

# Analysis of GPS Fleet Tracking Data to Infer Commercial Vehicle Travel Patterns in Ontario

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P13: Freight Data and Planning

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# Introduction

- WSP is developing a province-wide model for the Ministry of Transportation of Ontario (MTO), which includes:
  - Commodity flow model
  - Long-distance truck model
  - Tour-based urban truck model
- MTO has invested heavily in freight data collection to better understand how freight is travelling on Ontario roads
  - Commercial vehicle survey
  - GPS data from third party sources

# Objectives

- Develop a software tool that processes GPS data to travel diaries of stops, trips and tours
- Available data
  - Latitude, longitude and timestamp of vehicle history
  - Other spatial data (e.g. road maps)
- Distributions of truck travel behavior in Ontario:
  - Stop durations
  - Trip lengths and durations
  - Tour number of stops, start times, lengths and durations

# Processing Algorithm

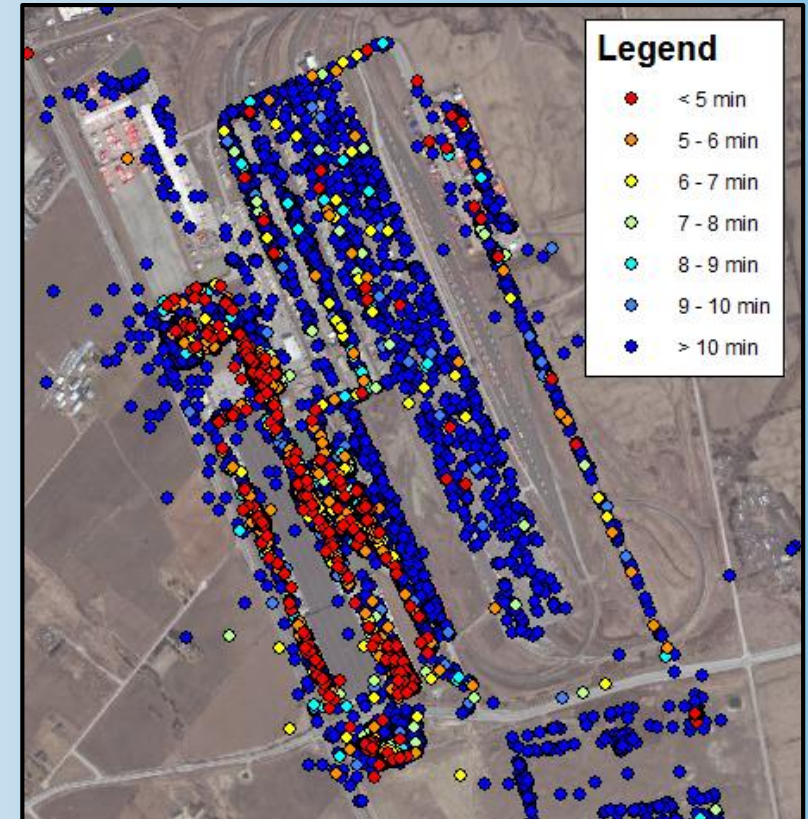
# High-Level Structure

1. Identify stop candidates
2. Combine nearby stop candidates
3. Identify likely depots
4. Create trips and tours

# Identify Stop Candidates

Keep stop candidate if:

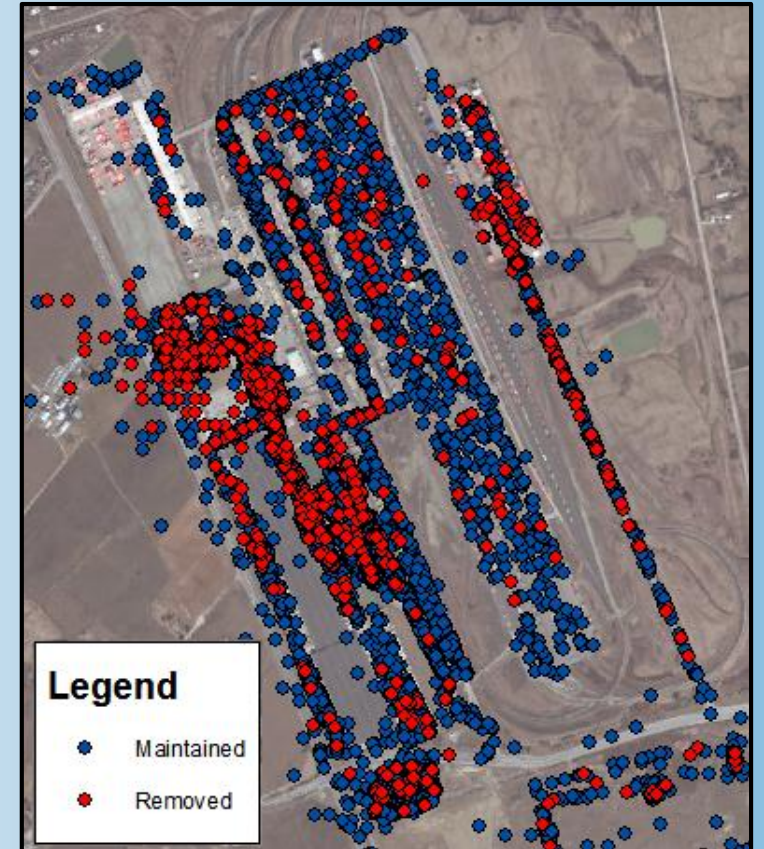
1. Not located within freeway buffer
2. Stays below 5 kph for at least 4 minutes
3. If on a major road, and the duration is below 10 minutes, then the average speed in the stop must be below 1.8 kph



