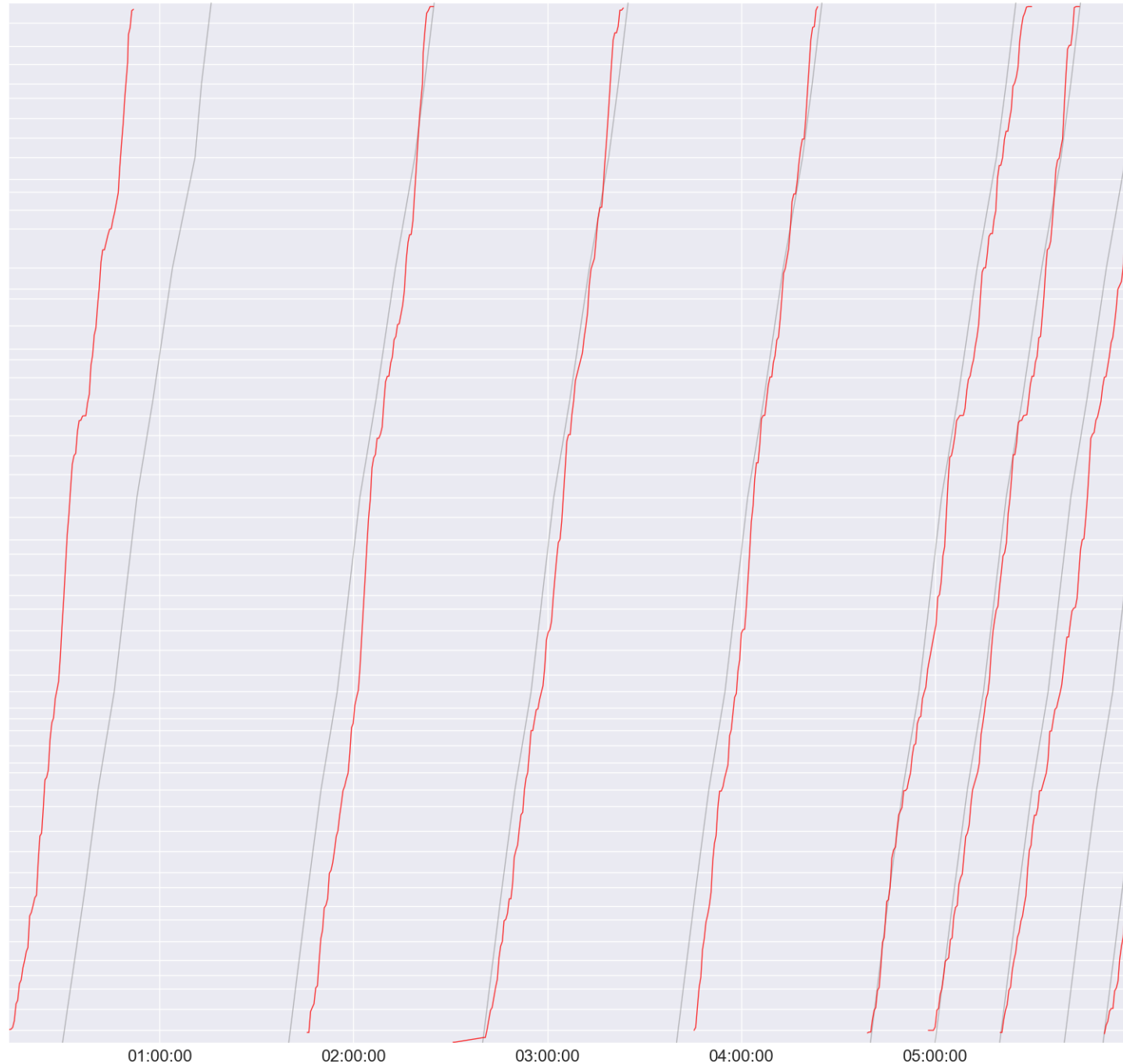COLUMBUS AV/W 97 ST
COLUMBUS AV/W 100 ST
MANHATTAN AV/W 112 ST
W 116 ST/ST NICHOLAS AV
W 116 ST/MALCOLM X BL
MALCOLM X B / W 119 ST
MALCOLM X BL/W 124 ST
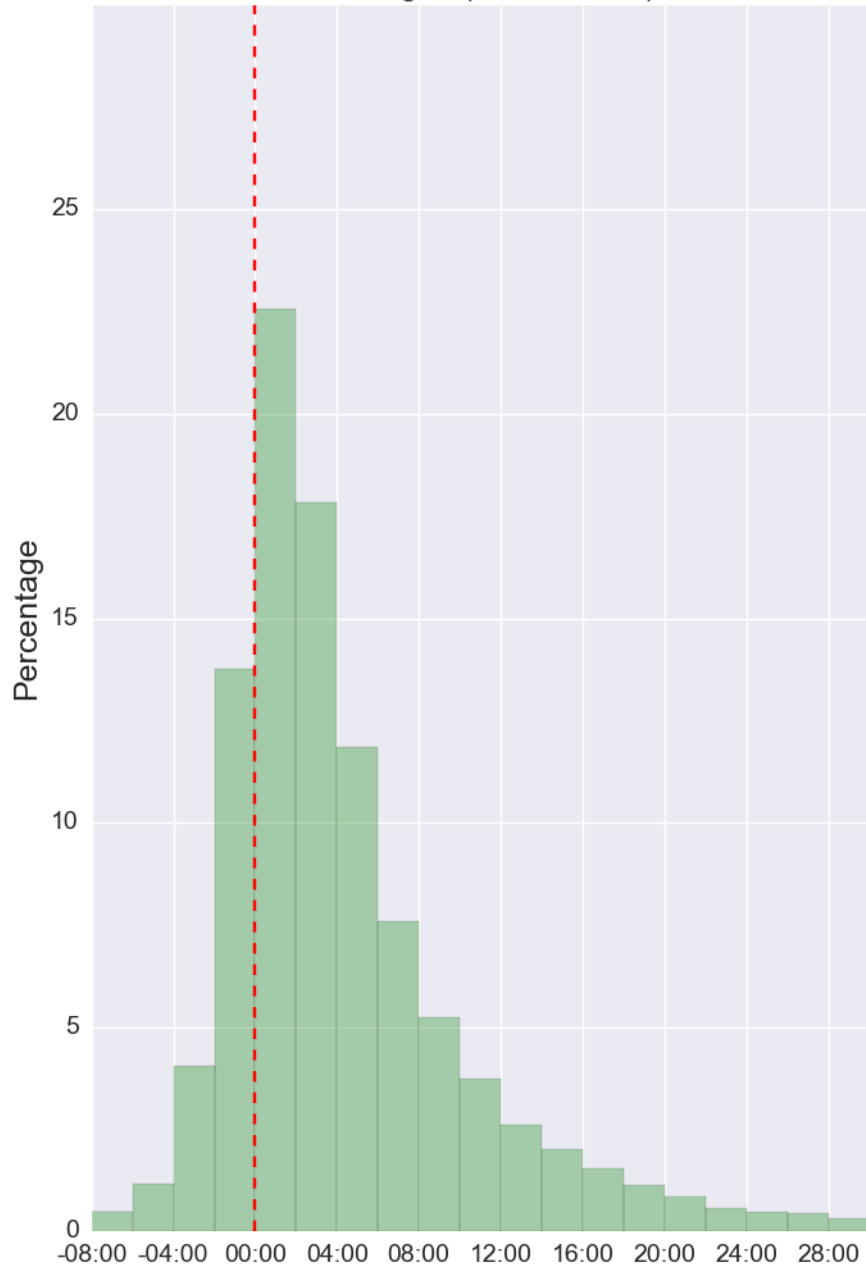MALCOLM X BL/W 129 ST
MALCOLM X BL/W 132 ST
MALCOLM X BL/W 139 ST
MALCOLM X BL/W 142 ST
W 146 ST/MALCOLM X BL

