




The Bone Scrapers

WeGo Project

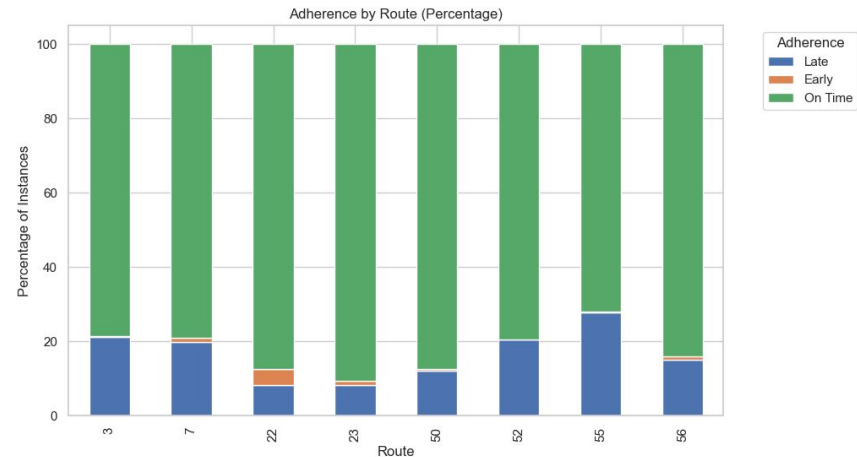
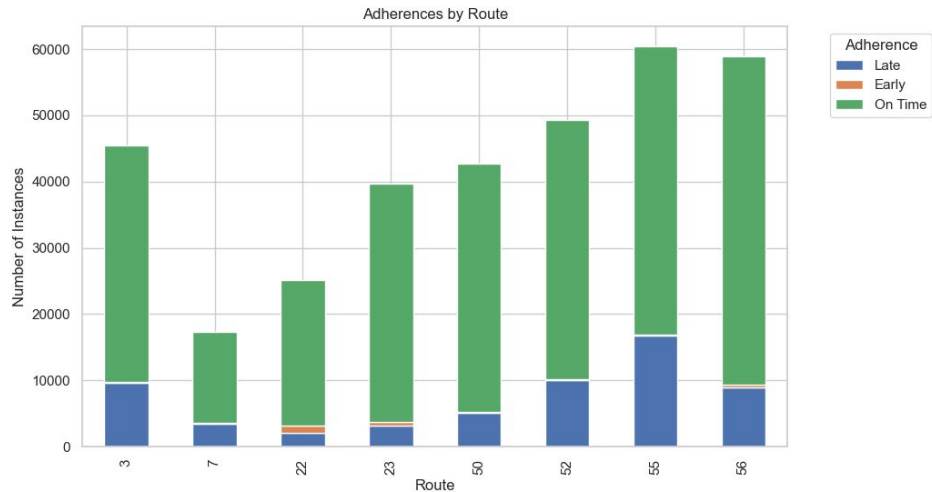


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NSS Data Science 7
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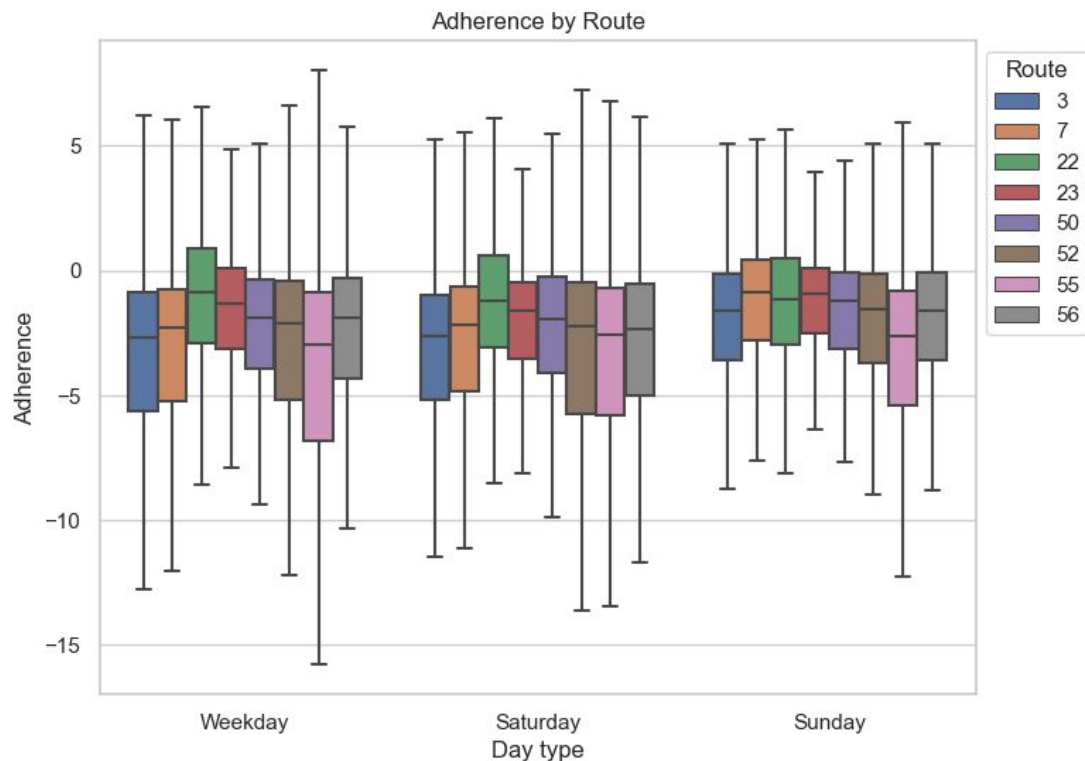


Adherence



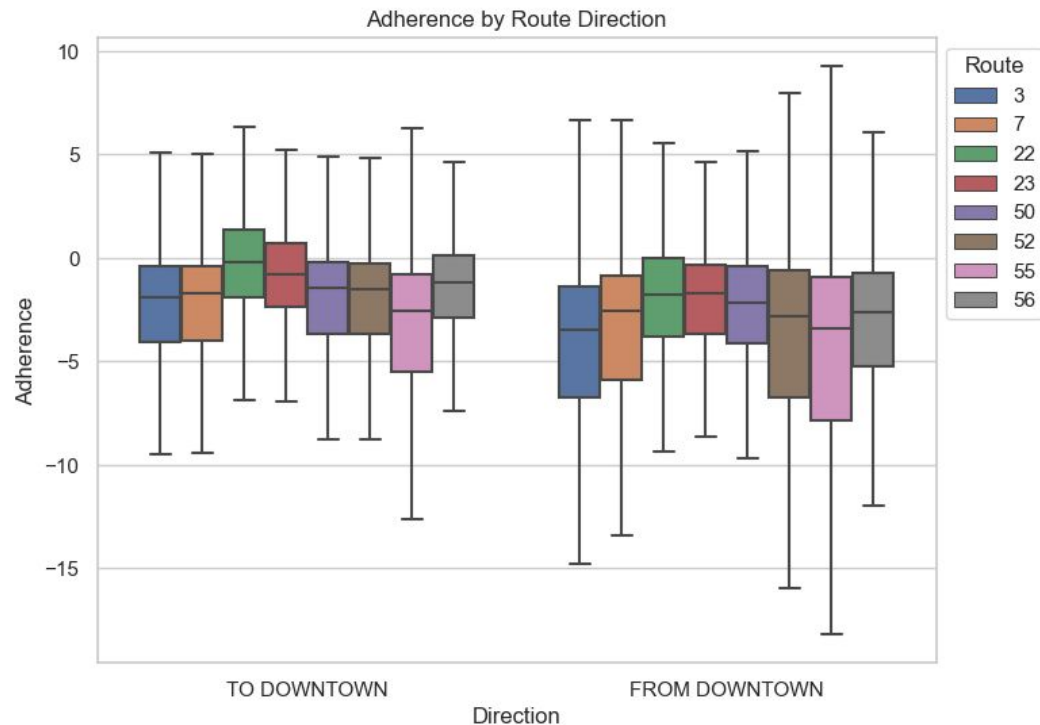
- Cutoff used: 6 minutes
- Most buses seem to be on time.
- Leaving early is relatively rare.
- Highest on-time was Route 23 (91%)
- Lowest on-time was Route 55 (72%)

Adherence by route and day of the week



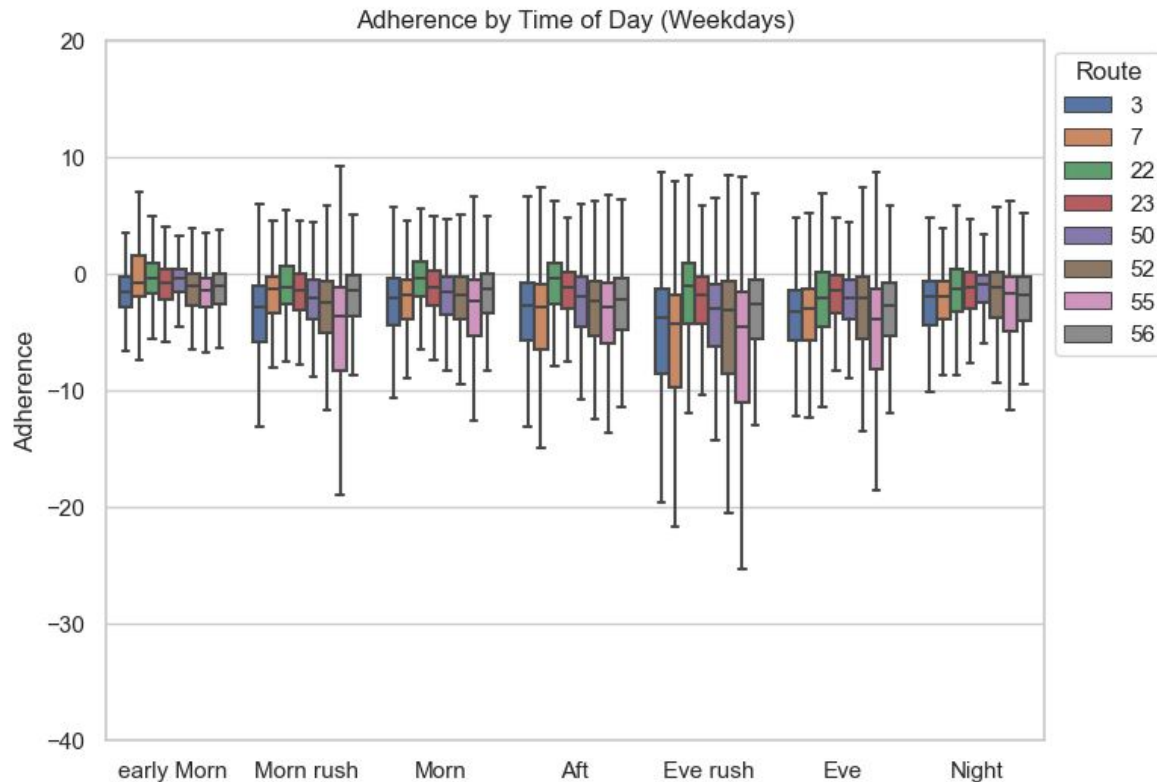
- Outliers not shown
- Median adherence is negative across the board
- Most variability in Route 55
- Route 22 seems to have the highest tendency to depart early.

