# Analysis of Freight Tours in a Congested Urban Area Using Disaggregated Data: Characteristics and Data Collection Challenges

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# Motivation

- Confidentiality issues are usually an insurmountable barrier that precludes the collection of detailed and complete freight data.

- Understandably, companies are unwilling to disclose any type of information that may be used by competitors or that may infringe customers' rights regarding privacy, proprietary data, or security

# Motivation

- If LTL disaggregated tour data is available, what can we learn from the disaggregated data?
- Is several months of daily truck data in a congested urban area enough for operational purposes (route design) ?
- How much information is needed for adequate LTL route planning?

# A Case Study of LTL Deliveries in Sydney

# LTL Sydney Data

- The routing data to be presented in the next slides was extracted from truck activity sheets over an eight-month period.

- The data corresponds to less than truckload (LTL) routes of a twelve-ton truck, making deliveries to companies in the retailing, service, and manufacturing sectors.

# LTL Sydney Data

- The data was provided by a freight forwarding company based in Botany Bay (port area)

- In the eight-month period the truck served 190 different customers, however, the top 20% of delivery locations account for 71.2% of the total number of deliveries/stops during the eight-month period.

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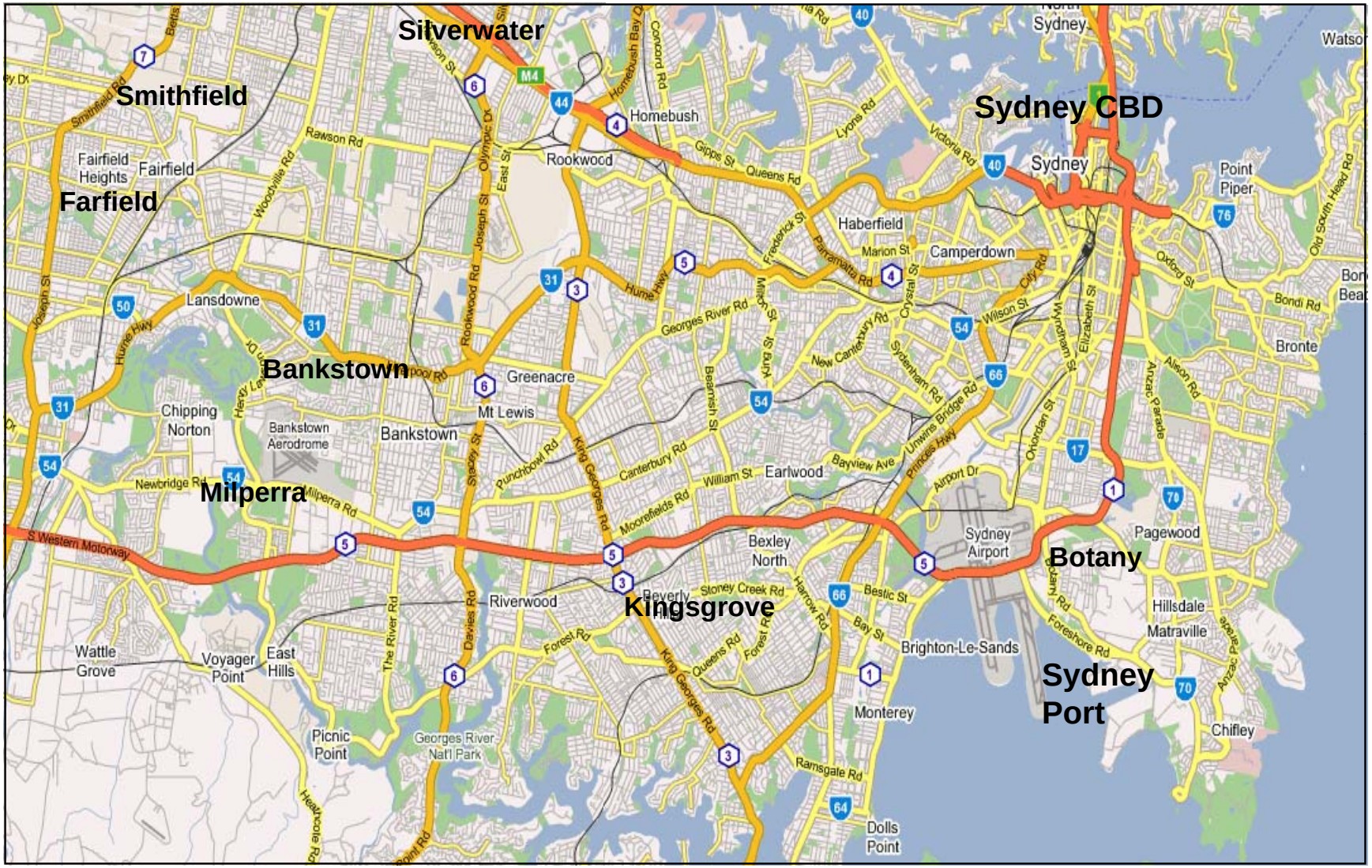
# Relative Location of the Port of Sydney and Delivery Areas