01:00:00   02:00:00   03:00:00   04:00:00   05:00:00
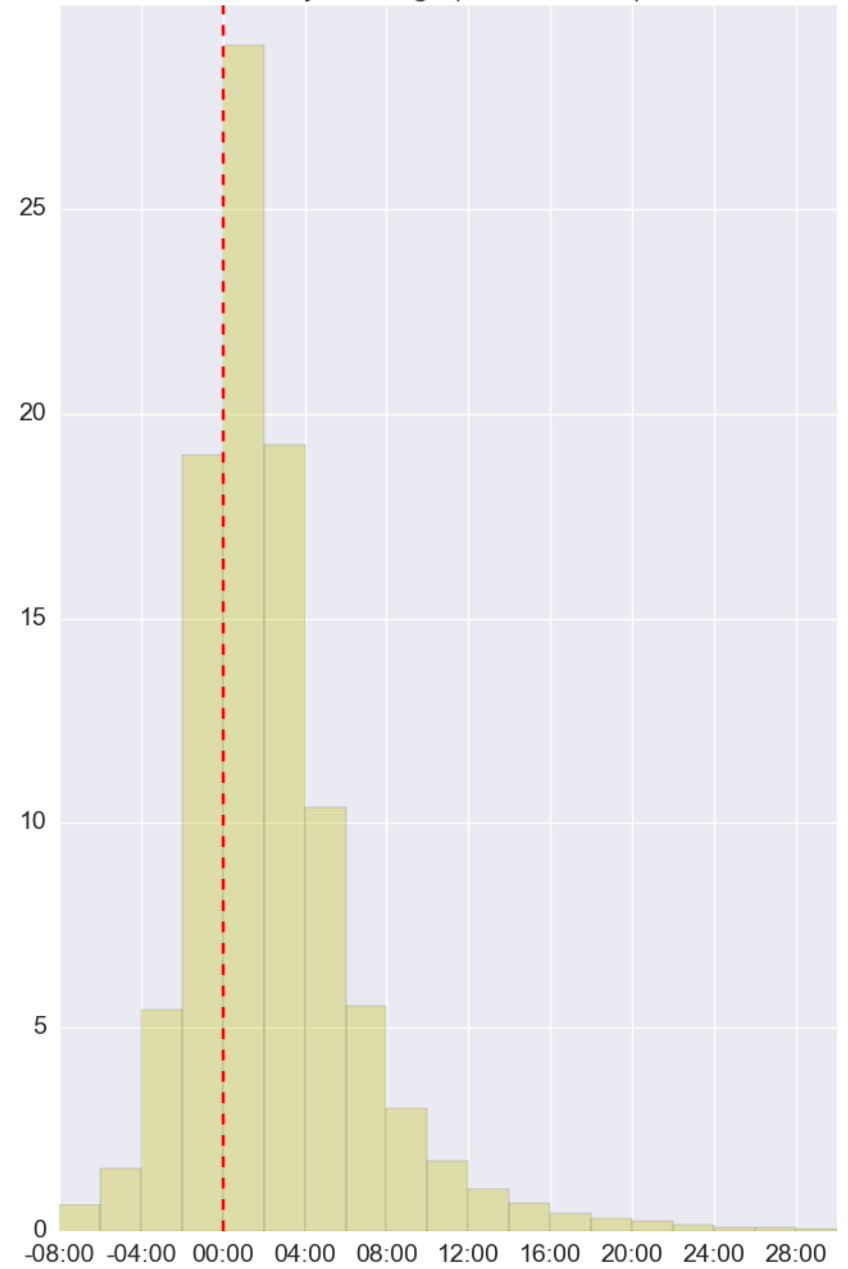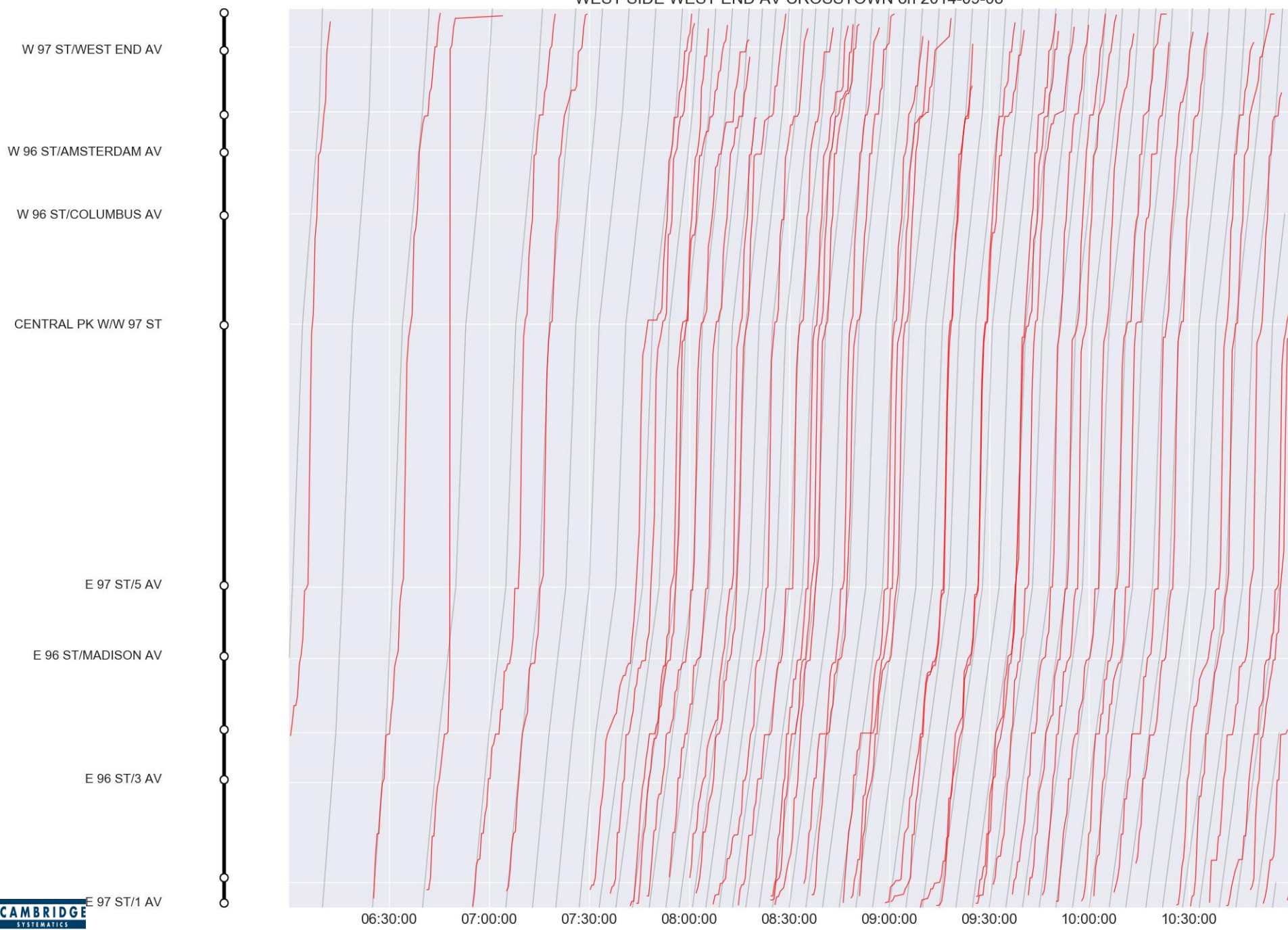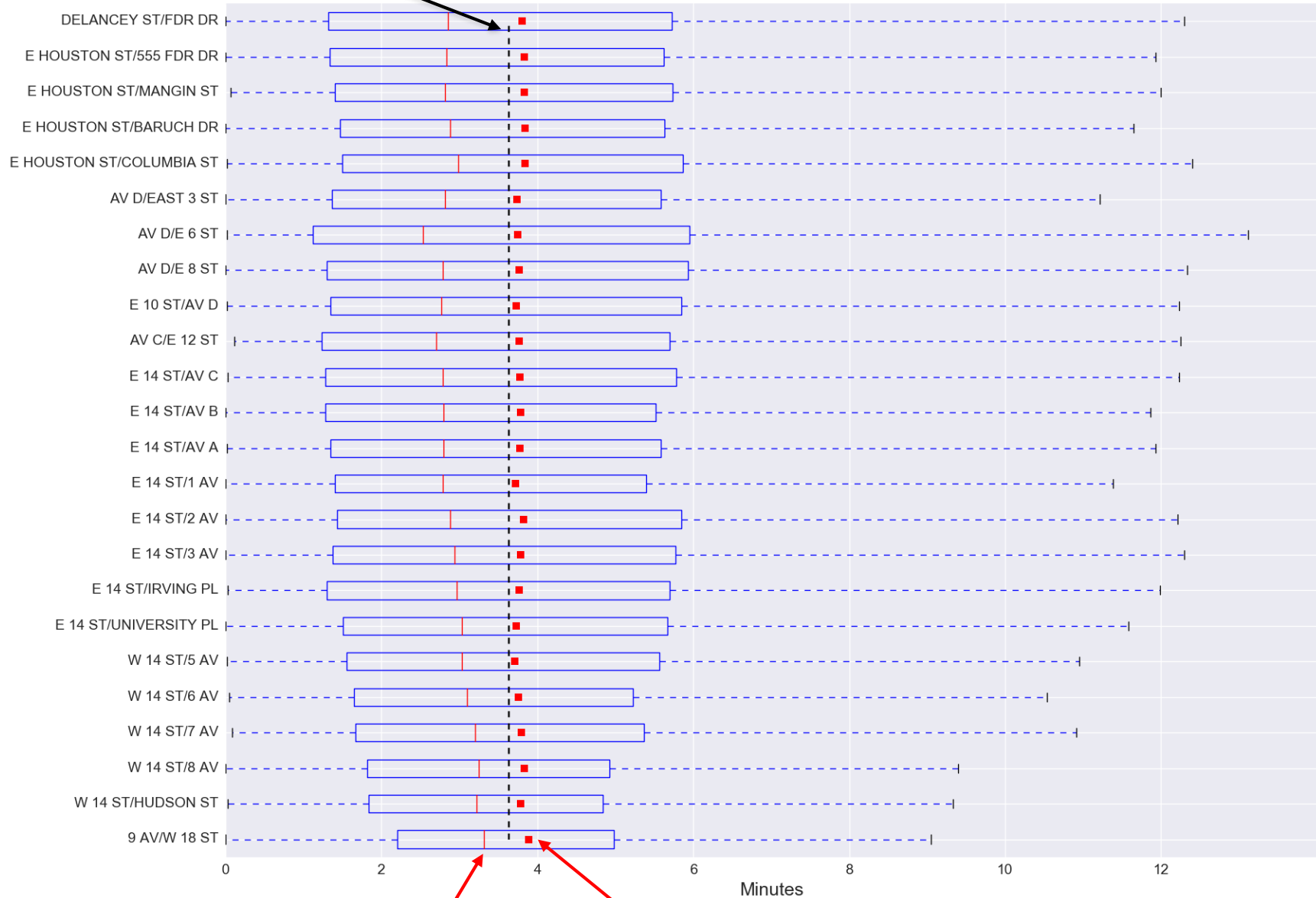
On-Time Performance