Adherence by direction of travel



All routes have higher variability in the FROM DOWNTOWN direction.

Adherence by time of day (Weekdays)



Time periods:

early morning 3AM - 6 AM

morning rush 6AM - 9 AM

late morning 9AM -12 PM

afternoon 12 PM - 4 PM

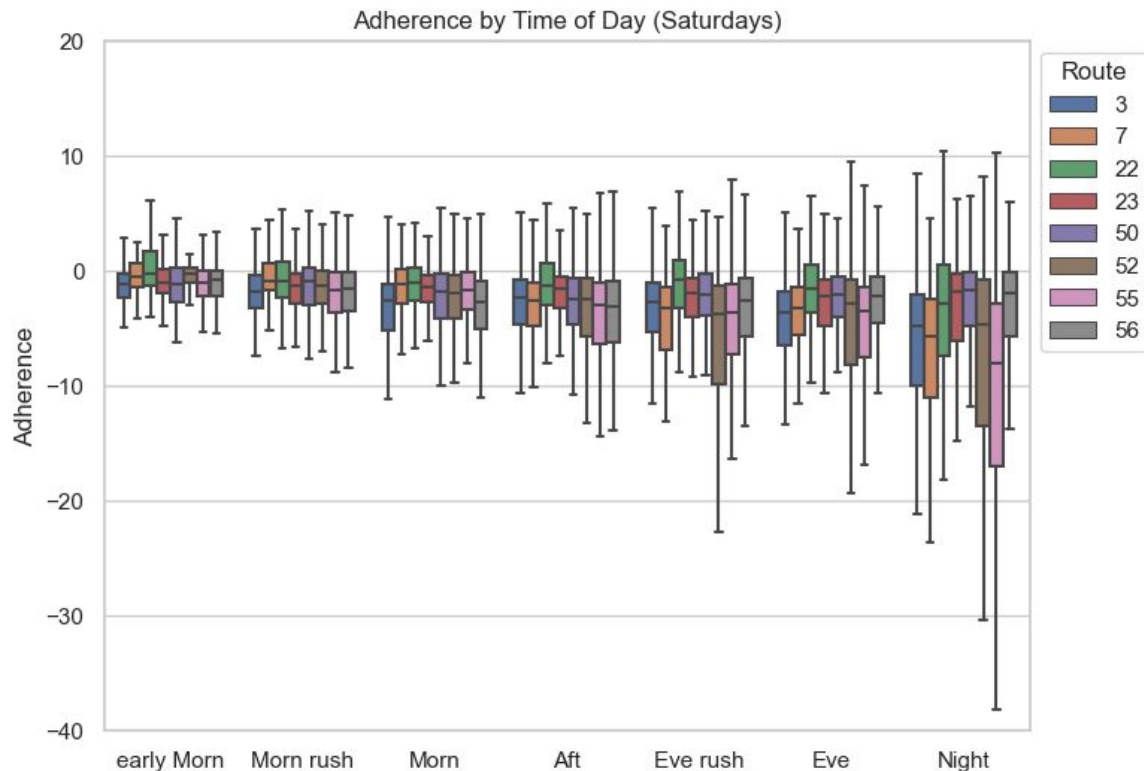
evening rush 4PM - 6 PM

evening 6PM - 10PM

late night 10PM +

Higher variability on morning and evening rushes

Adherence by time of day (Saturdays)



Time periods:

early morning 3AM - 6 AM

morning rush 6AM - 9 AM

late morning 9AM -12 PM

afternoon 12 PM - 4 PM

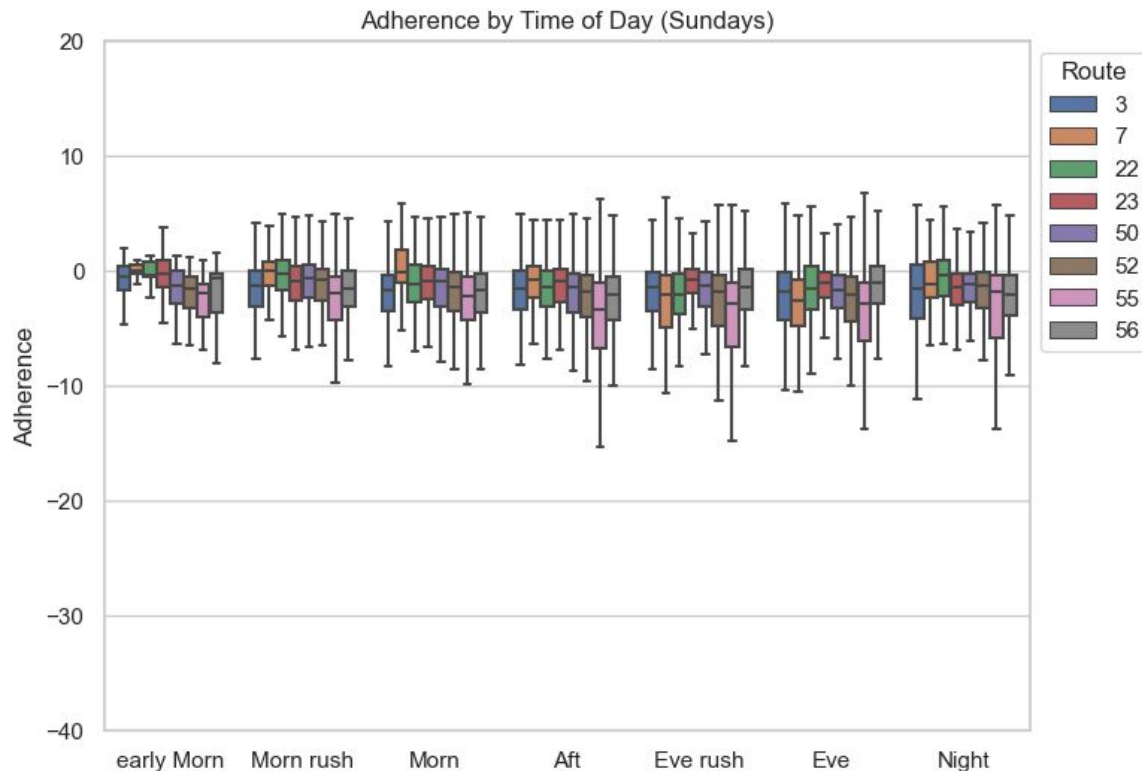
evening rush 4PM - 6 PM

evening 6PM - 10PM

late night 10PM +

Highest variability during late night, particularly for route 55

Adherence by time of day (Sundays)



Time periods:

early morning 3AM - 6 AM

morning rush 6AM - 9 AM

late morning 9AM - 12 PM

afternoon 12 PM - 4 PM

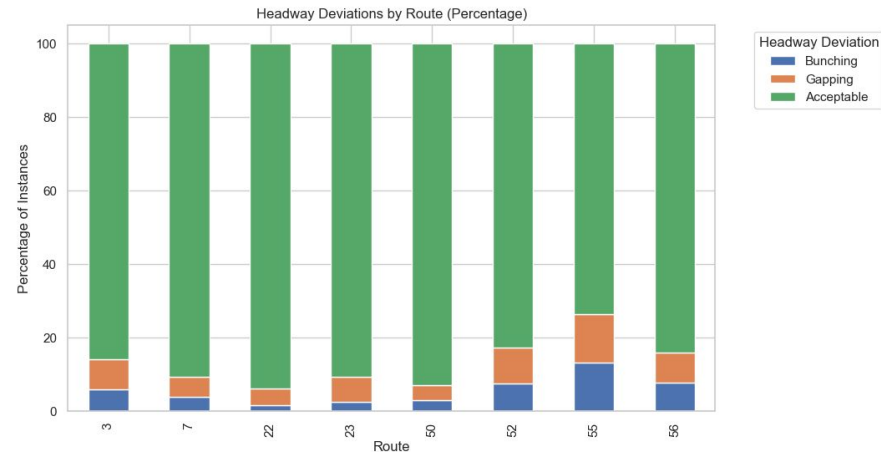
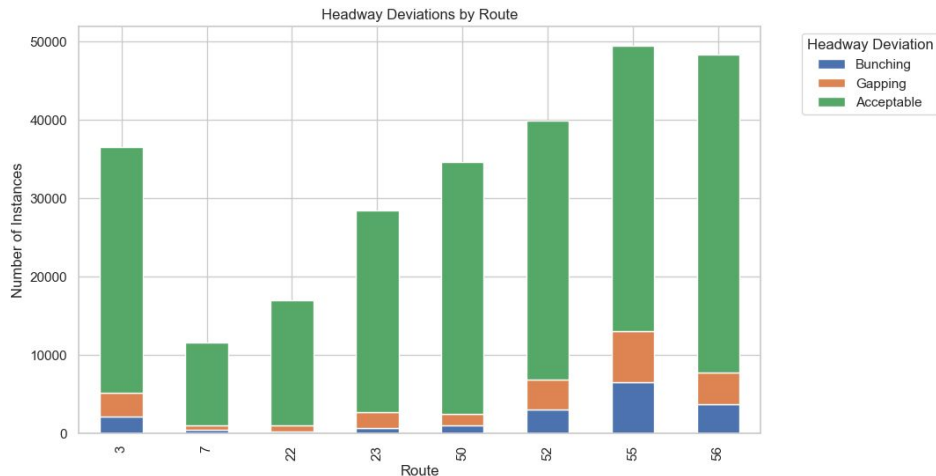
evening rush 4PM - 6 PM