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# Tour Summary Data

| | Trip Distance (km) | Trip Travel Time (min) | Stop Time (min) | Average Speed (km/hr) | Stops per Tour | Tour Length (h:m) | Tour Distance (km) |
|---|---|---|---|---|---|---|---|
| Average | 14.1 | 28.2 | 38.7 | 26.6 | 6.8 | 7:57 | 108.6 |
| Median | 7.5 | 20.0 | 30.0 | 25.0 | 7.0 | 8:30 | 99.1 |
| St. Dev. | 15.4 | 21.4 | 31.3 | 17.0 | 2.4 | 2:07 | 53.6 |
| Min. | 0.1 | 5.0 | 5.0 | 0.2 | 1.0 | 1:45 | 7.9 |
| Max. | 100.7 | 195.0 | 285.0 | 109.9 | 12.0 | 10:00 | 290.9 |

What is a typical tour?

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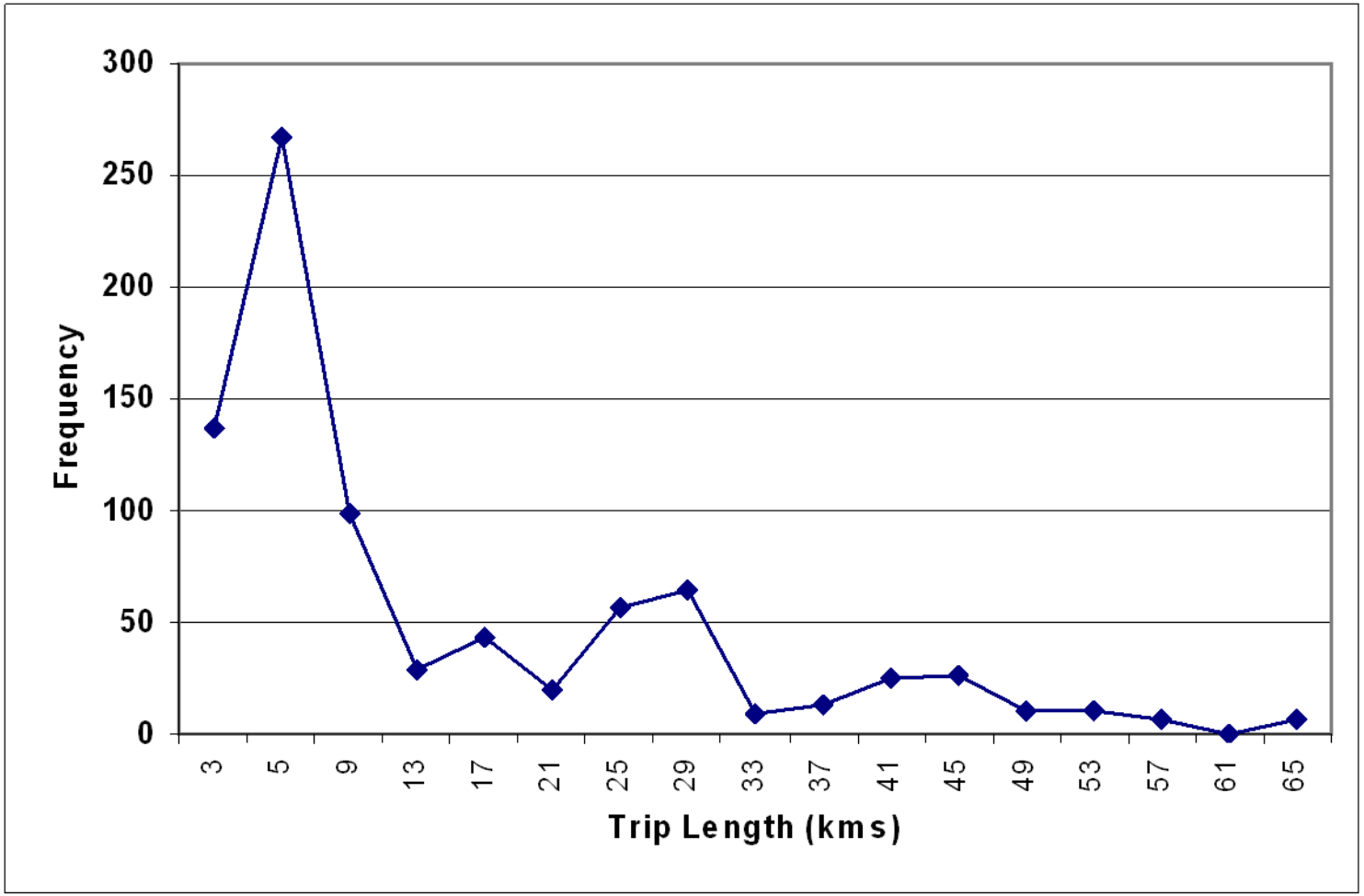
# Average Speed by Trip Distance and Departure Time