Weeknights (9PM to 12AM)

Early mornings (12AM to 5AM)

M96 East Side - West Side via 96th St Crosstown
WEST SIDE WEST END AV CROSSTOWN on 2014-09-08

Headway Variability

M14D Lower East Side - Chelsea Piers via 14th St Crosstown
LOWER E. SIDE DELANCY-FDR CROSSTOWN

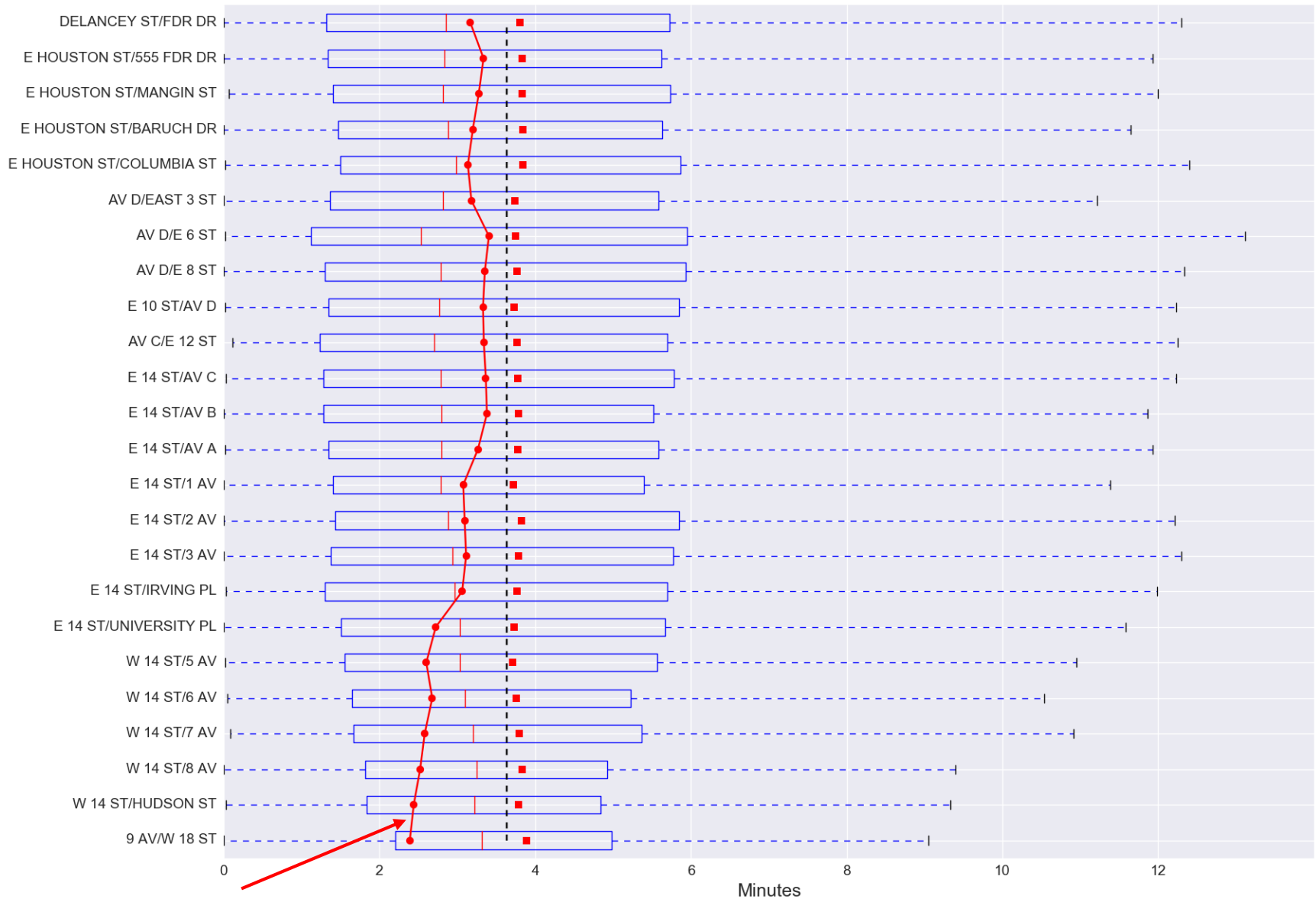Mean of scheduled headways

Median

Mean of observed headways

Headway Variability

M14D Lower East Side - Chelsea Piers via 14th St Crosstown
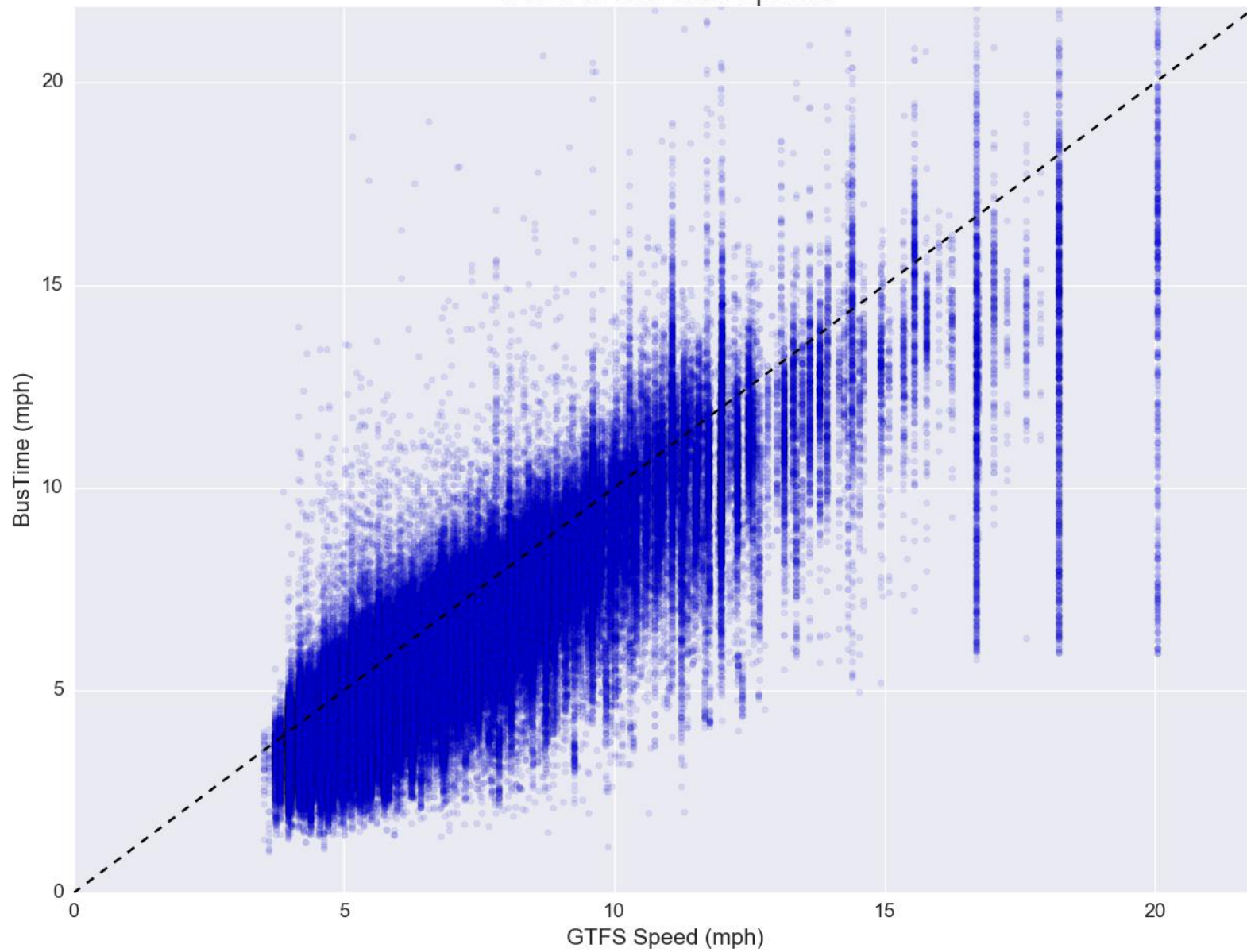LOWER E. SIDE DELANCY-FDR CROSSTOWN
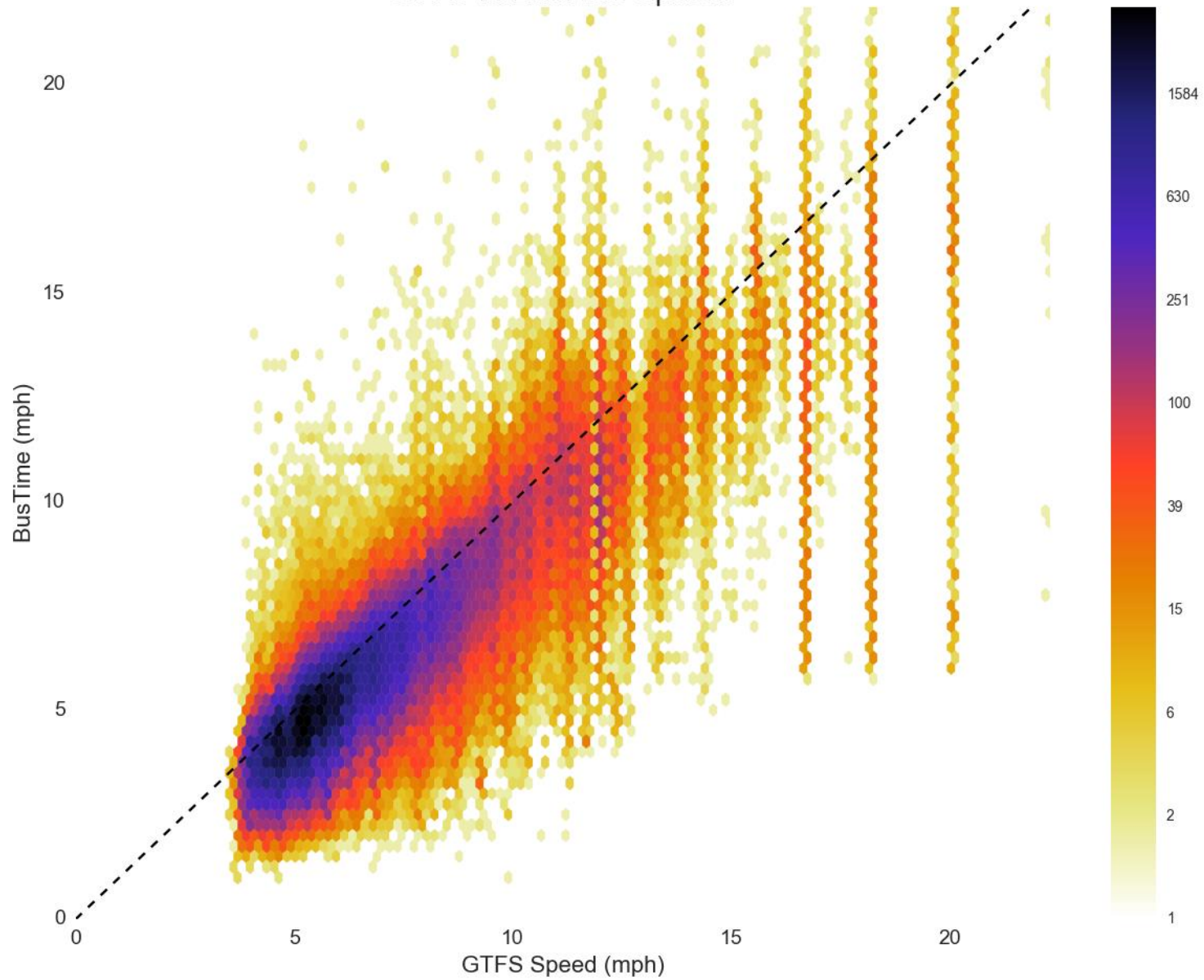
Standard Deviation