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late night 10PM +

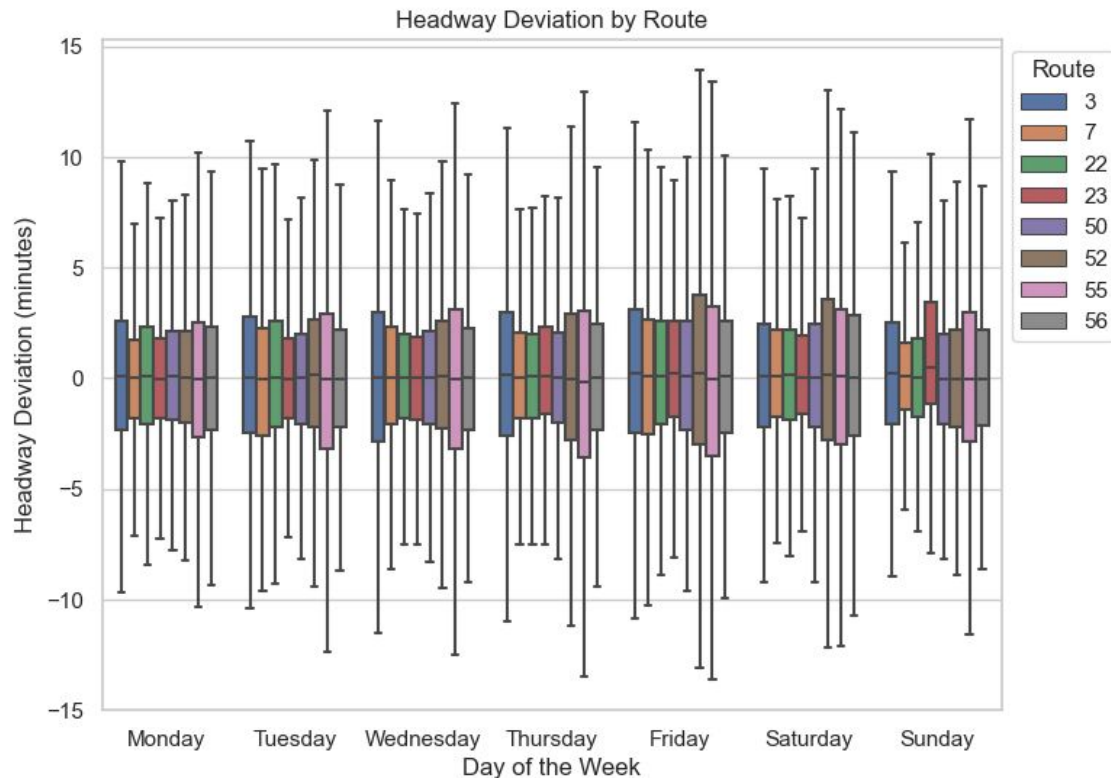
Uniform variability throughout the day.

Headway Deviation



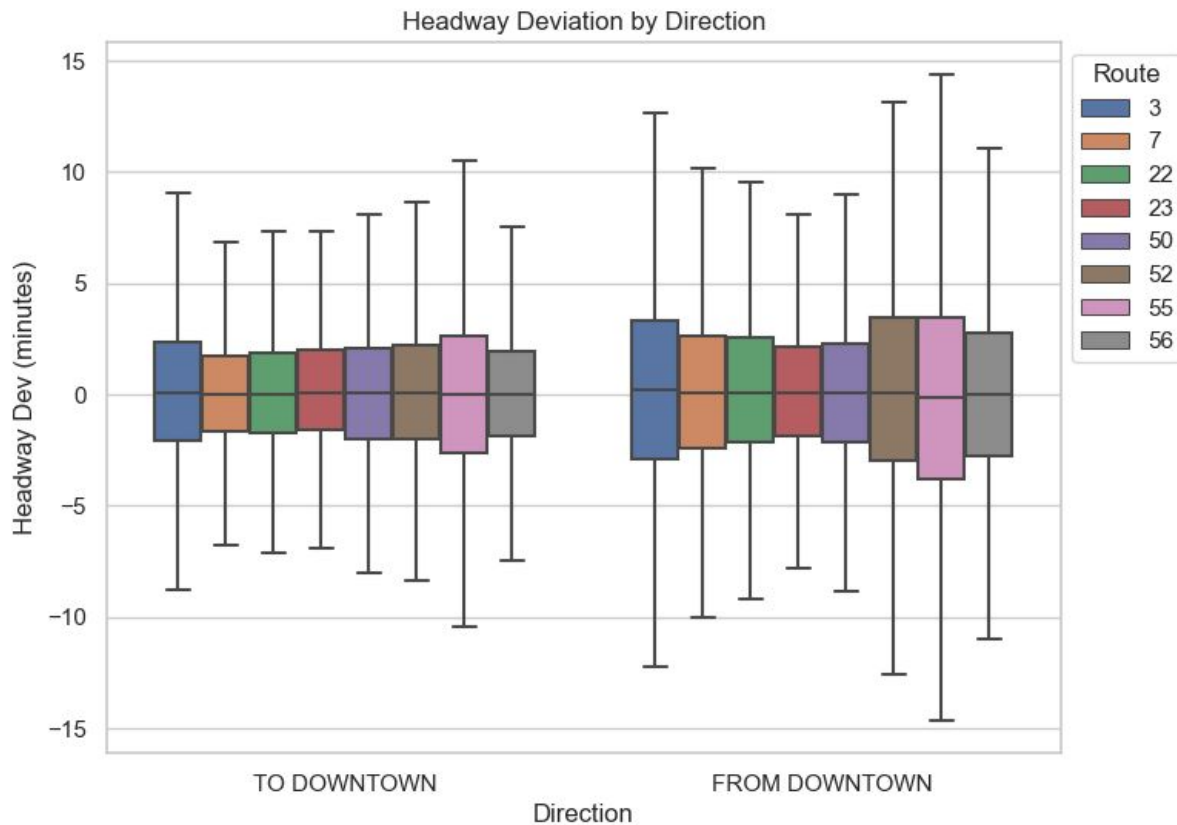
- Cutoff used: 50% of scheduled headway
- Most buses seem to be in the acceptable range
- Highest acceptable was Route 22 (93%)
- Lowest acceptable was Route 55 (73%)
- Highest bunching (13%) and gapping (13%) in route 55
- Lowest bunching (2%) and gapping (4%) in route 22

Headway Dev. by route and day of the week



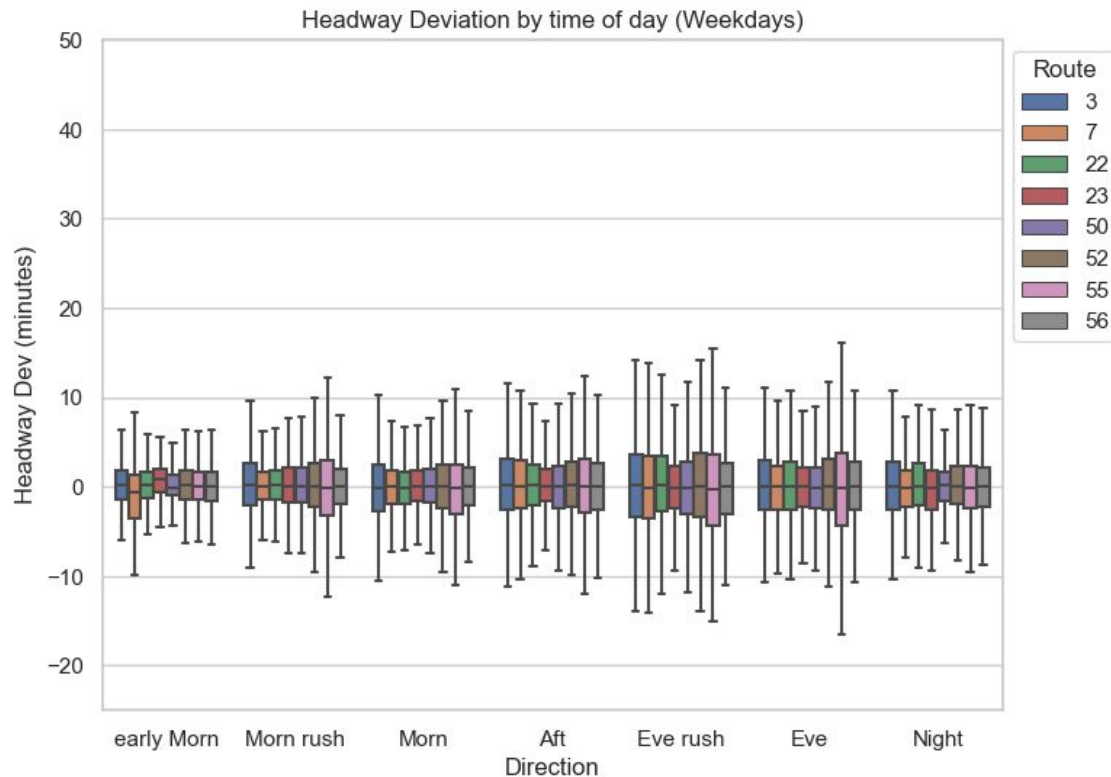
- Median headway dev is very close to 0 across the board
- Routes 52 and 55 seem to have the highest variability.