Sample Shaw data at a rail intermodal yard

# Combine nearby stop candidates

- Threshold depends on land-use densities
- Manually identified large plots (e.g. rail yards, airports and customs facilities)



Removed stops at this rail intermodal yard.

# Depot Identification

## Why?

- Equivalent to 'home' in passenger travel
- Behavior at depots is different than other stops
- Used to identify tours

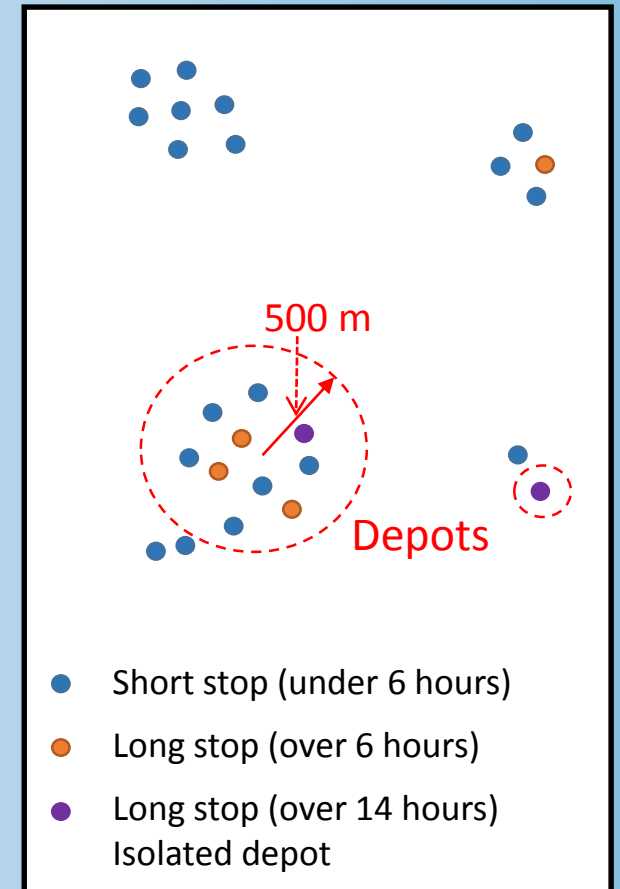
## How

- No vehicle, shipper or carrier information are available
- Number of stops
- Longer stops