Trajectory Visuals Summary

◉ Bus motion is 100% described

   » Position, speed

   » Dwell time? (probably not)

◉ Timetable adherence is also evident

◉ Additional observations

   » Bus bunching

   » Congestion
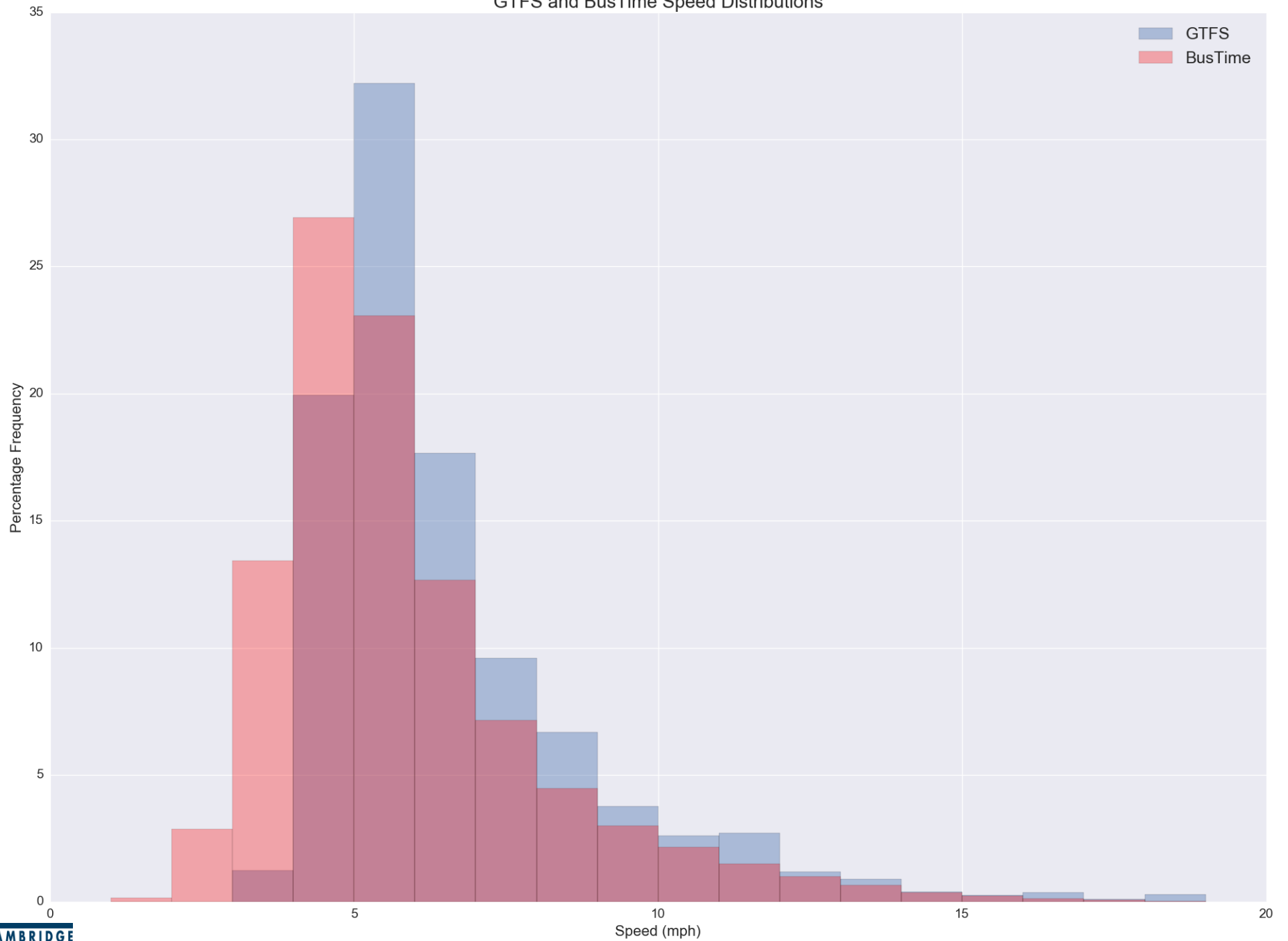
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NYC Bus Speeds
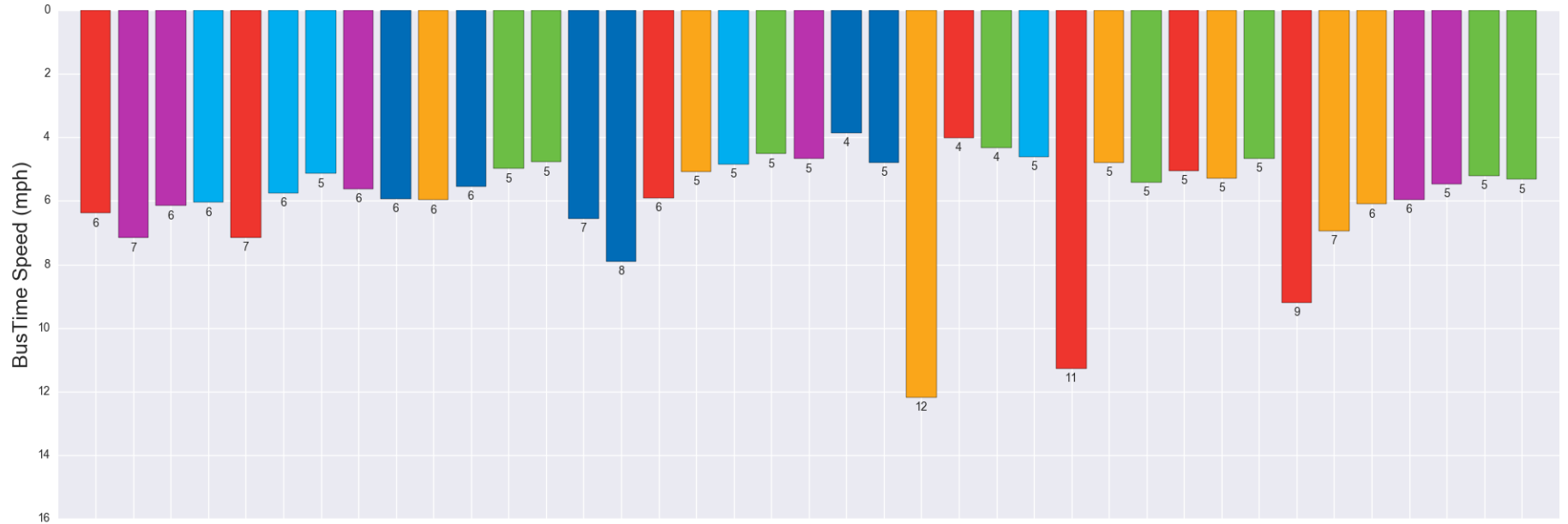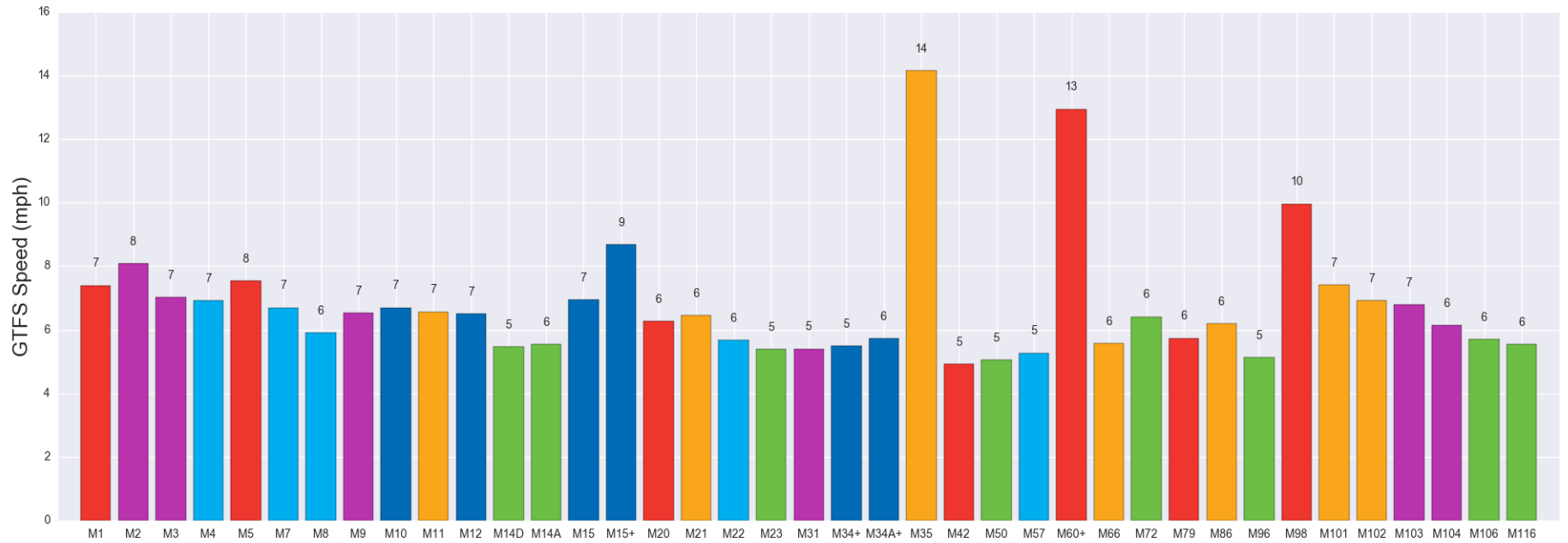
Scatter Plot
GTFS vs BusTime Speeds