Headway Dev by direction of travel



All routes have higher variability in the FROM DOWNTOWN direction.

Headway Dev by time of day (Weekdays)



Time periods:

early morning 3AM - 6 AM

morning rush 6AM - 9 AM

late morning 9AM - 12 PM

afternoon 12 PM - 4 PM

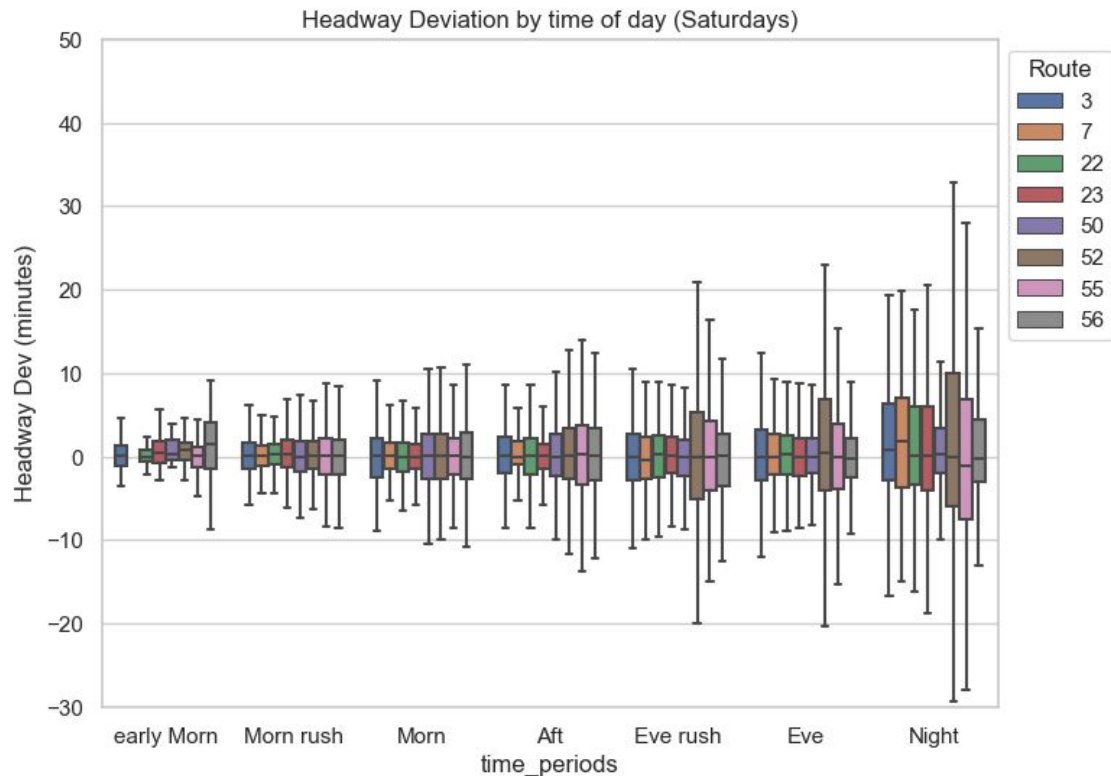
evening rush 4PM - 6 PM

evening 6PM - 10PM

late night 10PM +

Highest variability during the evening rush

Headway Dev by time of day (Saturdays)



Time periods:

early morning 3AM - 6 AM

morning rush 6AM - 9 AM

late morning 9AM - 12 PM

afternoon 12 PM - 4 PM

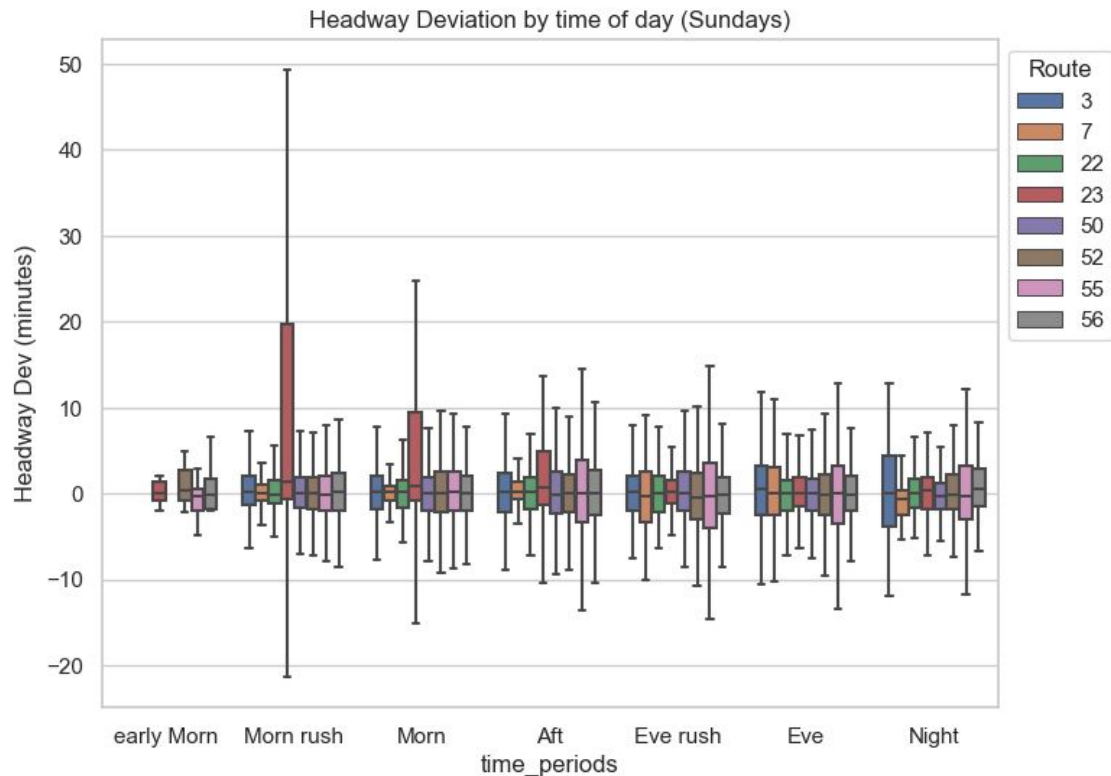
evening rush 4PM - 6 PM

evening 6PM - 10PM

late night 10PM +

Highest variability during the late night hours,
particularly for routes 52 and 55

Headway Dev by time of day (Sundays)



Time periods:

early morning 3AM - 6 AM

morning rush 6AM - 9 AM

late morning 9AM - 12 PM

afternoon 12 PM - 4 PM

evening rush 4PM - 6 PM

evening 6PM - 10PM

late night 10PM +

High variability for route 23 during the morning hours.

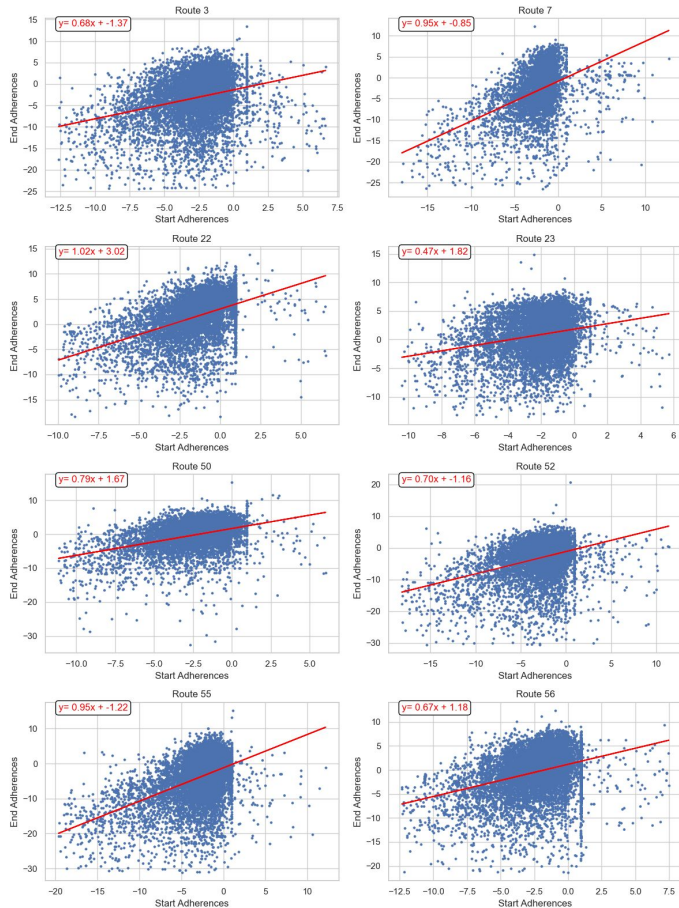
Complete trips

- We extracted all the complete trips from the data (a complete trip starts with TRIP_EDGE=1 and ends with a TRIP_EDGE=2 and has the same TRIP_ID throughout).
- Found 67411 complete trips.
- Allows us to analyze individual trips.