# Depot Identification

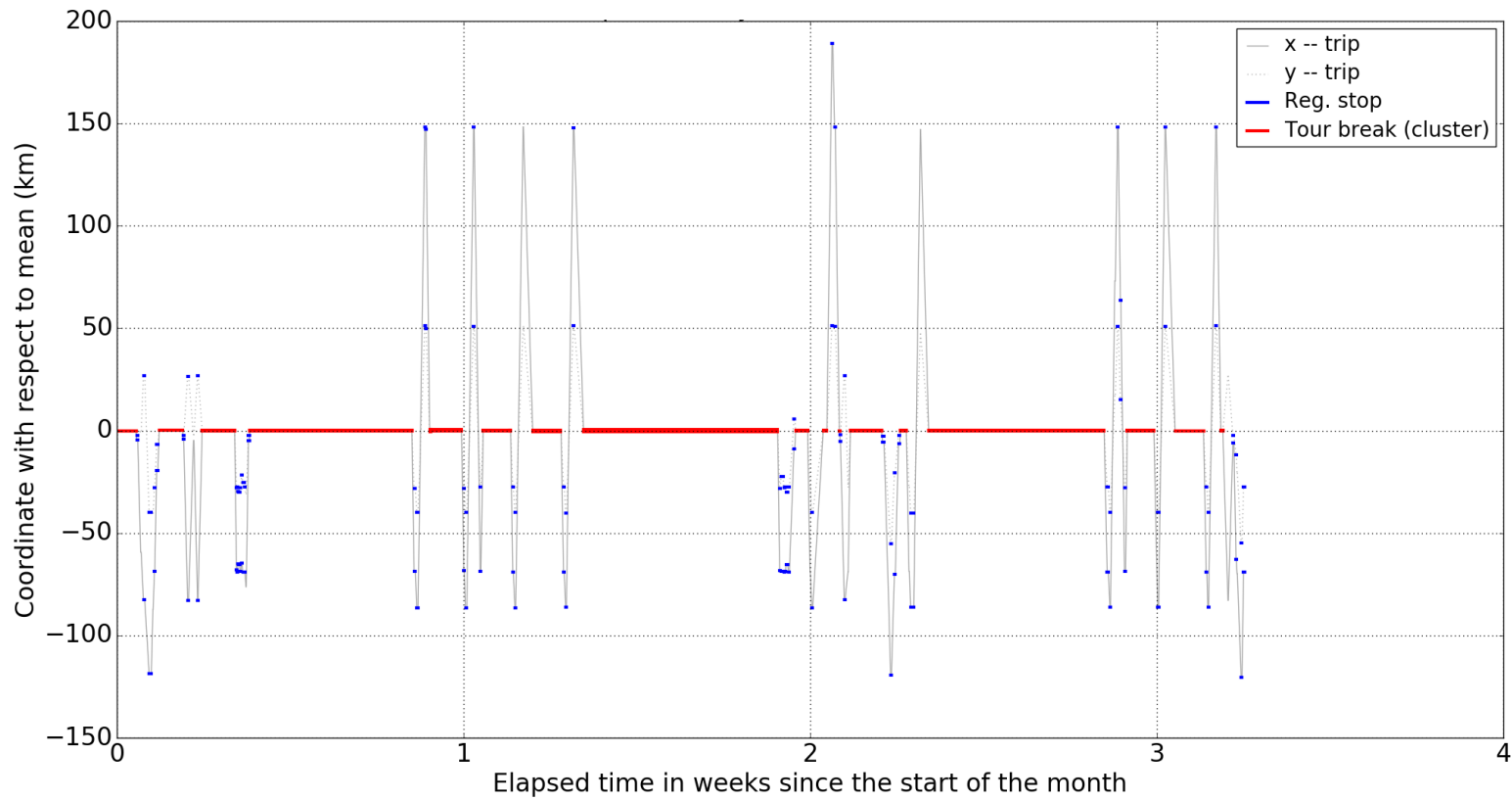
1. Cluster long stops (> 6 hour duration)
  - HAC, cut at a distance threshold of 400 m
2. Identify clusters with at least:
  - 3 long stops
  - 4% of all stops by vehicle
  - if no such clusters exist, take the cluster with the most long stops
3. Find all stops within 500 m of the center of identified clusters
4. Mark all remaining stops over 14 hours as *isolated* depots