Two Dimensional Frequency Plot
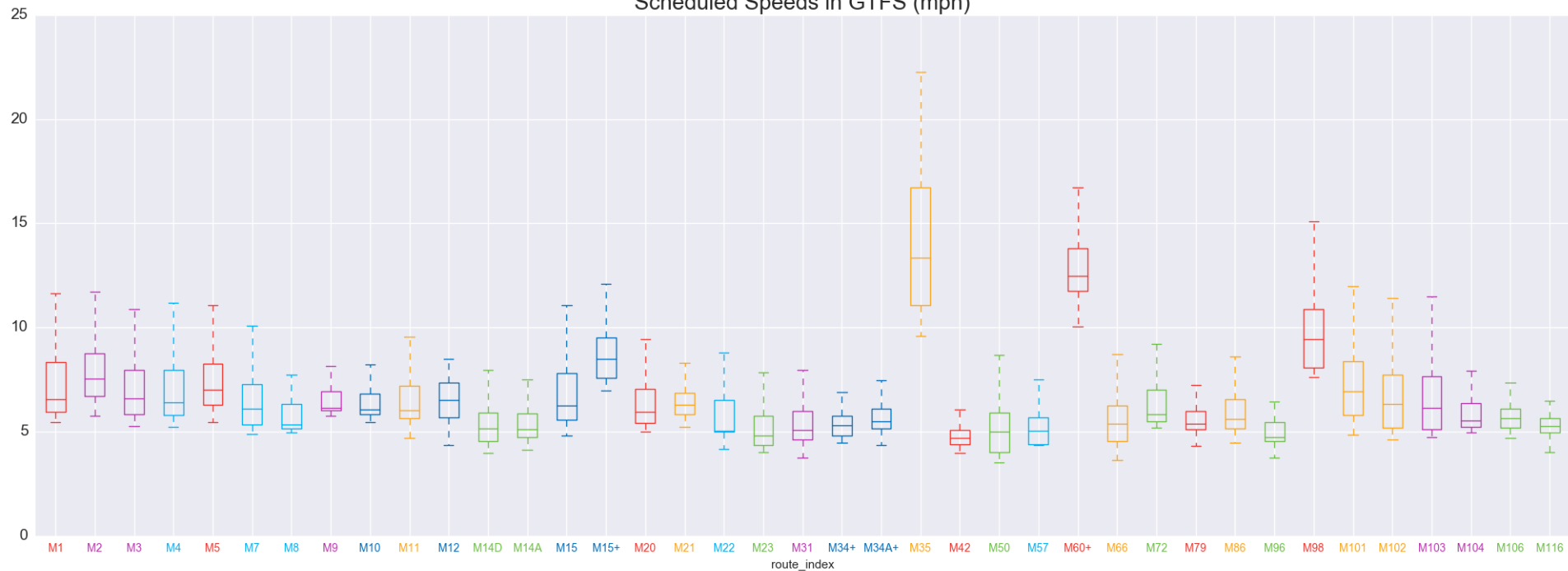GTFS vs BusTime Speeds