| Speed Average | | | | |
|---|---|---|---|---|
| **Trip Distance** | **5:30 to 7:30** | **7:30 to 9:00** | **9:00 to 11:00** | **11:00 to 16:00** |
| **0 to 5 kms** | **16.2** | **15.1** | **12.9** | **12.6** |
| **5 to 20 kms** | **30.9** | **21.4** | **26.1** | **27.9** |
| **+ 20 kms** | **38.3** | **33.3** | **37.2** | **48.6** |

Without aggregation it is hard to present figures with enough statistical significance!

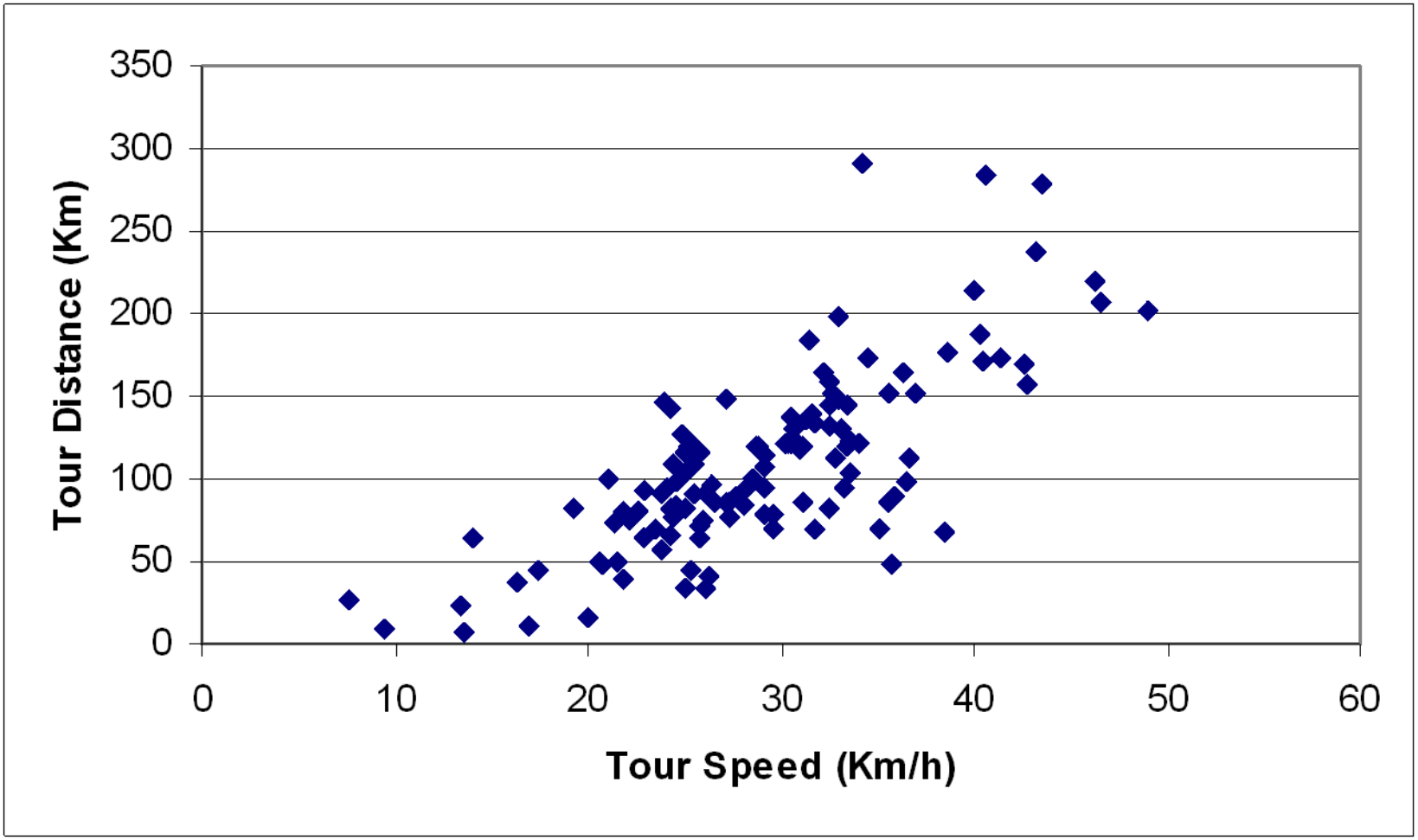
Why?