Starting vs Ending Adherences

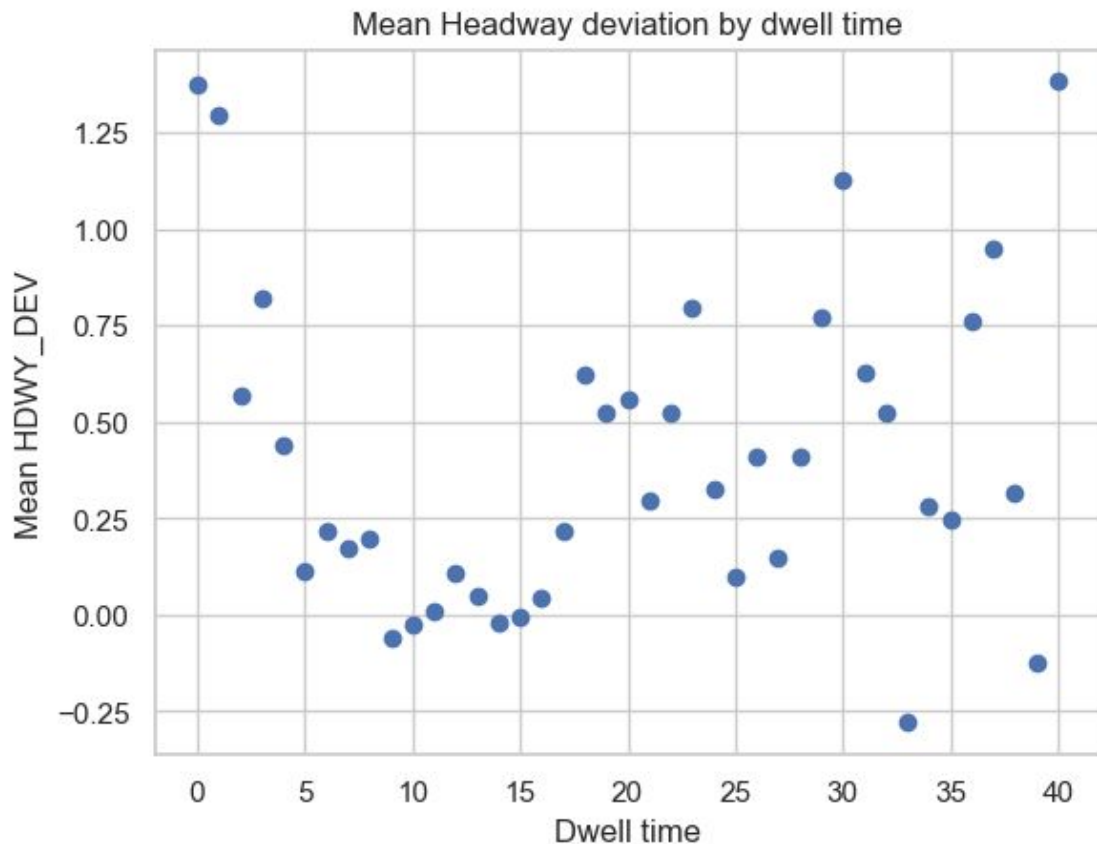
- We plot the start adherence of each trip against the end adherence of the same trip
- Since the data includes a lot of outliers we restrict each variable to three standard deviations of the mean.

Starting vs Ending Adherences by Route



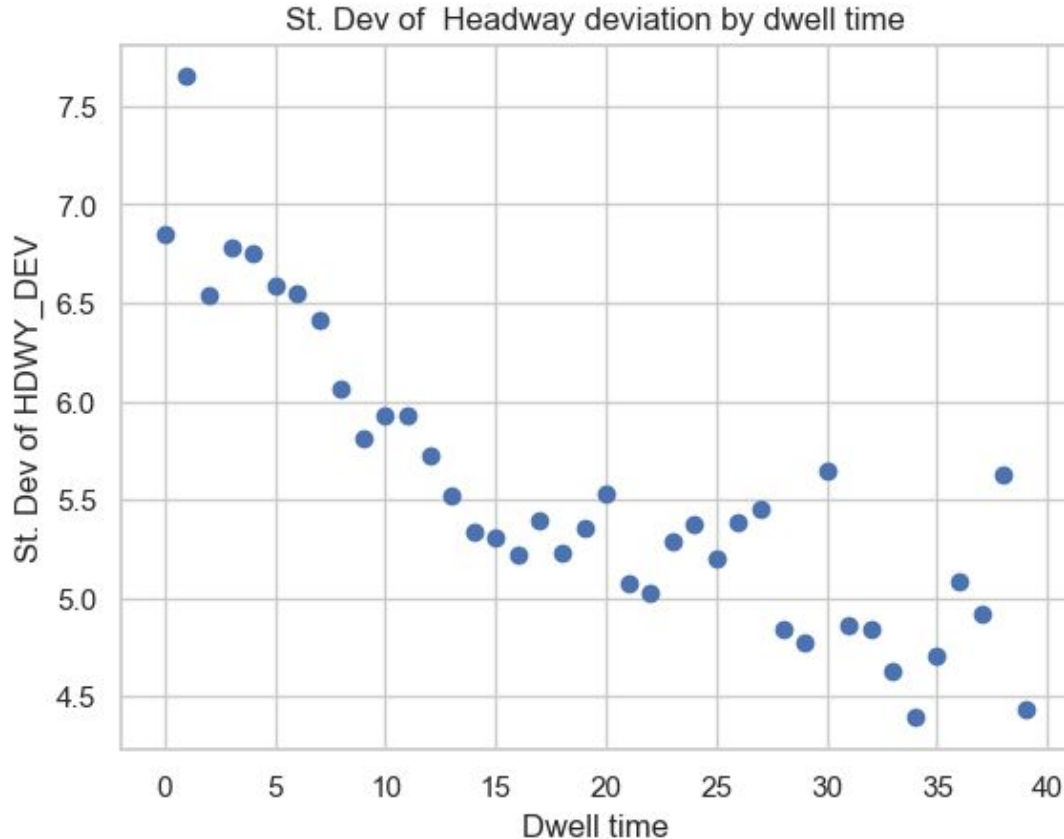
- We plotted end adherences vs start adherences for each route, and show regression lines.
- Correlation coefficients are ~ 0.40 .
- Regression slopes range from 0.47 (route 23) to 1.02 (route 22)
- Lower regression coefficients on some routes (particularly 3, 23 and 56) imply that if the bus started late it will not be as late at its destination.

Mean Headway Dev vs Dwell Time



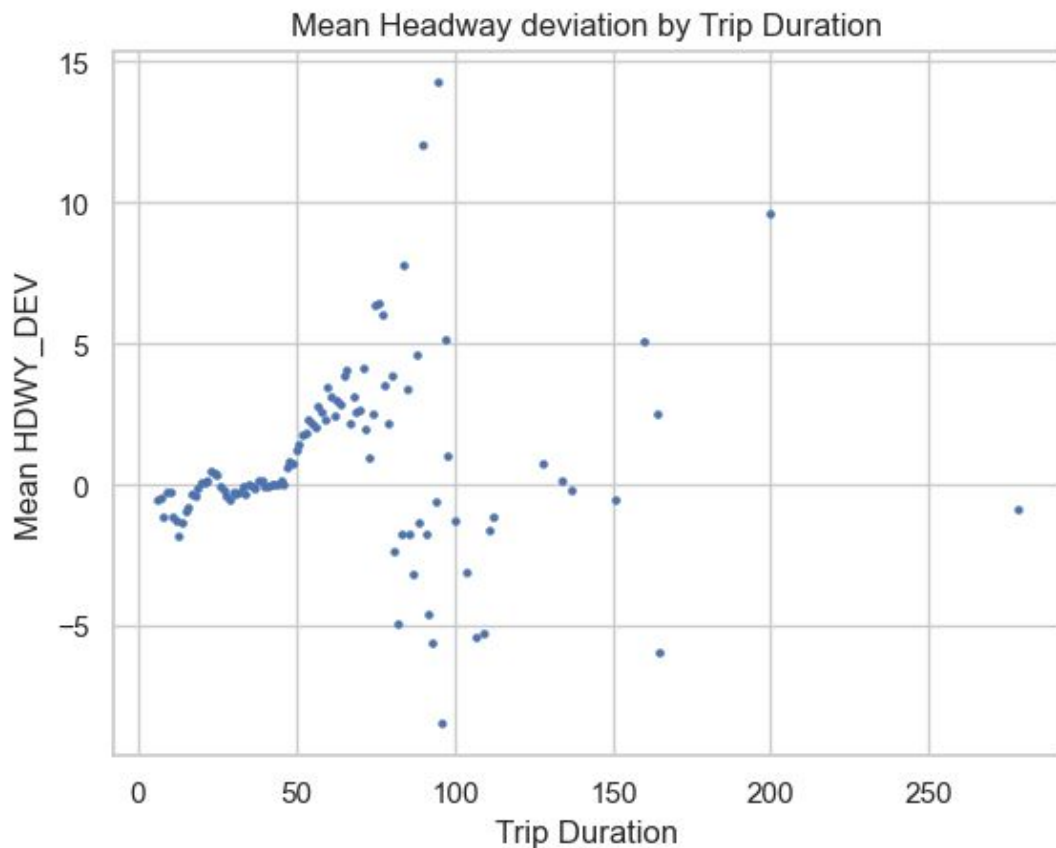
- We calculated the mean headway deviation (at the end of the trip) for all trips with a given (rounded) dwell time (at the start of the trip).
- Mean Headway deviation seems to be close to 0 for all dwell times.