GTFS and BusTime Speed Distributions

Average Route Speeds in Manhattan
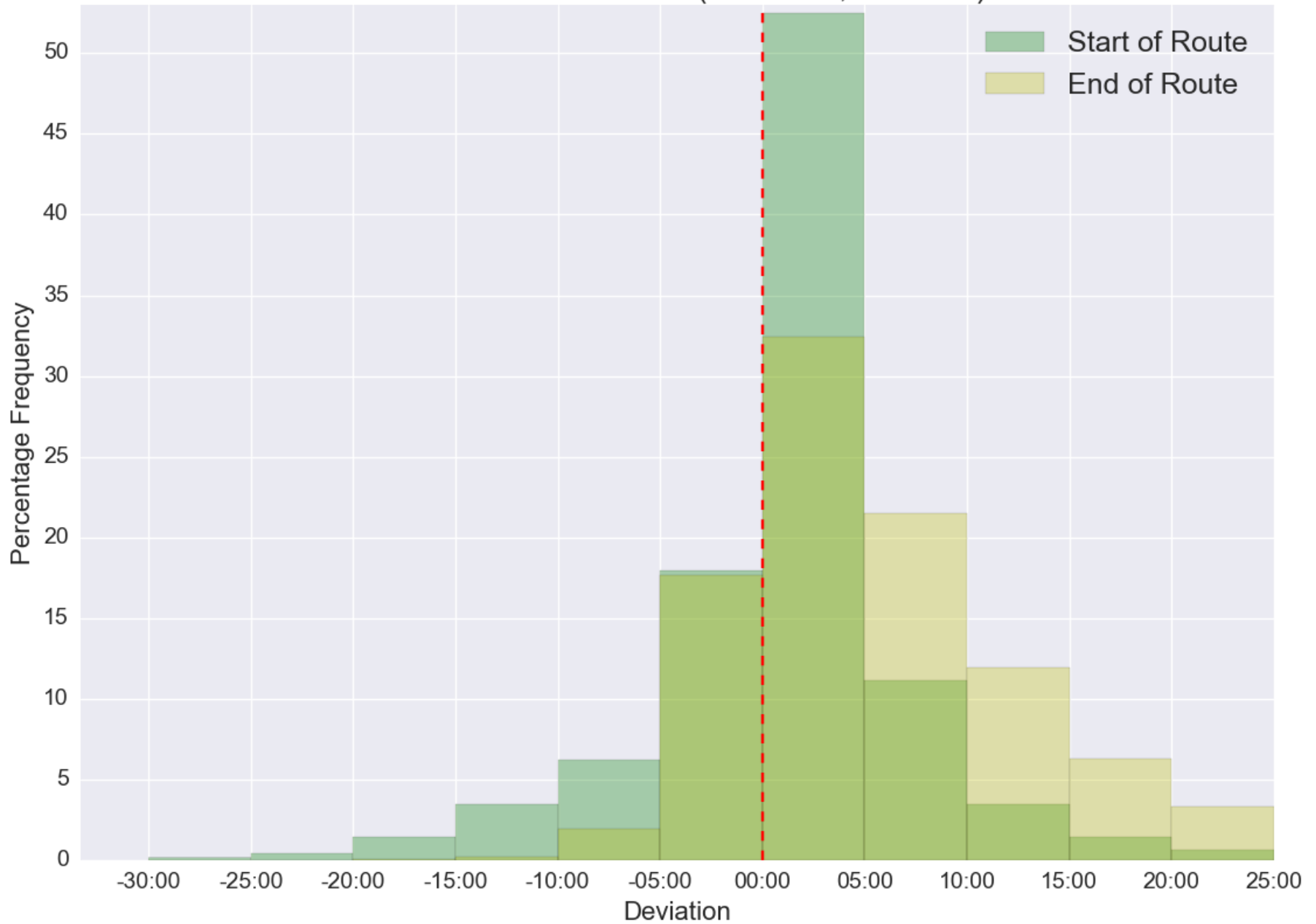
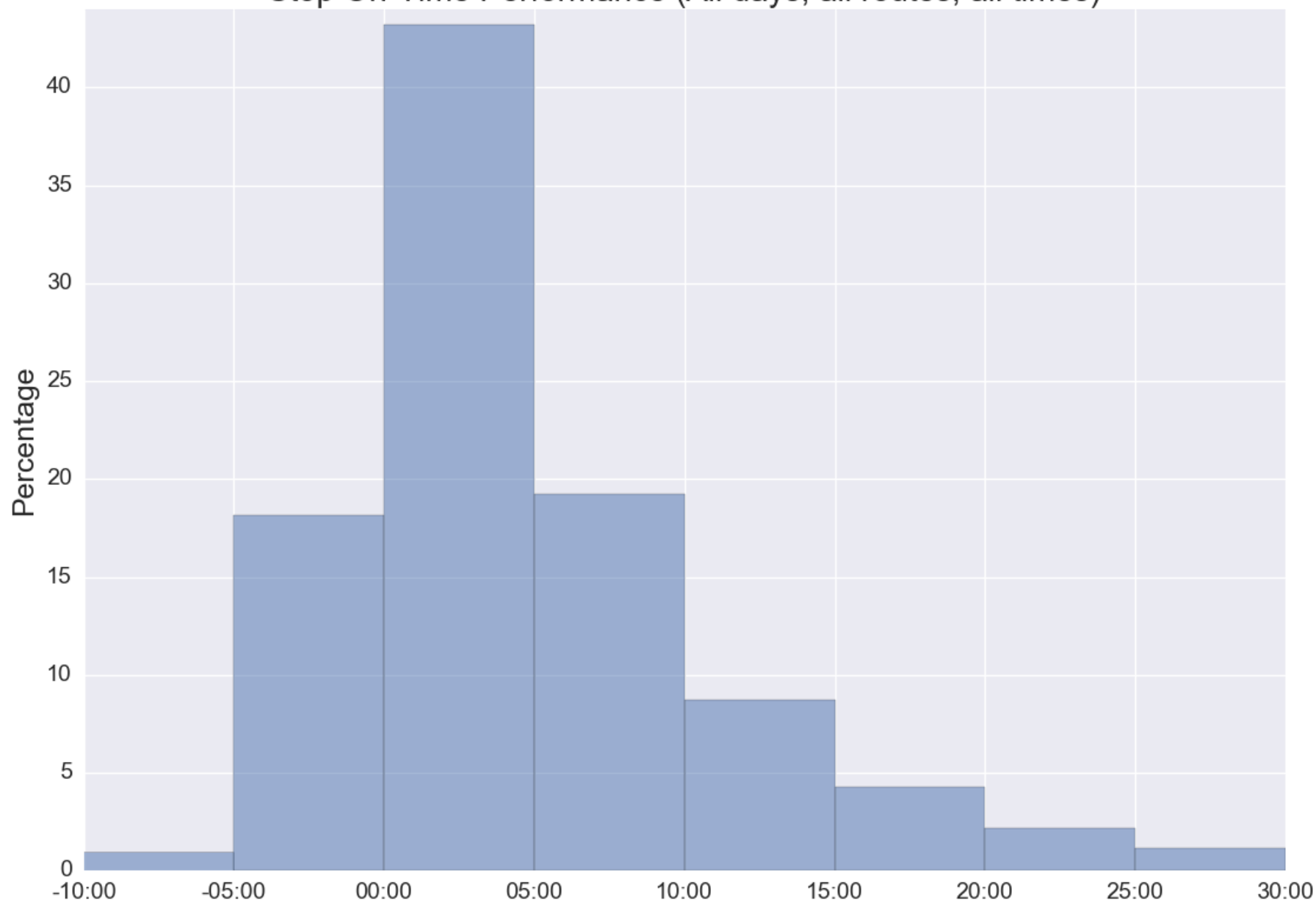Scheduled Speeds in GTFS (mph)

BusTime speeds (mph)

Bus On-Time Performance

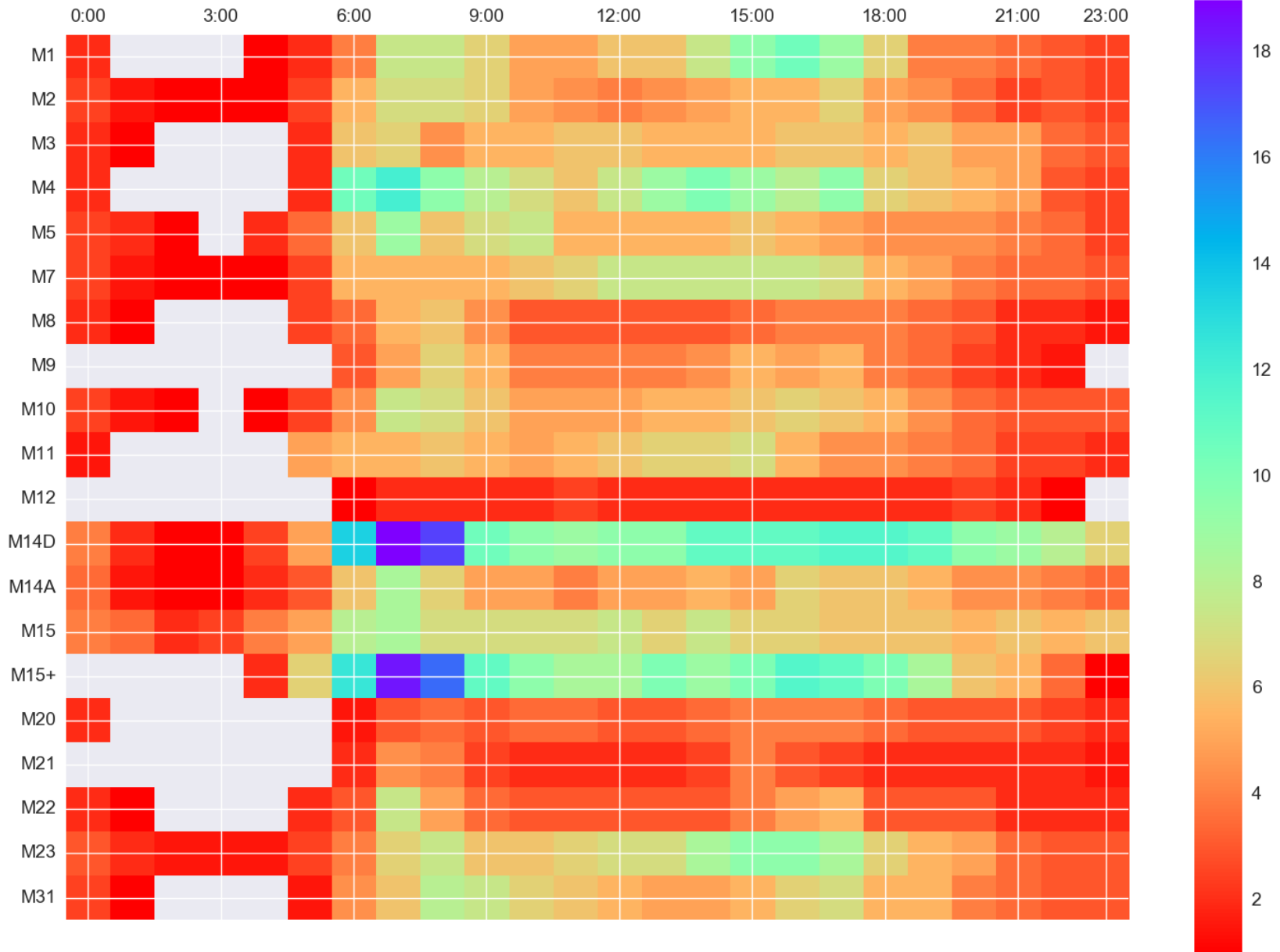On-Time Performance (all routes, all times)