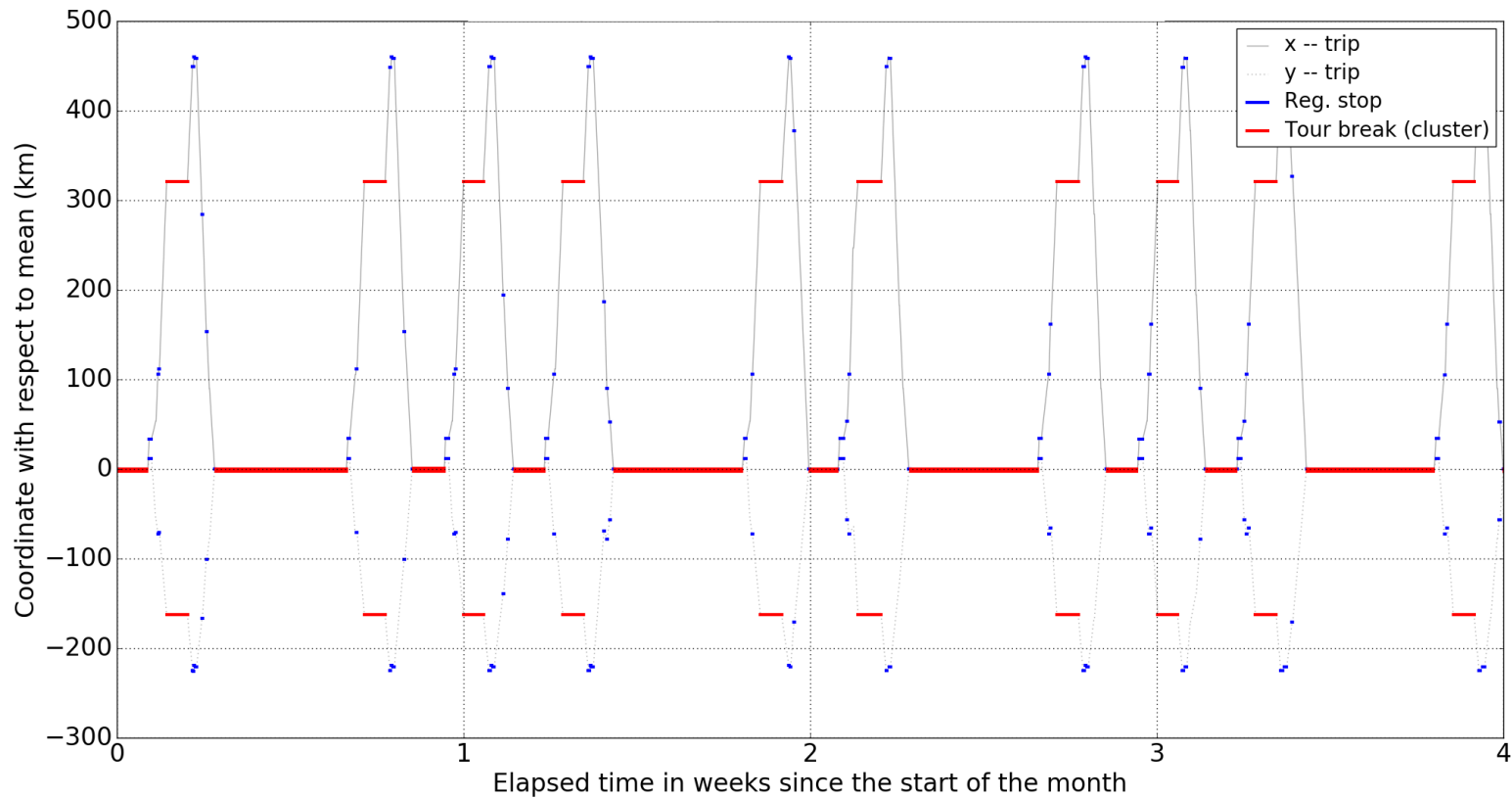
# Creating Trips and Tours

- Combine adjacent stop candidates where both are at depots and intervening trip distance is  $< 2$  km
- Create trips between remaining stop candidates, joining trip segments at removed stop candidates
- Stops are created to separate trips
- Build tours between depots

# Depot Identification – Parameter testing



# Depot Identification – Parameter testing



# Test-driven development

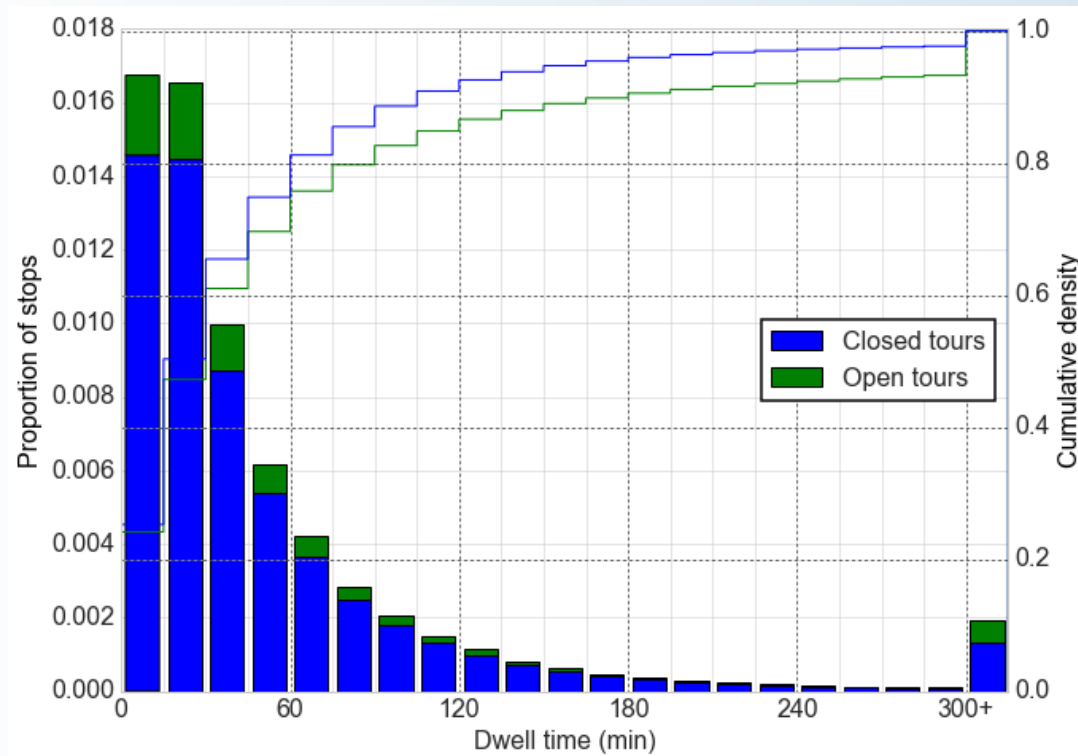
- Almost 50 unit tests developed to test code accuracy and consistency
- Example tests
  - If stop has an inbound trip, check that this trip arrives at the same stop
  - Test stop duration = departure time – arrival time  
(can do the same for trips and tours)
  - Depot identification: all depots meet identification criteria

