



Urban Logistics and Last Mile applications: models and methods to deal with the demand uncertainty

PhD Candidate:

Stanislav Fedorov

1. Introduction

Recently Last Mile logistics obtained a significant shift due to the wide usage of e-commerce platforms and B2C business model adaptation by carrier companies. Fleet consolidation and third-party logistics (3PL) appear to be key strategies allowing these changes. However, 3PL usage follows with the difficulties in fleet management mostly due to the chaotic e-commerce demand.

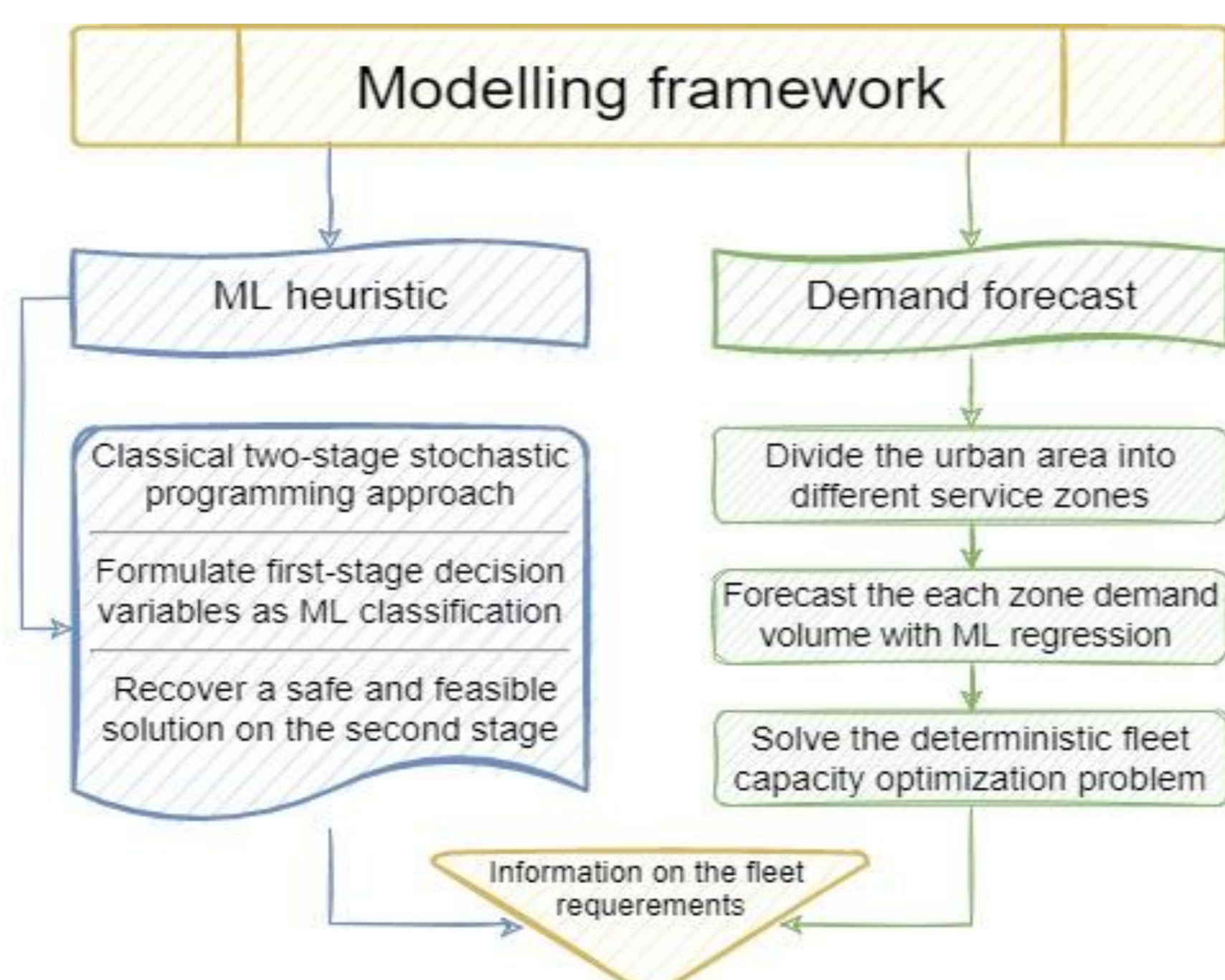
2. Objectives

The research objectives include the development of Machine Learning (ML) based models to optimize the fleet capacity for 3PL usage under uncertain demand. The main question can be formulated as follows:

“How much fleet is required to serve the next time period demand?”

3. Research directions and methods

The developed modeling framework can be divided into two main approaches, namely the application of ML-based heuristics and zone-based demand forecast.