# Trip Length Distribution



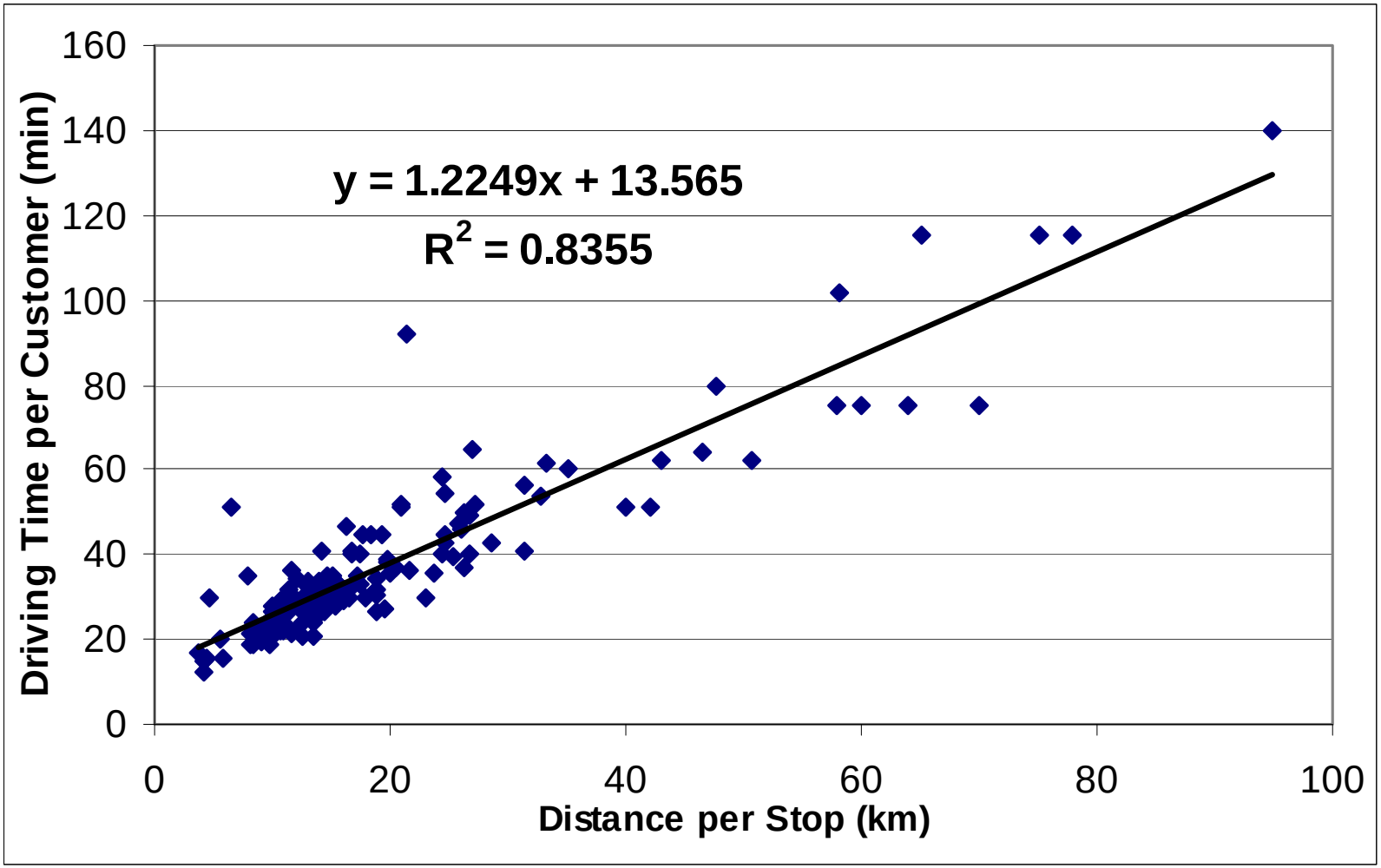

**Reflects the distance from the depot to the distribution areas**

# Tour Distance vs. Tour Speed



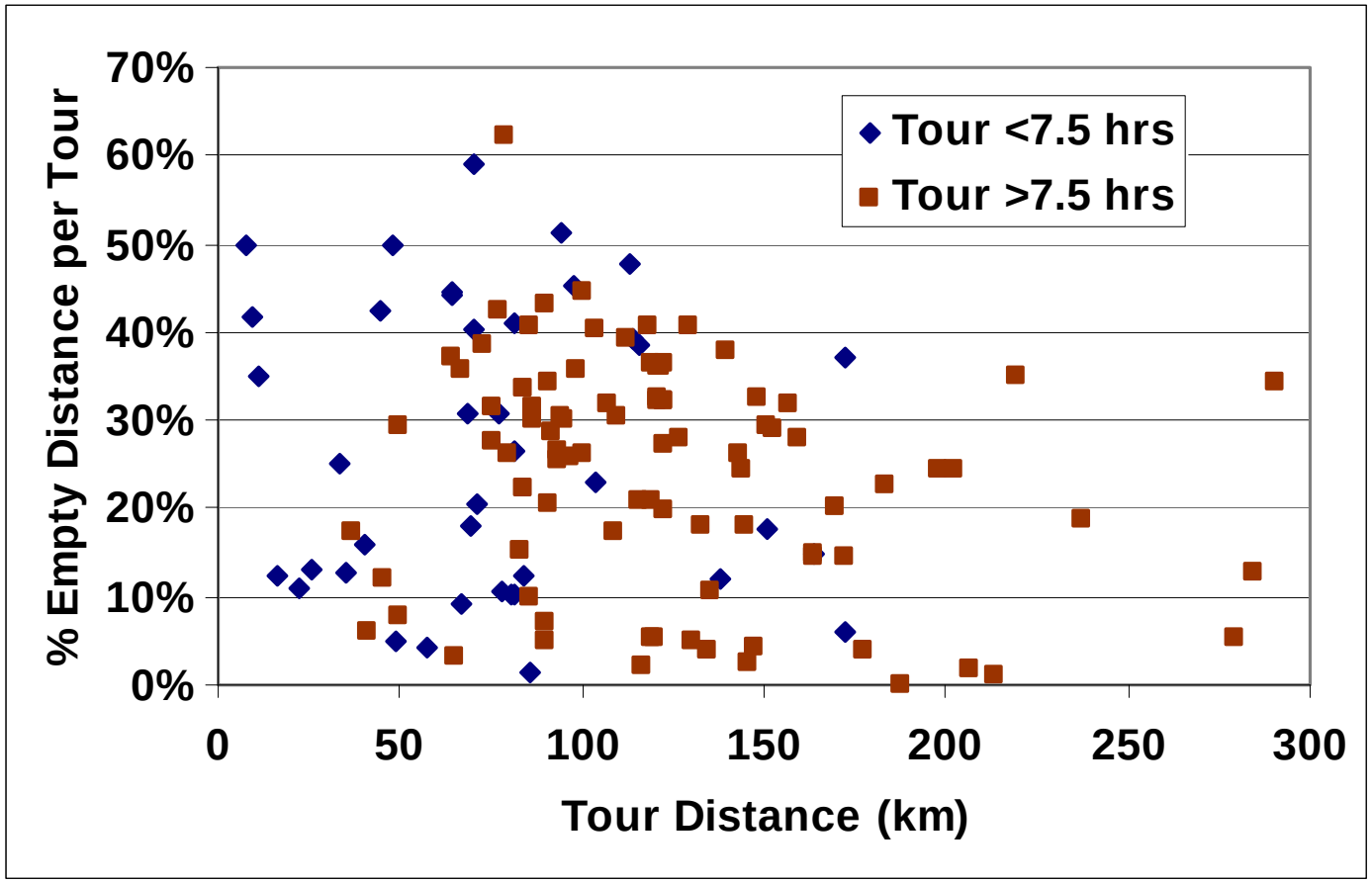

Good correlation between total tour distance and speed

# Tour Distance vs. Tour Time (per stop)




Even higher correlation !!!

# Empty Distance and Tour Distance




Empty Distance or % Empty Distance did not provide any insight

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# Tour classification by distance per stop

| Tour Class | Dist. per stop (km) | % Time Driving | Stops per Tour | Tour Duration (hr) | Tour Distance (km) | Tour Speed (km/hr) | Effective Tour Speed (km/hr) |
|---|---|---|---|---|---|---|---|
| Class I | 13.3 | 43% | 7.5 | 8.2 | 88.0 | 24.9 | 11.1 |
| Class II | 21.1 | 58% | 6.4 | 7.2 | 117.4 | 26.7 | 17.2 |
| Class III | 59.6 | 65% | 3.9 | 8.3 | 206.3 | 36.4 | 26.0 |

*Distance per stop* and *% time driving* are very useful to classify trip efficiency: (a) distance and (b) time costs

