

Spatio-Temporal Demand Modelling for On-Demand Transit Services

Nael Alsaleh, Ph.D. Student

Bilal Farooq, Associate Professor, *Canada Research Chair in Disruptive Transportation and Services*,
Laboratory of Innovations in Transportation (**LiTrans**),
Ryerson University

Thursday, January 28, 2021

Applied Urban Modelling 2020: Modelling the New Urban World

Outline

- ❑ Introduction
- ❑ Objectives
- ❑ Methodology
- ❑ Results
- ❑ Conclusion & Policy Recommendations

Introduction

❑ On-Demand Transit (ODT) Service:

- Definition
- Purpose
- Belleville's ODT Pilot Project

Introduction

- Belleville's ODT Pilot Project (September 2018 – Till now)



a) Fixed service

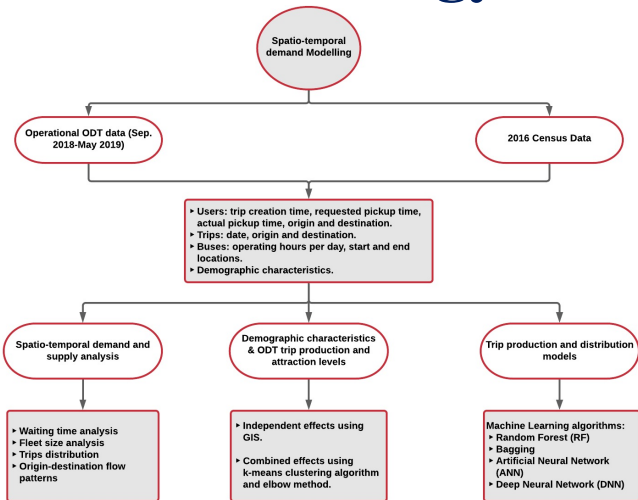


b) On-demand service

Objectives

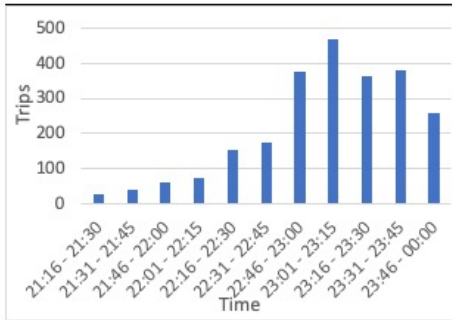
- Perform a detailed spatio-temporal demand and supply analysis for Belleville's ODT service.
- Investigate the relationship between the demographic characteristics and the ODT trip production and attraction levels.
- Four-Step Approach: Trip production and distribution.

Methodology

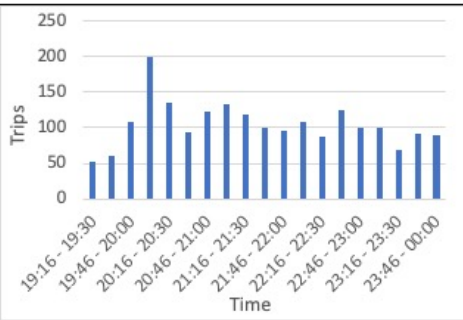


Temporal Trip Distribution

➤ Highest trip demand:



(a) Weekdays



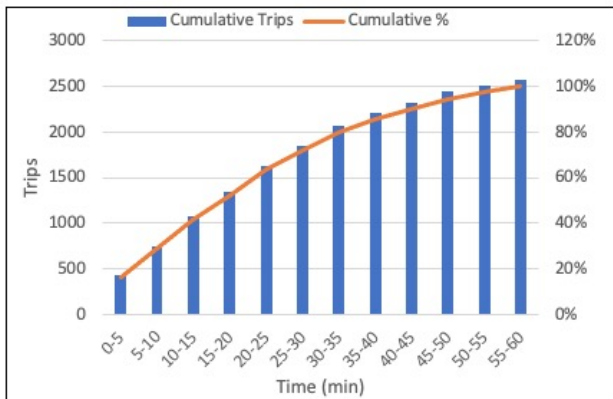
(b) Weekends

Weekdays : 11:00 pm – 11:45 pm

Weekends: 8:00 pm -8: 30 pm

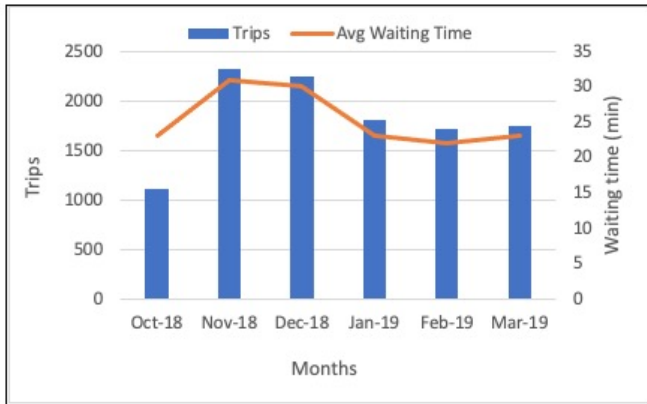
Waiting Time Analysis

- Waiting time and percentage of trips

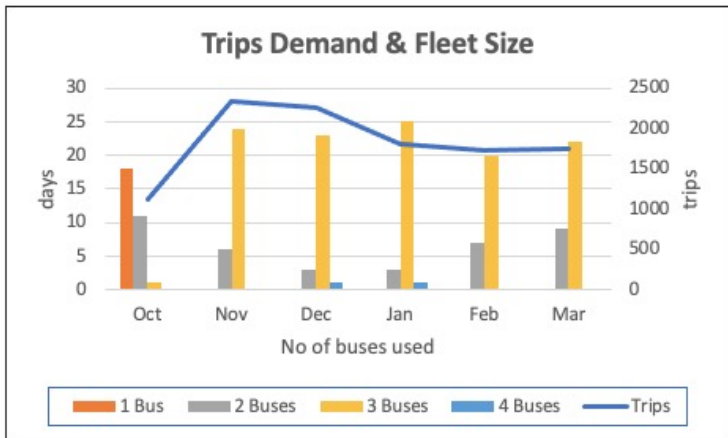


Waiting Time Analysis

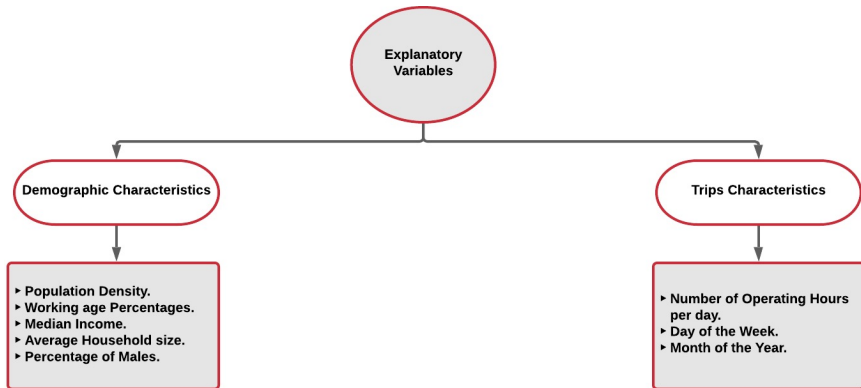
➤ Waiting time and trip demand



Fleet Size Analysis



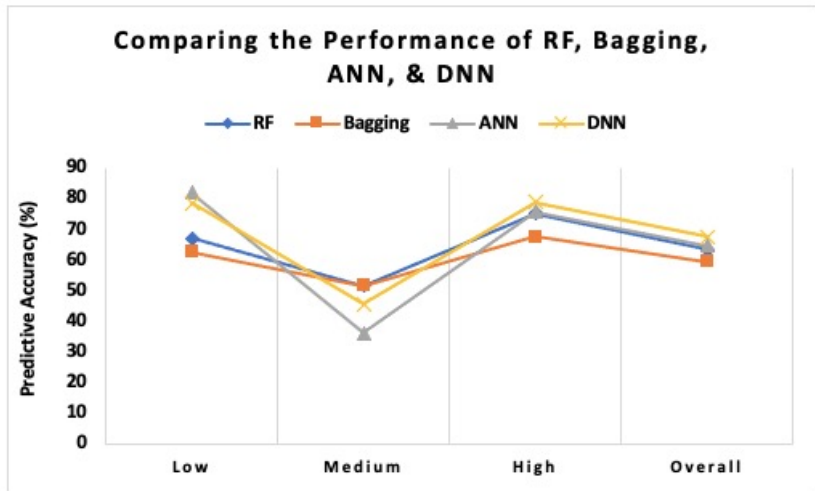
Trip Production & Distribution Models



Trip Production Model

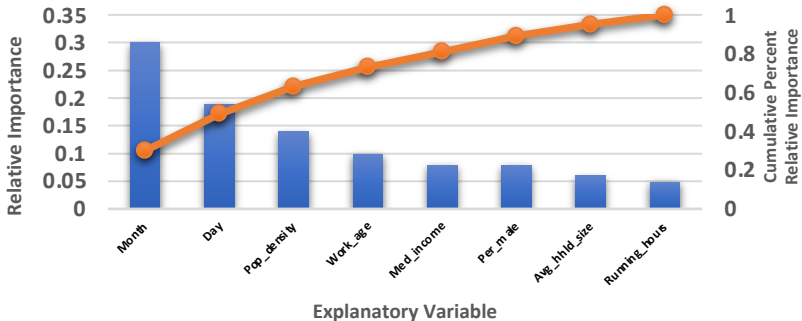
- Trip Production: Dependent Variable is Pick Up Counts.
 - Pick up counts can be best represented by three classes:
 - Class 1: **Low** trip production level (1 pickup per day).
 - Class 2: **Medium** trip production level (from 2 to 5 pickups per day).
 - Class 3: **High** trip production level (more than 5 pickups per day).

