Analyzing the Effect of Mandatory Smart-Card Use and Priority Lanes on Public Transport Reliability

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Transit Data
2019
Paris

2019
Paris
The Israeli Ministry of Transportation is executing a national program aimed to add numerous Public Transportation Priority Lanes in 17 districts in Tel Aviv Metropolitan area.
Background

Two events, related to the Tel Aviv Public Transportation, takes place in six months

January 2019
all boarding at buses in Tel-Aviv metropolitan,
are with "Rav-Kav",
the Israeli PT smart-card

April 2019
two priority lanes
opened in Tel-Aviv
Analyze the change and the improvement (if such exist), related to travel time and schedule adherence.
Data Sources

- **GTFS**
  - Static planned data

- **SIRI\ AVL**
  - Realtime vehicle location
  - 1.2M records

- **AFC**
  - Fare Collection
  - 147K records

- **Bus Log**
  - Bus built-in monitoring
  - 69.5K records
Test Playground

2.76 Kilometer
13 Bus Stations
25 Bus Lines
5 Operators
~2K Tap-On per day
AVL and AFC Data Samples

Payment can only be made with smart card (Rav-Kav)

- Nov. 2018: 1st data sample
- Jan. 2019
- Feb. 2019: 2nd data sample
- Mar. 2019
- Apr. 2019: 3rd data sample

Priority lanes opened

- All data samples were taking choosing typical week with no vacations or holidays
- Data samples contain Thursday to Thursday data
Analytics Technology

Azure SQL
Main database

QlikView
Data preparation and manipulation

python
Data preparation

Power BI
Main visualization platform
Dwell Time

2 methods to calculate:

AVL data -

dwell time = \sum \text{seconds where the bus is within radius of } n \text{ meters from station}

Bus log –

dwell time = \text{CD}_{\text{current station}} - \text{OD}_{\text{current station}}

OD – First door open timestamp
CD – Last door closed timestamp
AVL was found as not usable:

The AVL data supplied is being collected at 1 min. intervals. while the average dwell time is 9 sec.
Analyzing the bus station with complete data from the BUS logs we can see that the effect of implementing mandatory use of smart payment card is fast and effective.

Insights

Analyzing 16.25K Bus trips

Doors open time = > 0 and < 300 sec.
Average Dwell Time

When drilling down to only rush hours (08:00 – 09:30 AM), we can see that in 4 out of 5 stations there is an overall improvement over 7 months (Dec. to June).

Analyzing 2,643 bus trips

Time = 08:00 – 09:30 AM
Doors open time = > 0 and < 300 sec.
Month = Dec. 18 to June 19
Finding A

The use of mandatory smart card reduced the average dwell time roughly by 1.2 sec. (9.1 sec in Nov. to 7.9 sec June)
Schedule Adherence

Improvement level was tested through 2 channels:

**Headway Reliability**
A person waits at a bus station for a bus that is scheduled to arrive every ‘t’ minutes – Will there be an improvement in frequency reliability?

**Travel Time Stability**
What is the improvement (if exist) in the stability of the time it takes for the bus to go through stations where priority lane was added?
In short routes or cases where the priority lane is at the beginning of the route, an improvement is clearly shown.

Insights

3 of 21 Stops
H. - 60 Min.
Analyzing 160 Days
Time = 08:00 – 09:30 AM
Headway Reliability

In short routes or cases where the priority lane is at the beginning of the route, an improvement is clearly shown.
Headway Reliability

As distance from origin station increases, priority lanes becomes less and less effective.

**Insights**

- **6 of 43 Stops**
- **H. - 20 Min.**
- **Analyzing 181 Days**
- **Time = 08:00 – 09:30 AM**
As distance from origin station increases, priority lanes becomes less and less effective.
At long routes (30+ stations) when the street tested is in the middle of the route, we can see that in most cases, the priority lane had no effect.

Insights

Headway Reliability

42 of 51 Stops
H. - 15 Min.
Analyzing 192 Days
Time = 08:00 – 09:30 AM
Headway Reliability

At long routes (30+ stations) when the street tested is in the middle of the route, in most cases, the priority lane had no effect.
Finding B

There is a strong correlation between the bus origin station and the distance to where a priority-lane is located.
Travel Time Stability
Travel Time Stability

1st to 3rd station ride time

1st to 2nd station ride time

2nd to 3rd station ride time

10K Trips

226 Days
Future Work

A further research is in needed to re-validate some of our conclusions here

- Enrich the data by joining the different sources
- Assess the long time effect of each of the parameters analyzed
- Formulate the correlation between the distance from origin of PL and the improvement it produces
Thank You

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