Variability in Headway Dev with Dwell Time



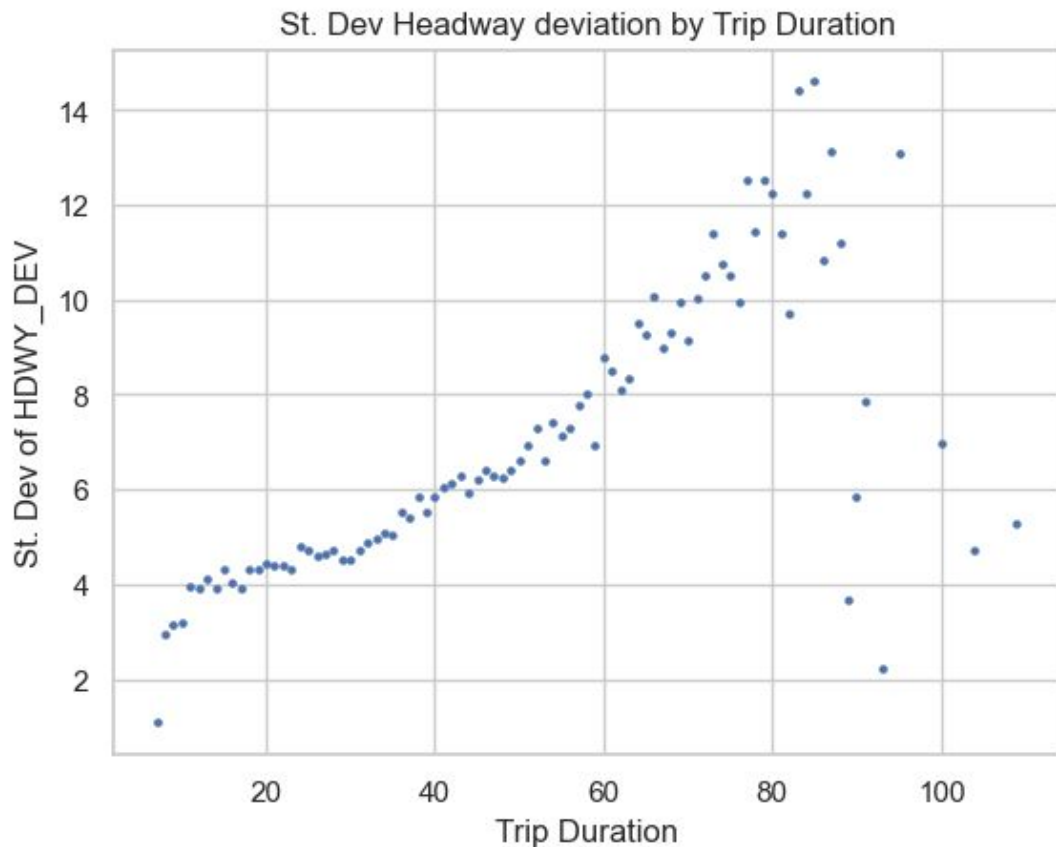
- Plotting the std. dev. of the headway deviation (at the end of the trip) for all trips with a given (rounded) dwell time (at the start of the trip).
- Variability in Headway deviation clearly decreases as the layover time increases, but the relationship is tenuous after about 15 mins

Mean Headway Dev vs Trip Duration



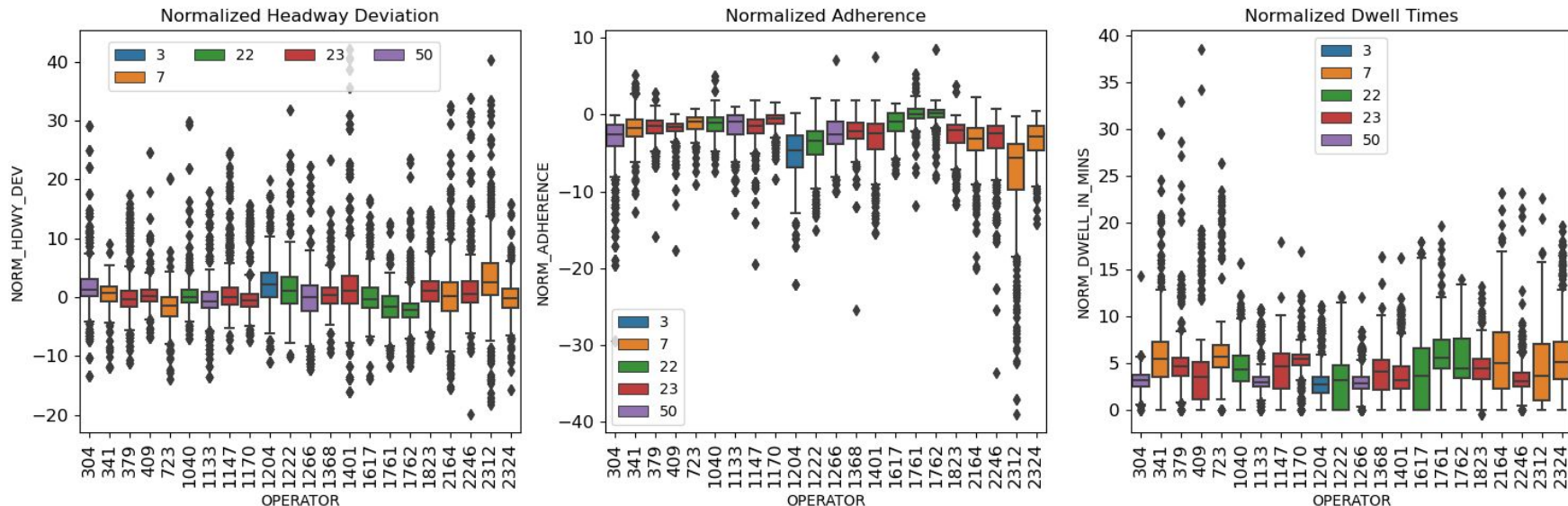
- We calculated the mean headway deviation (at the end of the trip) for all trips with a given (rounded) duration.
- Mean Headway deviation seems to be between -5 to +5 mins for trips of all durations

Variability in Headway Dev with Duration



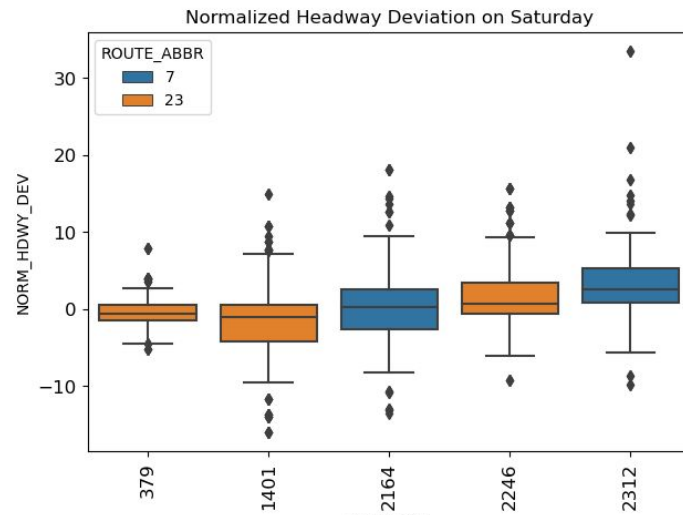
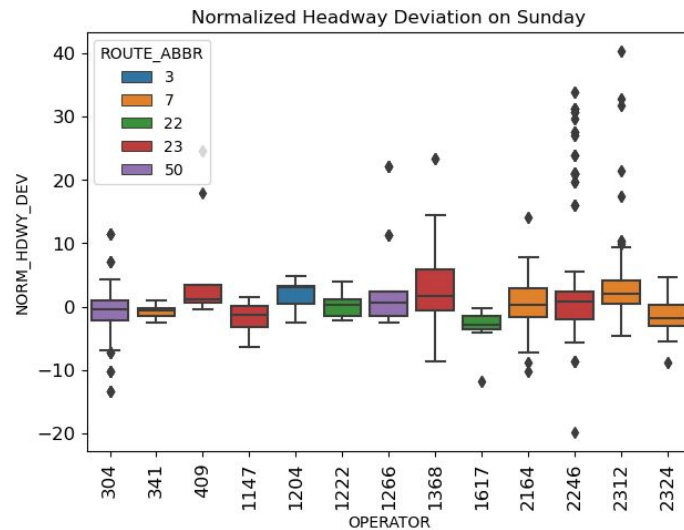
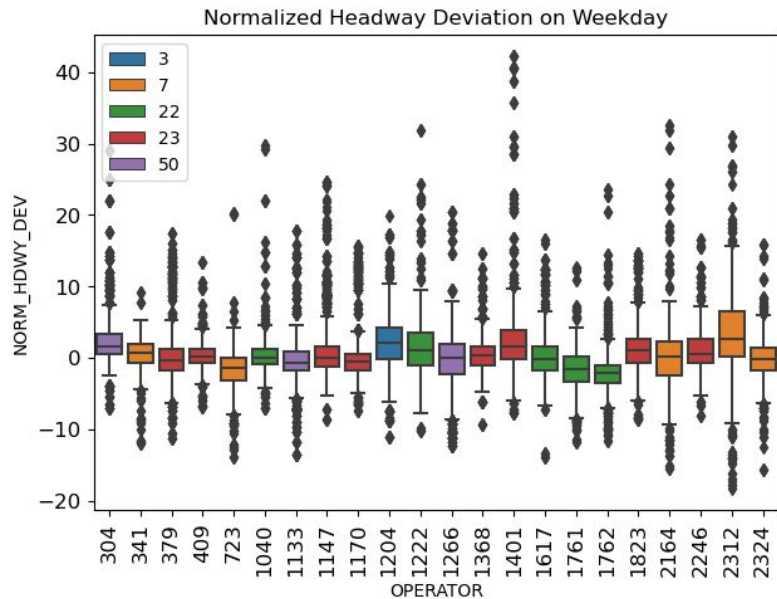
- Plotting the std. dev. of the headway deviation (at the end of the trip) for all trips with a given dwell time (at the start of the trip).
- Variability in Headway deviation seems increase as the trip duration increases up till a duration of ~80 mins.