Trip Production Model



Trip Production Model

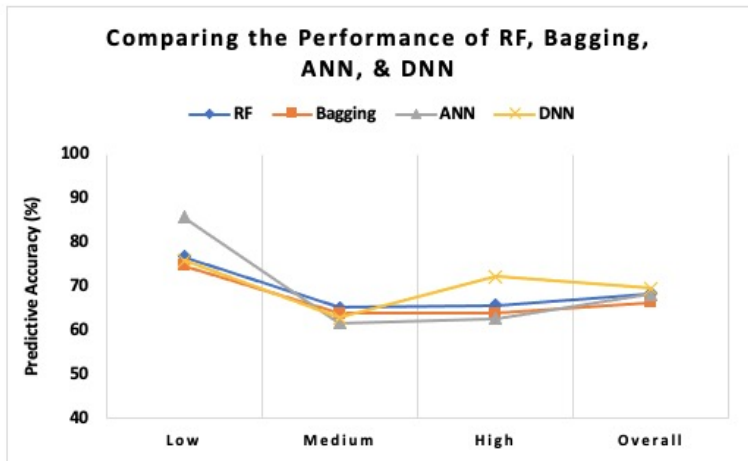
Pickup Demand Variables' Relative Importance



Trip Distribution Model

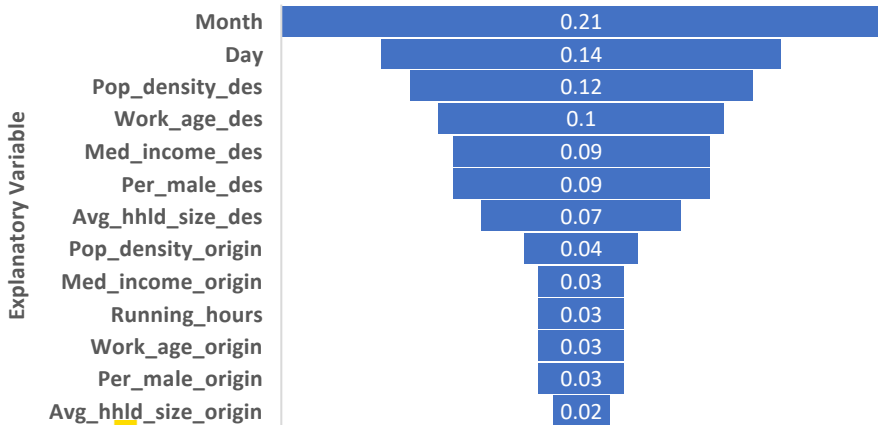
- Trip Distribution: Dependent Variable is Number of trips.
 - Number of trips can be best represented by three classes:
 - Class 1: **Low** trip demand level (One trip per day).
 - Class 2: **Medium** trip demand level (two trips per day).
 - Class 3: **High** trip demand level (more than two trips per day).

Trip Distribution Model



Trip Distribution Model

Trip Demand Model Variables' Relative Importance



Concluding Remarks

- ❑ Higher chance of success in:
 - Low-density areas with mixed land use.
 - Neighbourhoods with low-income population, multi-family housing.
- ❑ Key recommendations:
 - Adaptive approach to changes in the spatio-temporal demand.
 - Proactively relocating the empty ODT vehicles.
 - Use of medium occupancy vehicles.
- ❑ Future work:
 - Understanding user preferences and willingness to adapt.

Acknowledgements

*We greatly appreciate the **CUTRIC and Ryerson University** for providing funding for this study. We are also thankful to **Pantonium** and the City of Belleville for providing us access to the data used in this study.*

For Further Details

- ✓ Sanaullah, I., Alsaleh, N., Djavadian, S. and Farooq, B., 2020. **Spatio-Temporal Analysis of On Demand Transit: A Case Study of Belleville, Canada.** *arXiv preprint arXiv:2012.02600.*
- ✓ Alsaleh, N. and Farooq, B., 2020. **Machine Learning Based Demand Modelling for On-Demand Transit Services: A Case Study of Belleville, Ontario.** *arXiv preprint arXiv:2010.15673.*