Modeling framework pipeline divided into two basic approaches

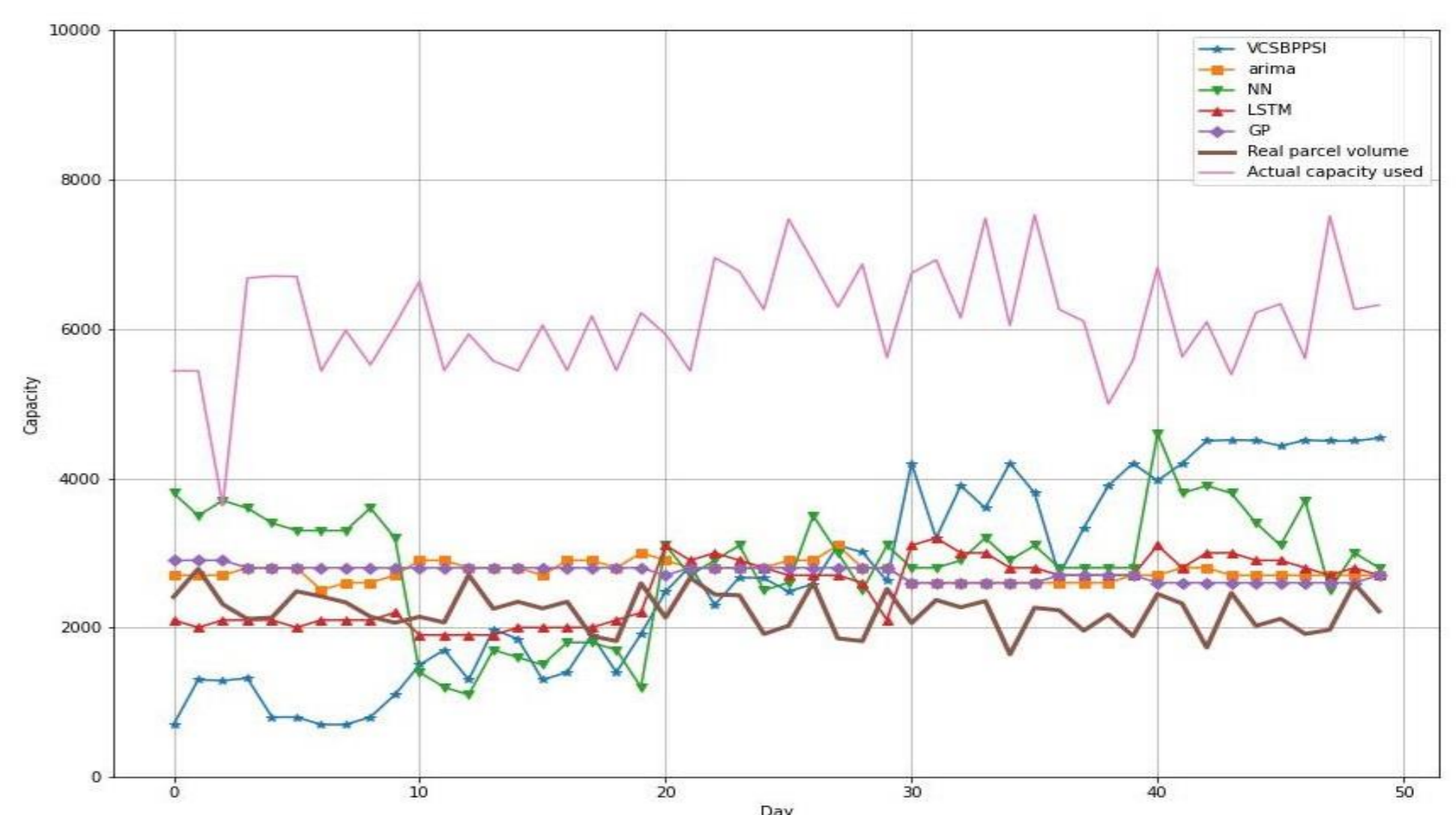
4. Results

• ML-based heuristics

The proposed solution shows an average 5% solutions gap, at least 30 times faster than the exact method and 6 times faster than the recent PH approaches [2]. We dealt with instances of up to 3000 items (case of Berlin-size city) in around 4 minutes on the laptop (i7-9750H CPU @ 2.60GHz).

• Demand forecast

This direction is developed in close collaboration with the practitioners in the field, identifying actual industrial needs. We made a complex study of the different ML regression methods' performance related to city separation (grid/clustering) and introduced a new zone capacity assignment optimization problem [2]. The resulting framework can safely predict the required fleet capacity with a complete absence of order information.



Predicted capacity of different forecast methods for the 50 days scenario compared to actual item volume and capacity used.

5. References

1. Fadda, E., Fedorov, S., Perboli, G. and Barbosa, I.D.C., 2021, July. Mixing machine learning and optimization for the tactical capacity planning in last-mile delivery. In 2021 IEEE 45th Annual Computers, Software, and Applications Conference (COMPSAC) (pp. 1291-1296). IEEE.
2. Fadda, E., Fedorov, S. and Perboli, G. Machine Learning Heuristic Optimization for Third-Party Logistics. Under submission to Computers and Operations Research, 2022