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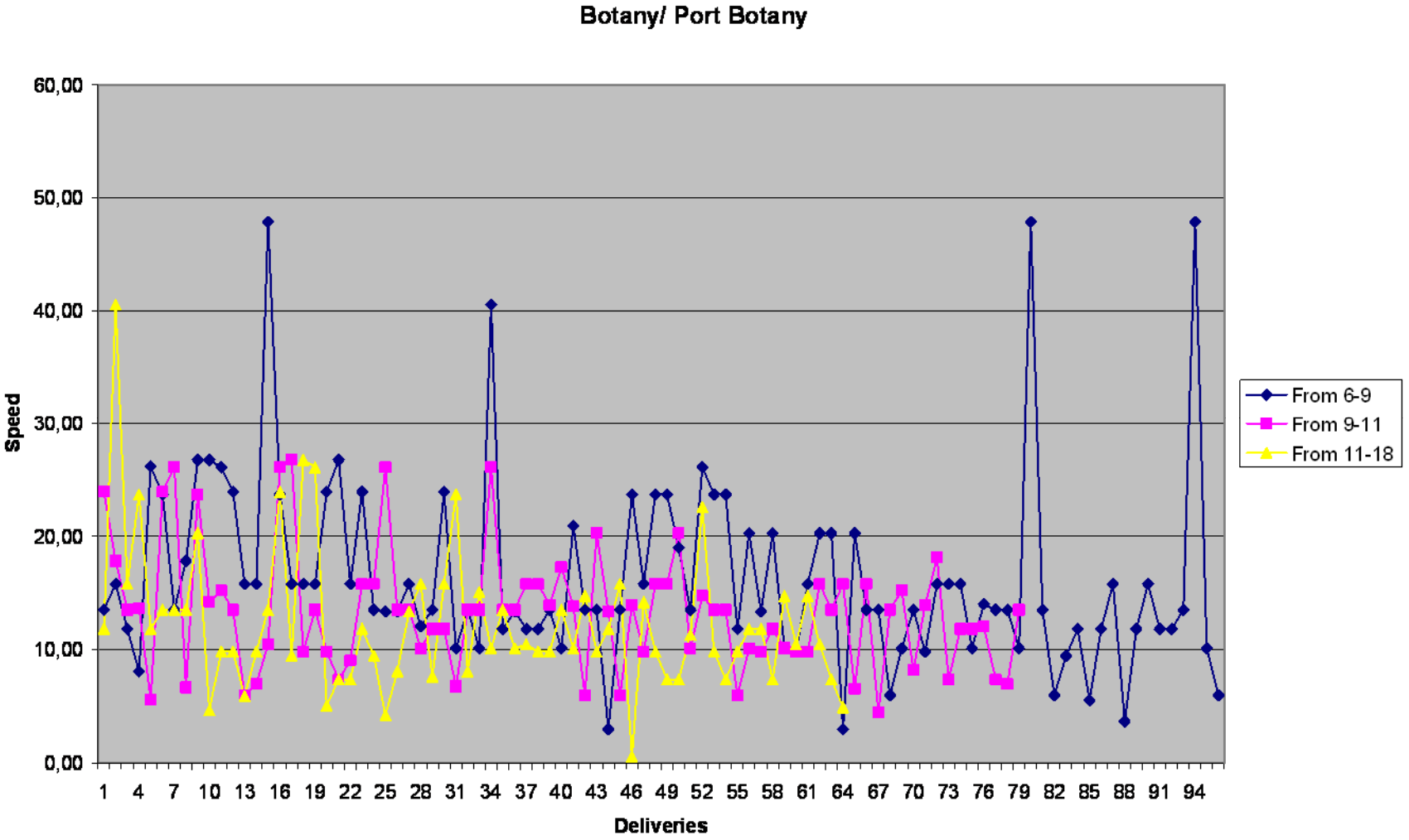
# Travel Time Example



# Sample Size Issues (1)

- Sample size undoubtedly affects the level of detail or granularity achievable in the congestion analysis.
- Despite the use of several months of complete routing data, congestion analysis proved to be a difficult task
- Six factors that complicated the travel reliability analysis for the company are mentioned

# Sample Size Issues (2)

1. The sheer number of possible origin destination (OD) pairs. For 190 customers, the possible number of network links is 17,955.
2. Time of day breakdown, distinguishing between peak and non-peak periods.
3. Departure time vs. arrival time: long trips may fall in both rush and non-peak periods.
4. Directional effects (e.g. to CBD or away from CBD)
5. No information available about potential travel times in alternative routes.
6. At the tour level, variation of customer demands precludes the direct comparison of tours travel times.

# Correlations in Travel Time

- An adequate number of observations to estimate speed standard deviations were obtained for the most frequently traveled depot-customer pairs.
- The data also demonstrated a positive correlation between travel times.
- Given the tour sequence:
  - depot→customer A→customer B
  - if a higher than average travel time takes place for the link depot→customer A, then a higher than average travel time between customer A and customer B is likely
  - Correlations can be important in multi-stop tours (cumulative effect of delays and size of buffer needed)

# Conclusions

- For planning purposes/aggregate level
  - good correlations between speeds and distances, distances and tour durations
  - Tour data can be nicely classified using average distance per customer and % time driving are

- For operational purposes/disaggregate level
  - A lot of observations are required !
  - Not enough information for the estimation of averages,
  - standard deviations, and correlations
  - No enough to give data by time of day, direction, etc.

# THANK YOU

For related papers/working papers:

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