# Initial Results

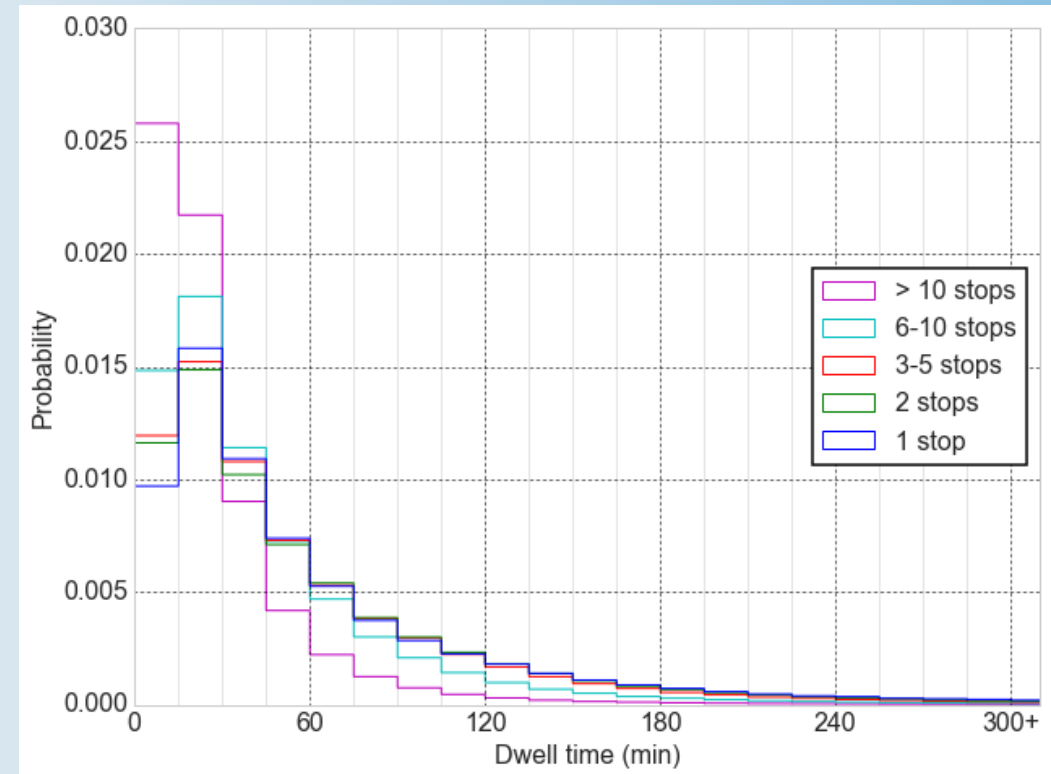
Truck behavior parameters for truck microsimulation models, processed from Shaw data (Jan. 2014 – Jun 2015)