Operator vs Headway Deviation

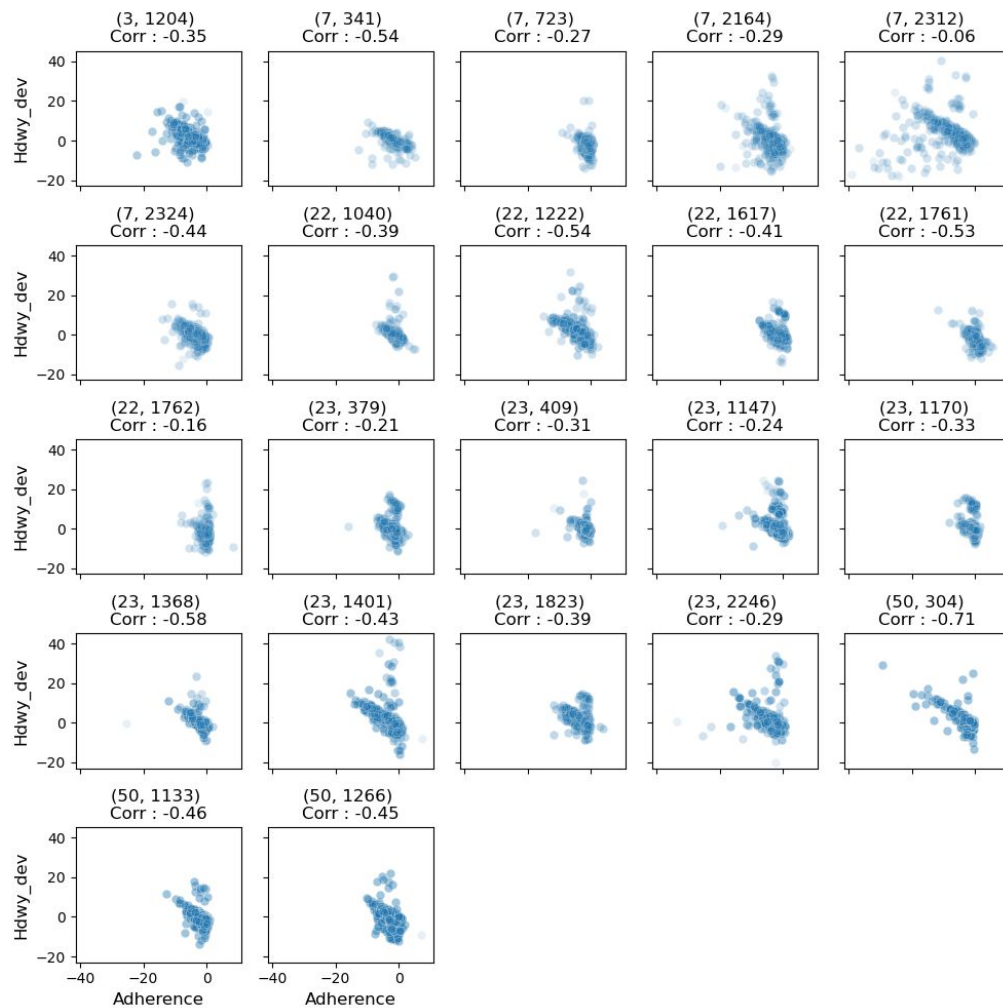


1. First the outliers are removed by taking only 99.9th percentile of the dataset.
2. Only those data for which each operator for that individual route has >400 unique trips are chosen
3. The headway deviations, adherences and dwell times are normalized for the combination of route and operator for the trip.

Split by day of the week



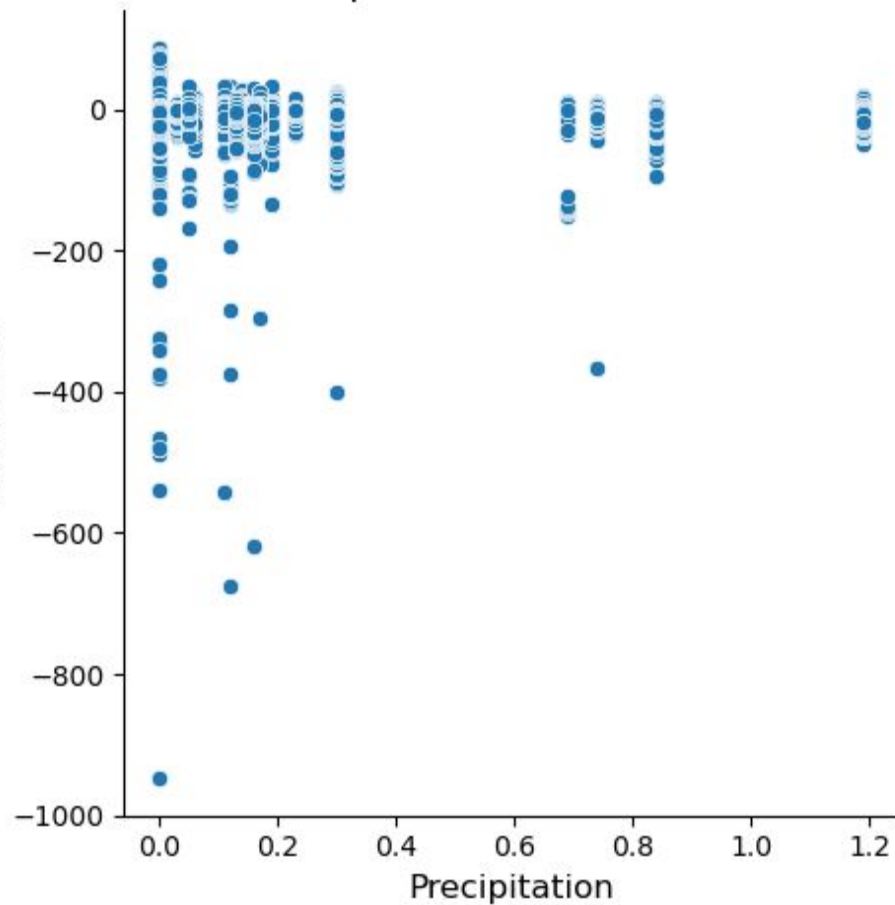
Headway deviation vs Adherence by operator/route



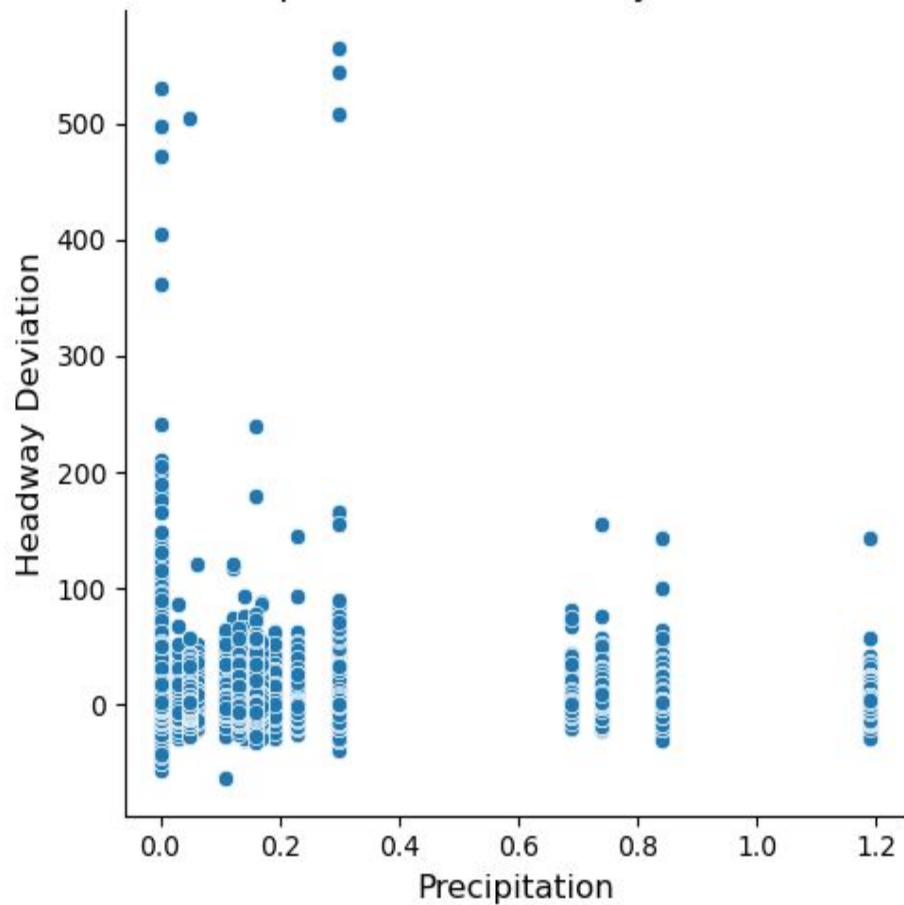
Weather

- Days were categorized by amount of precipitation:
 - None
 - less than 0.5"
 - Up to 1"
 - Over 1"
- Data limited to 3 standard deviations from the mean

