Chapter 7

Average Speed of Public Transport Vehicles Based on Smartcard Data

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ABSTRACT

In public transport, traveler dissatisfaction is widespread, due to long waits and travel time, or the low frequency of the service provided. Public transport providers are increasingly concerned about improving the service provided. To improve public transport, detailed knowledge of the network and its weaknesses is necessary. An easy and cheap way to achieve this information is to extract knowledge from the data daily collected in a public transport network. Thus, this chapter focuses on data analysis resulting from the smartcard-based ticketing system. The main objective is to detect patterns of average speed for all days of the week and times of the day, along with pairs of consecutive stops. To perform the analyses, the average speed was deduced from ticketing data, and clustering methods were applied. The results show that it is possible to find segments with similar patterns and identify days and times with similar patterns.

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INTRODUCTION

The development of cities led to an urban traffic increase. In turn, public transport providers and the government are encouraging the population to use public transport. This usage allows to save fuel, to reduce congestion, and it offers a safe, affordable, and convenient way to travel. However, improvements in public transport systems are a constant need. The introduction of Information and Communication Technologies with, for example, the implementation of smart cards and the vehicles’ geolocation, and more recently, the use of smartphones enables the study and implementation of several service improvements through data analyses and optimization.

These technologies, as for example, Automatic Data Collection Systems (ADCS), created an opportunity to generate, at low marginal cost, large quantities of precise and disaggregate passenger trip data (Wilson, 2013), such as boarding and alighting times and locations, journey distances and collected fares. This data allows researchers to observe when and where the transactions took place and extract the footprints of many thousands of individuals (Gan et al., 2019). The exploration of massive real-time data collected from the ADCS provides an efficient way to disclose hidden mobility patterns and spatio-temporal regularities in urban mobility patterns (Pelletier, Trépanier, & Morency, 2011). In particular, information about public transport passenger behavior, such as travel purpose or activity (Gu & Mark, 2014), could be extracted. The availability of descriptive data about service usage enables Urban Public Transport (UPT) providers to optimize the transport service and manage their resources more efficiently (Giannopoulos, 2004). However, for this information to be useful to both public transport providers and the population, detailed and correct data exploration should be made.

Although many studies have been carried out to assess UPT service, most of them are not based on the data that is currently being collected. Instead, they are collected through counts (for example) and with resources to people who perform this collection. Thus, this made the data needed to be expensive and slow to collect. Consequently, the difficulties in obtaining data caused data to be updated only sporadically. The exploration of the data nowadays collected could give much more knowledge than the one that has been extracted. Thus, it is essential to define the type of information and knowledge that can be drawn from the data collected by different UPT providers and by using different technologies.

Having that in mind and considering the difficulties and limitations to have access to all data types, this study focuses on UPT travel data collected by smart cards in order to extract useful information. In particular, the analyses are performed to extract knowledge regarding the average speed of buses summarizing them into average speed vectors for clustering analysis.

In this paper, it is intended to answer the following questions:

- Is it possible to infer bus speed based on travel ticketing information?
- Are there bus speed patterns throughout the days of the week or time of the day? How can they be grouped?
- How can the extracted knowledge from these analyzes help UPT providers in decision making?

The chapter is structured as follows: the second section presents the background. The third section presents the main focus of the chapter, where 1) the material and methods used are described, 2) the results and discussion of the most significant results are presented, and 3) the issues, controversies, and problems are identified. In the fourth section, the solutions and recommendations are discussed. Future
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