# Stop dwell times

## All stops

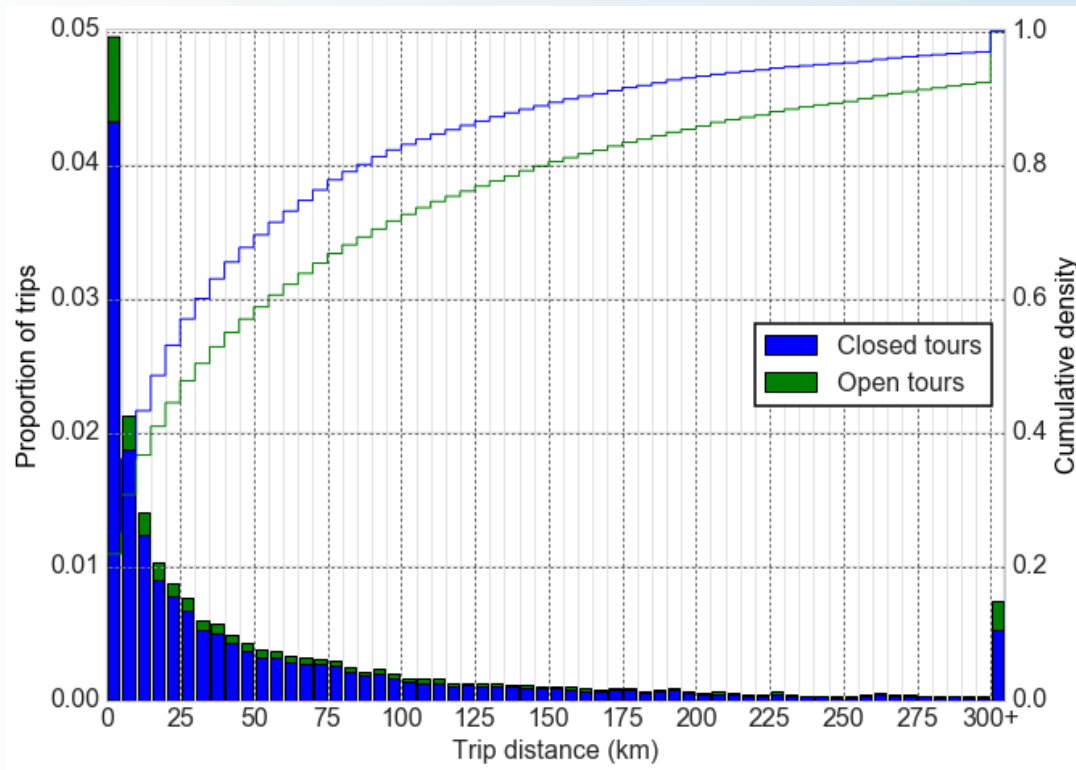


## Segmented by number of stops in tour

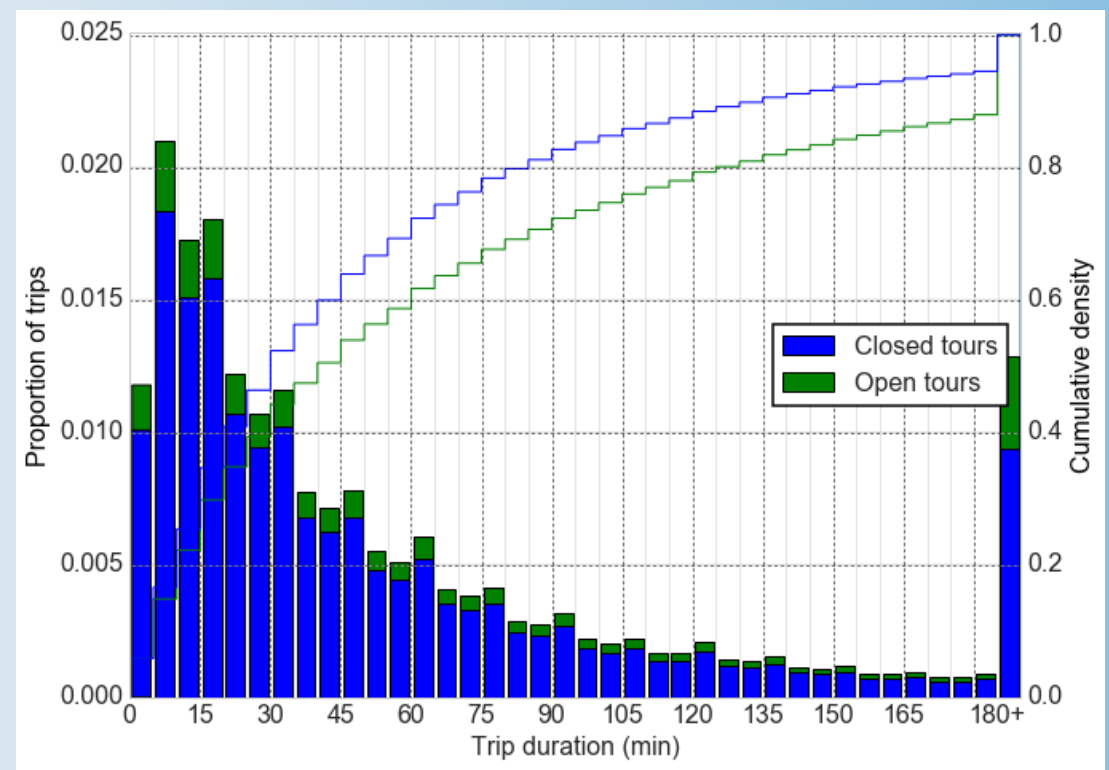


# Trip distances and durations

## Trip distances



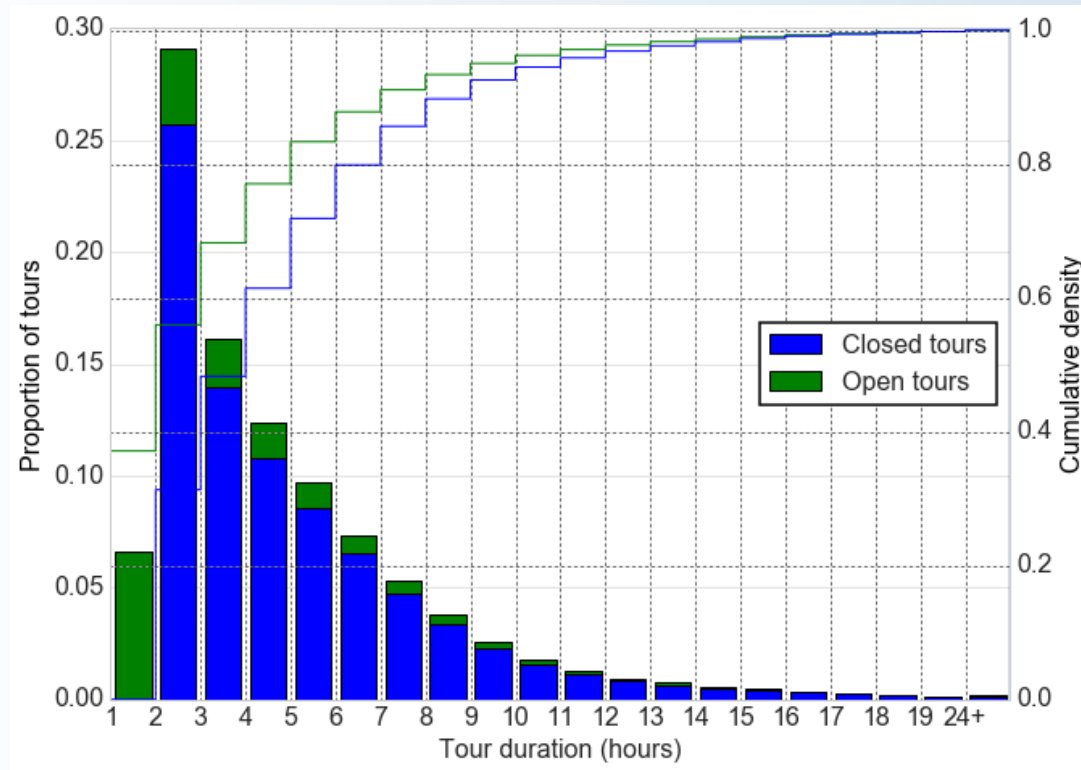
## Trip durations



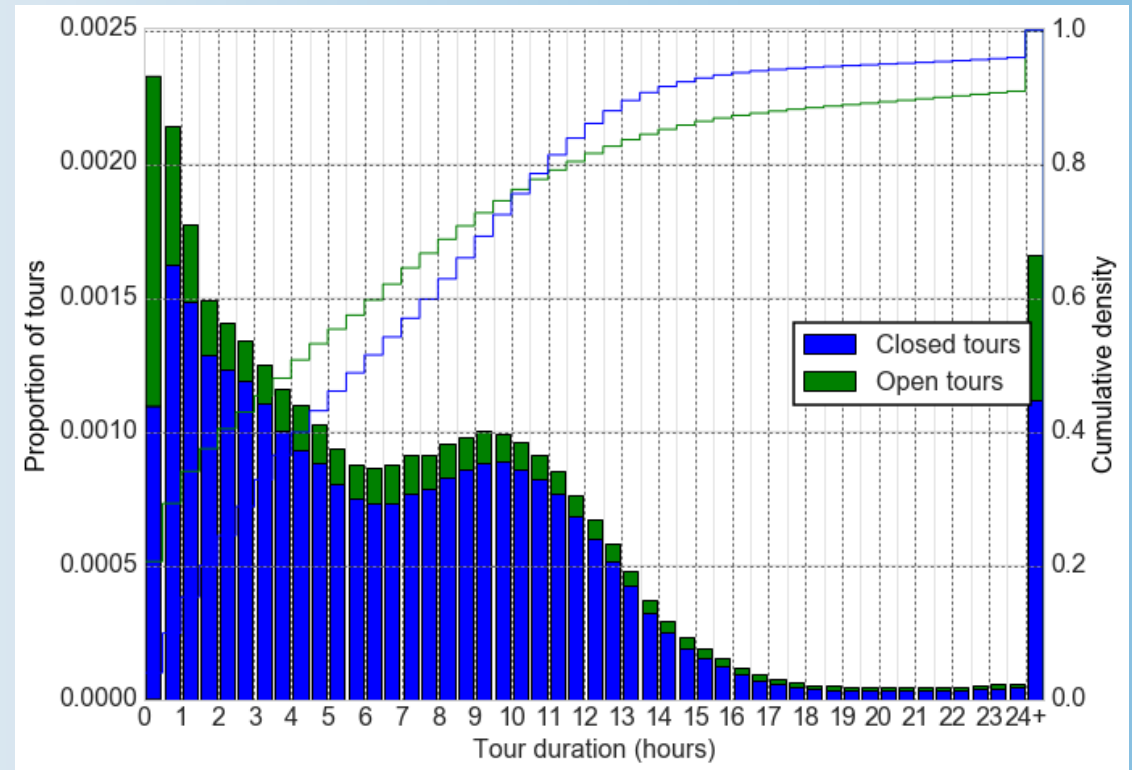


# Tour number of trips and durations

## Tour number of trips

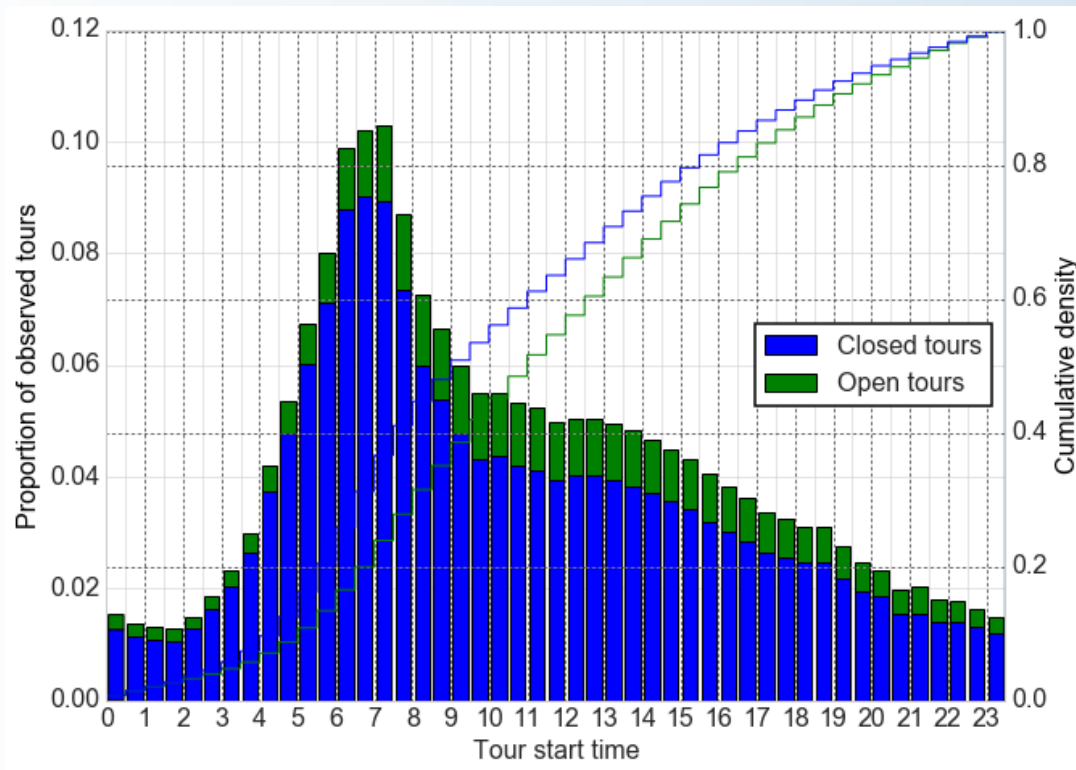