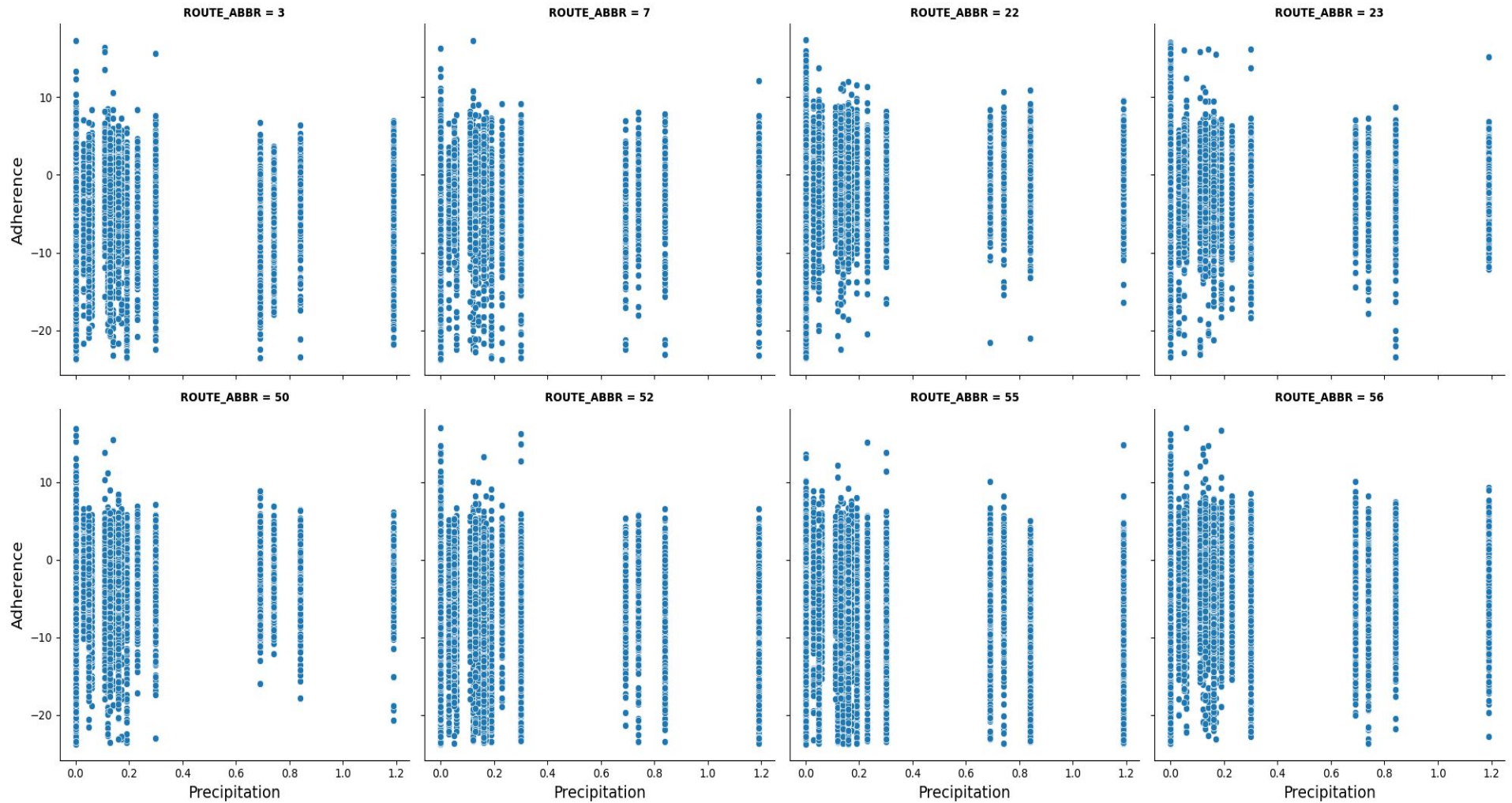
Precipitation vs Adherence



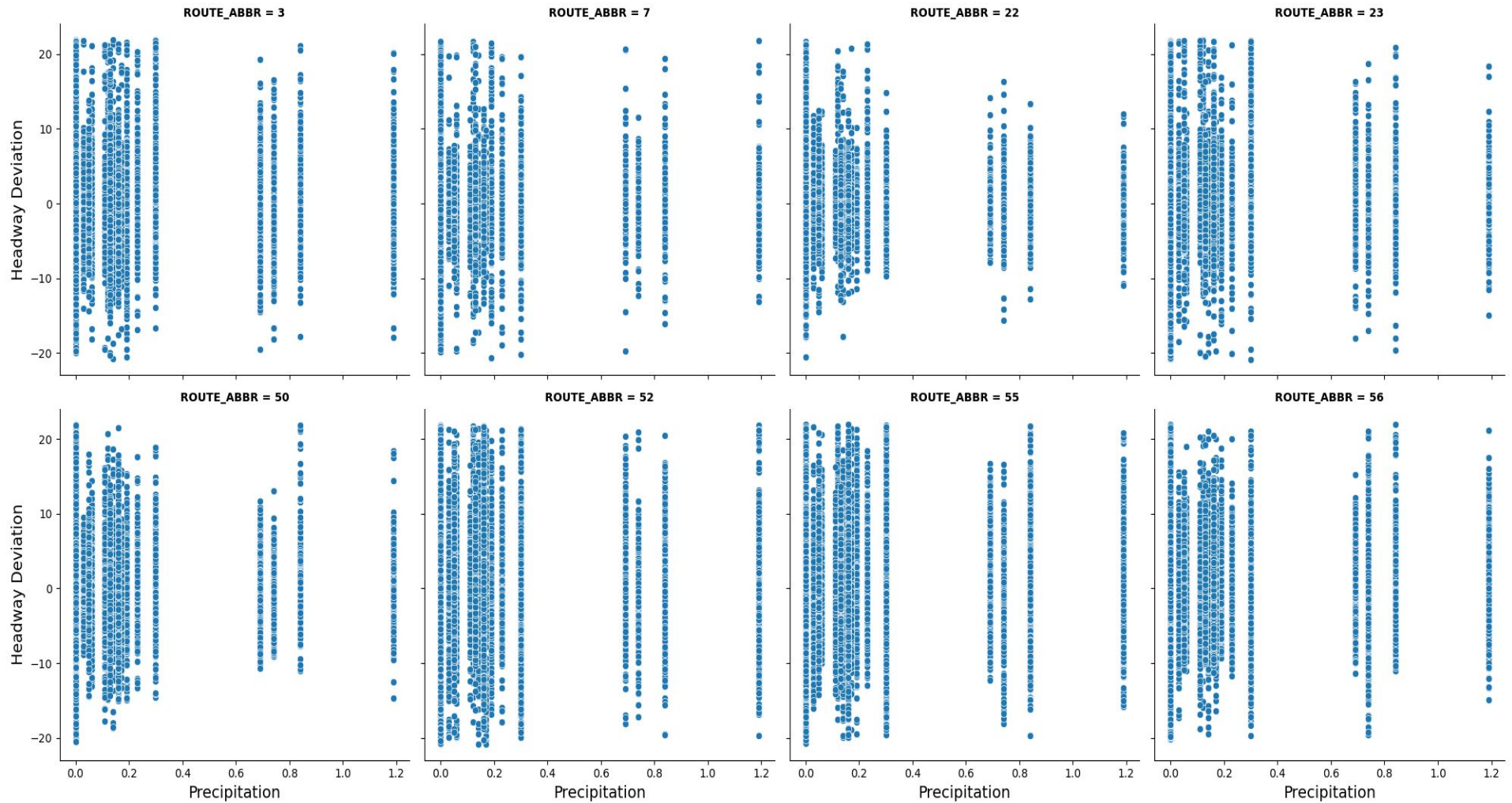
Precipitation vs Headway Deviation



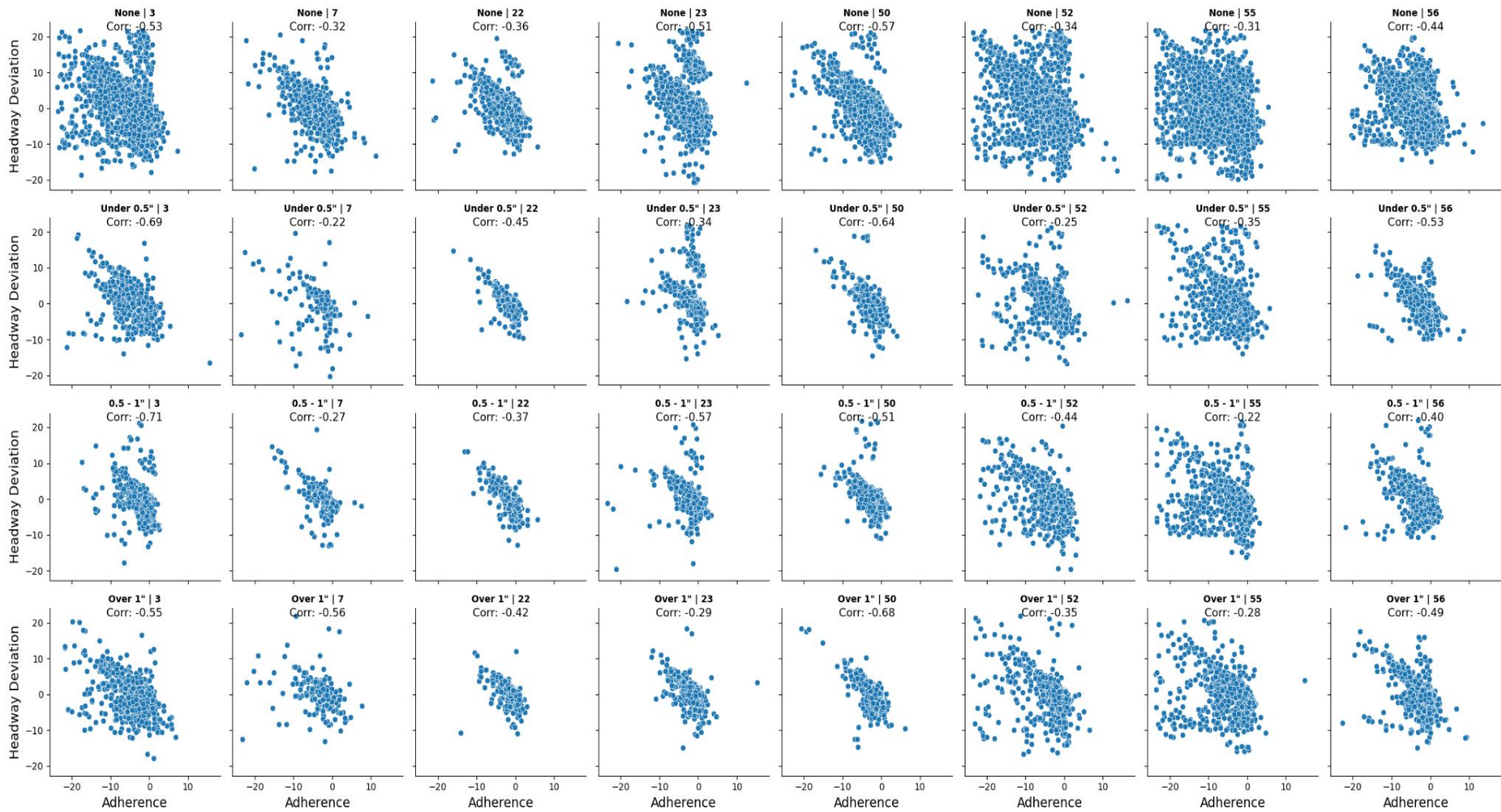
Precipitation vs Adherence by Route



Precipitation vs Headway Deviation by Route



Adherence vs Headway Deviation by Rainfall and Route



Conclusions

- Most buses are on time and have acceptable headway
- Adherence and Headway Deviation have the highest variability during the morning and evening rush hours and Saturday late nights
- Starting and ending adherences for a given trip are correlated.
- Variability of Headway deviation decreases as the dwell time increases till about 15 minutes
- Variability in Headway deviation increases as the trip duration increases till about 80 minutes
- Operators are generally on time with very minimal headway deviation most of the time. However, some routes and operators tend to have more extreme values than others.
- Moderate precipitation appears to have no effect on adherence or headway

Data Sources

- Bus adherence data provided by WeGo
- Weather data
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