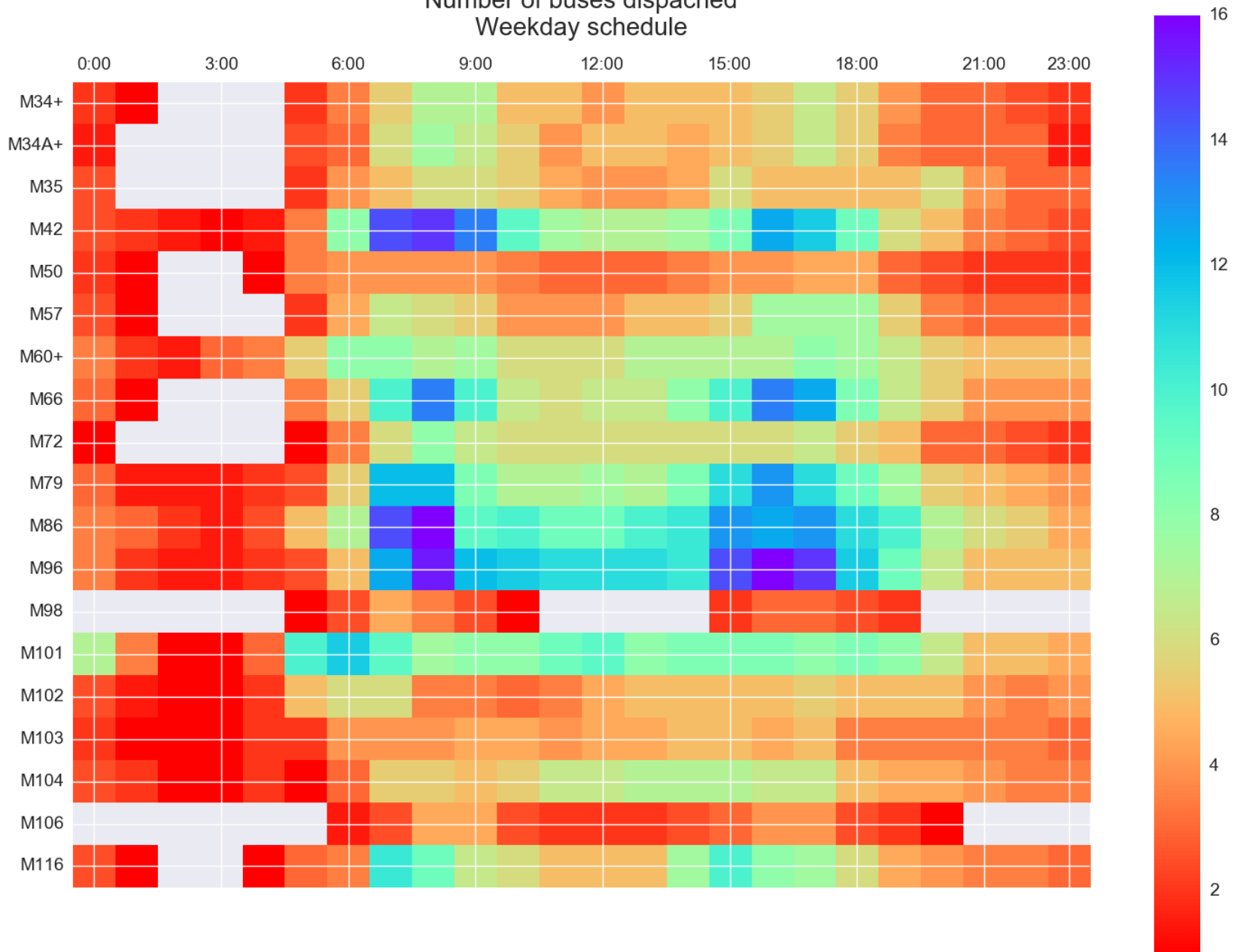Stop On-Time Performance (All days, all routes, all times)

When does On-Time Performance matter?

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Number of buses dispached
Weekday schedule
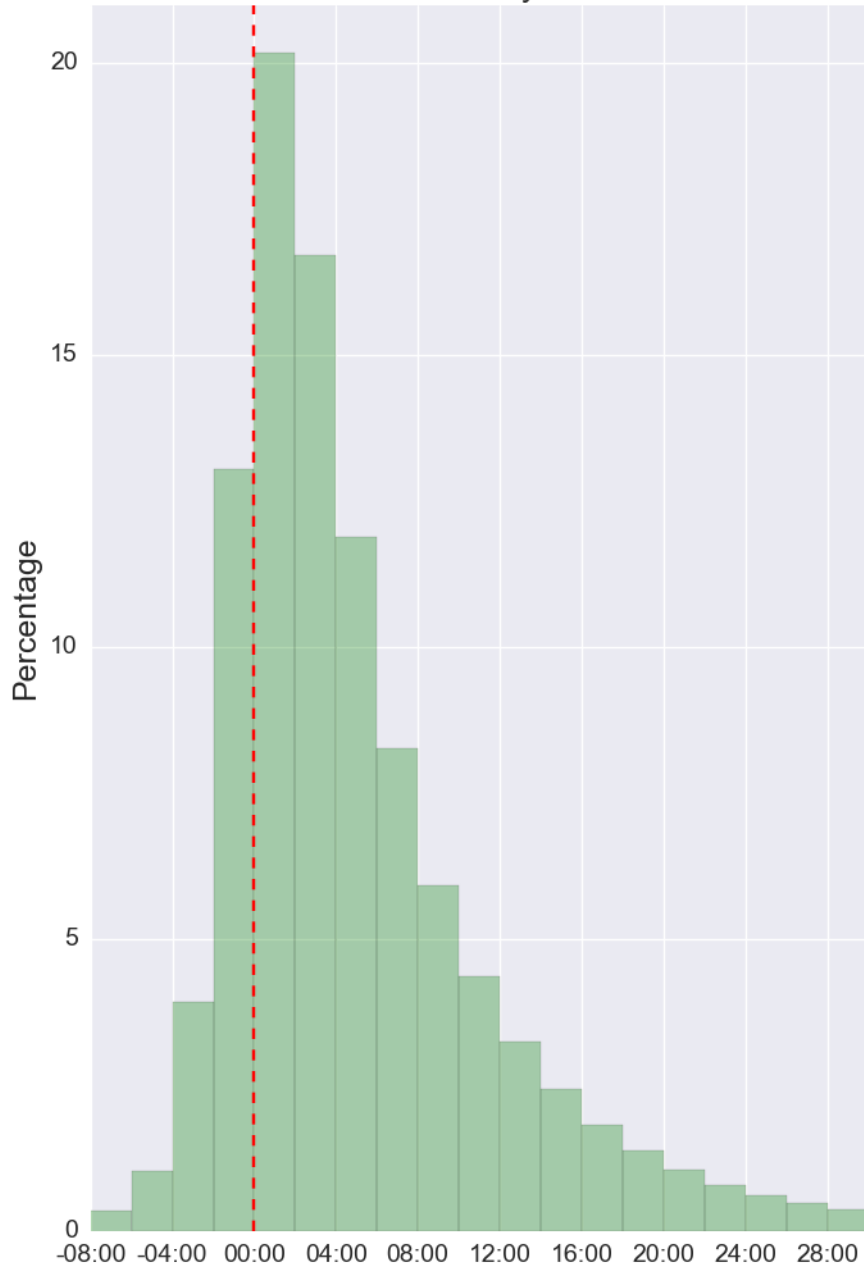
Number of buses dispached
Weekday schedule