## Tour durations

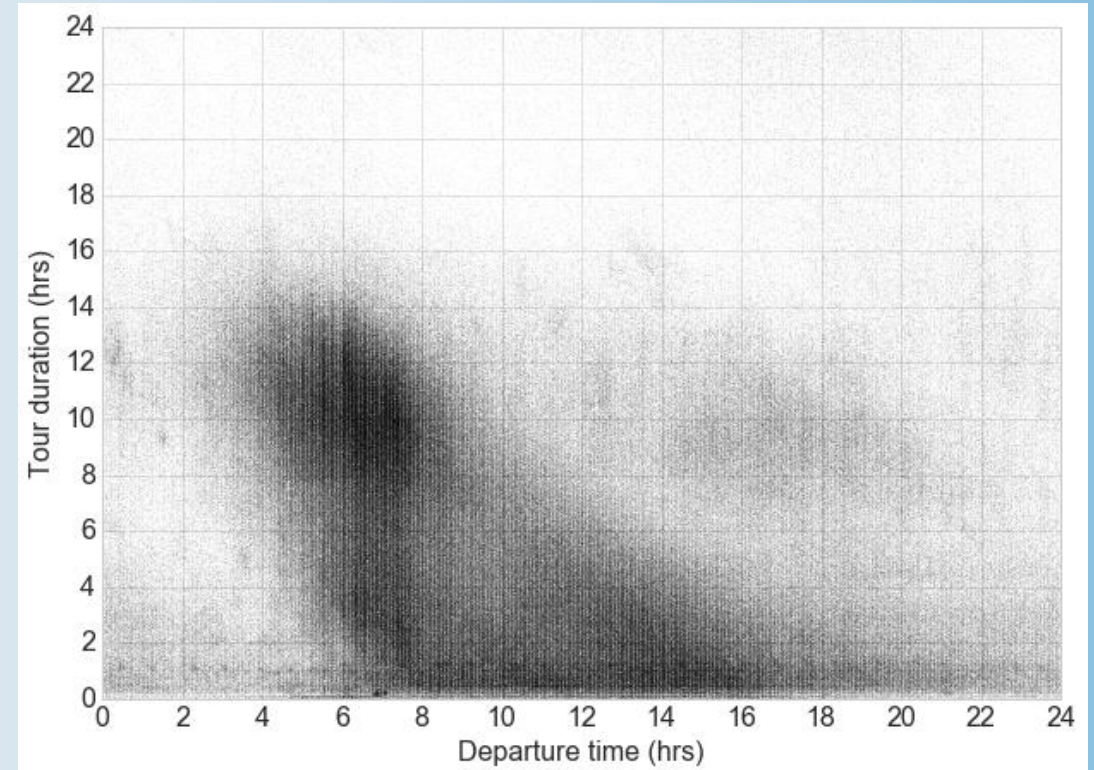


# Tour departure times

## Tour departure times



## Tour departure times vs duration



# Conclusions

- MTO is looking to use GPS data to better understand truck travel demand on road network
- WSP has created software to process the raw GPS data into a travel diary of stops, trips and tours
- Highlighted sample stop, trip and tour distributions

# Next Steps

## **Improved understanding of truck demand on Ontario roads**

- Use GPS data to show (heavily aggregated) truck travel demand
- GPS expansion using truck road counts
- Fuse GPS data with Commercial Vehicle Survey to improve understanding of commodity flows

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