On-Time Performance

Weekdays

Weekends

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Transportation leadership you can trust.
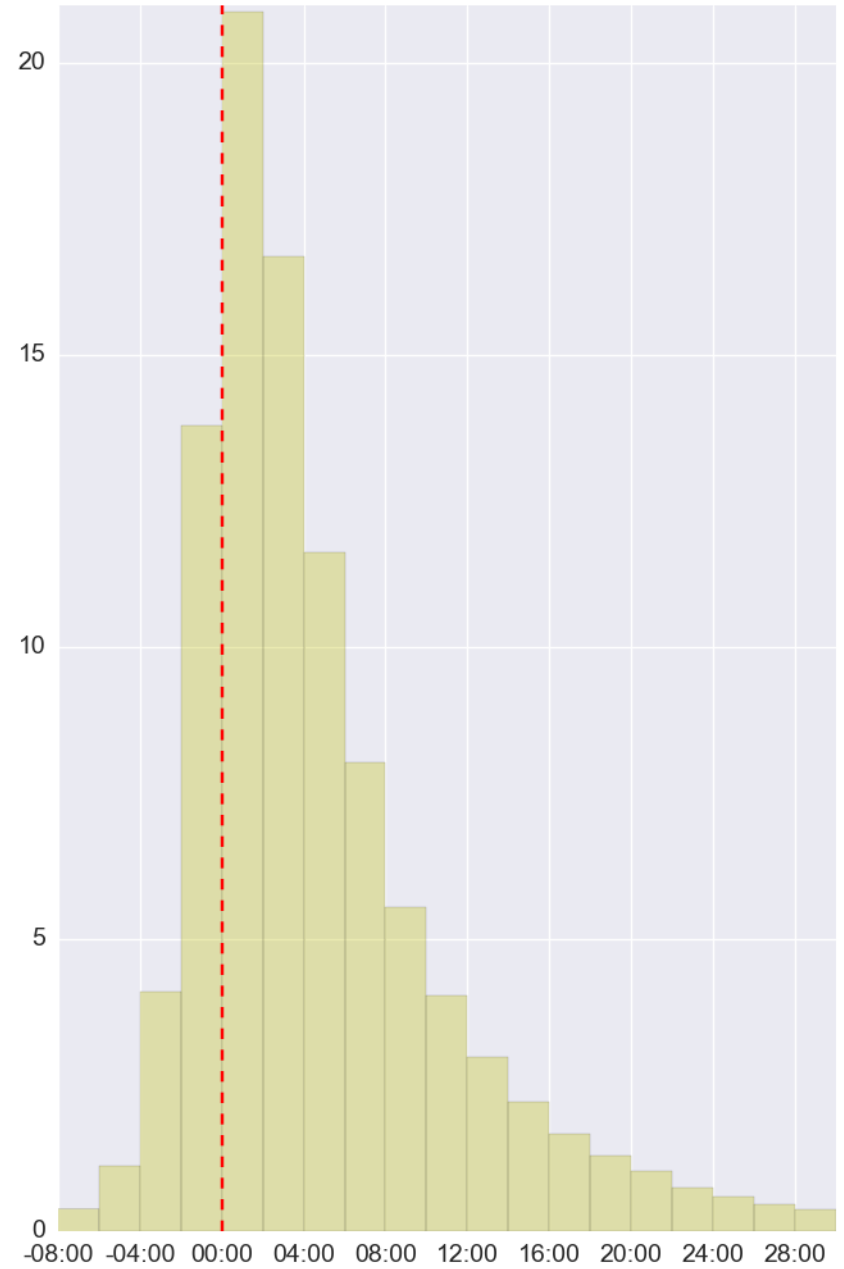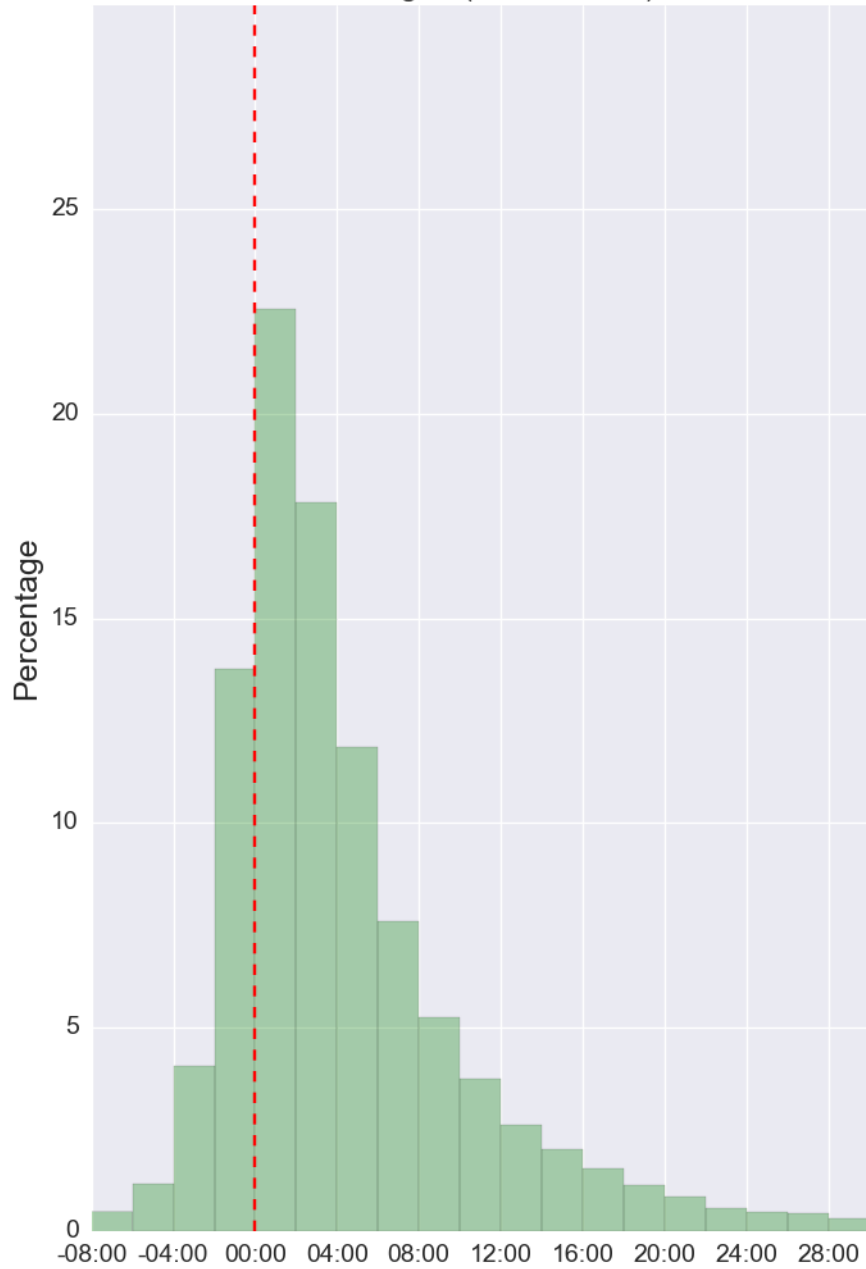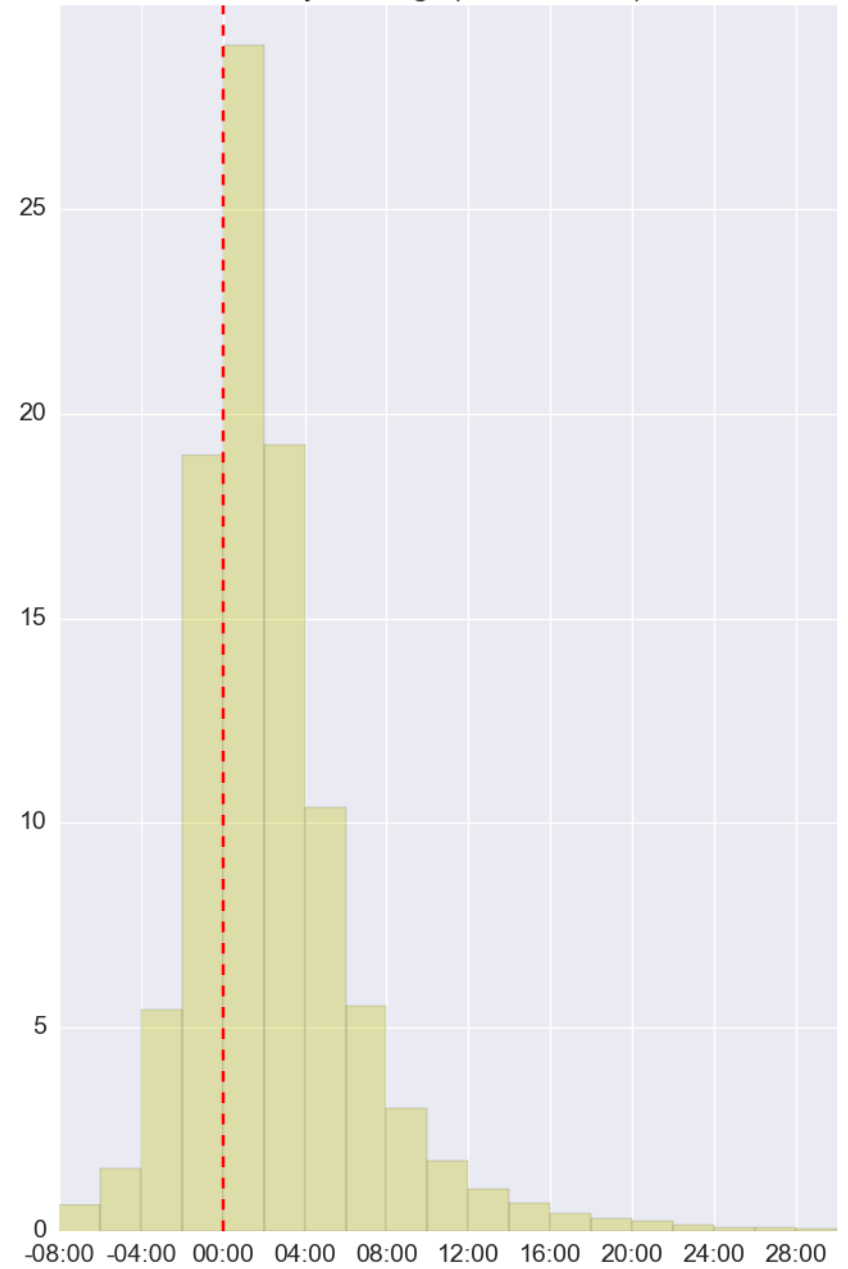
On-Time Performance

Weeknights (9PM to 12AM)

Early mornings (12AM to 5AM)

Next Steps

- We have produced descriptive statistics

- We are missing causality. Why things happen?

- We need to integrate other data sources

- Can we locate outliers?

- Can we apply predictive analytics? In real-time?

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Summary of Insights

- Bus Speeds are 1mph lower than scheduled speeds in fall 2014

- There is a ~50% chance a bus starts its trip less than 5 minutes late

- There is a 35% chance a bus ends its trip less than 5 minutes late

- Stop delays don't differ significantly between weekdays and weekends

- Buses are slightly more punctual in early morning

- There is 20% chance a bus arrives early at a stop

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Thank You!
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