Chapter 77
Long-Term and Short-Term Traffic Forecasting Using Holt-Winters Method: A Comparability Approach With Comparable Data in Multiple Seasons

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ABSTRACT

The need of faster life has caused the exponential growth in No. of vehicles on streets. The adverse effects include frequent traffic congestion, less time efficiency, unnecessary fuel consumption, pollution, accidents, etc. One of most important solution for resolving these problems is efficient transportation management system. Data science introduces different techniques and tools for overcoming these problems and to improve the data quality and forecasting inferences. The proposed long-term forecasting model can predict numerical values of effective attributes for a particular day on half-hourly basis, at least 24 hours prior to the time of prediction. The proposed forecasting model for short-term analysis will be having access to data as close as 30-minute difference from the time of prediction. Our proposed solution has integrated use of Holt-Winters (HW) method along with comparability schemes for seasonal approach.

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INTRODUCTION

The technological, social and socioeconomic advancements of 20th and 21st century is making the speed of life increasingly faster. The need of faster life along with reduction in cost of automotive technology and increasing consumer buying power in past few years has caused the exponential growth in No. of vehicles on streets. The adverse effects are frequent traffic congestions, less time efficiency, unnecessary fuel consumption, pollution, accidents, etc. To maintain the pacifying flow of life, there is a need of efficient transportation management system (Hou et al., 2015).

Many transportation management systems keep data of transportation behaviours. This data can be used to resolve the issues mentioned above. Traffic data collection methods include active sensors, speed gun data, manual collection, image processed data, etc. But, the data quality and usefulness may be compromised sometimes based on collection methods, conditions and volume. Data science introduces different techniques and tools to improve the data quality and forecasting inferences.

Data science is an interdisciplinary field about processes and systems to extract knowledge or insights from data in various forms, either structured or unstructured, and create analytical reports or results in order to use for decision making, policy planning, etc., which is a continuation of some of the data analysis fields such as statistics, data mining, and predictive analytics. The transportation behavioural data is of large volumes, hence it can be considered as 'big data.' The process methods on aforementioned datasets include pattern recognition, classification, predictive analysis and many more. Results and analytical reports from these types of methods will be useful in, decision making for traffic congestion control by moving traffic directions in particular directions for particular time, to predict the collision probability and hence control the outcome, to provide best route solutions to users for reaching destination with higher time efficiency.

Time series data shows various characteristics such as trends and seasonality (Daraghmi et al., 1994). Seasonality is repetition of pattern present in data, over a period. Trend is increasing or decreasing behaviour in recent data. These characteristics play important role in forecasting the value more accurately

The rest of this paper is organized as follows: Section II presents the Literature survey. Section III presents the Holt-Winters method. Section IV represents proposed "Comparability method". Section V represents proof of concept. Section VI concludes the paper and addresses future work.

RELATED WORK

Traffic is a critical problem that inspired several researchers (Meier, & Lee, 2009; Tchepnda et al., 2009; Biswas et al., 2016; Erden et al., 2016; Mukherjee et al., 2016; Roy, 2017). Various techniques have been utilized in forecasting traffic Out of which primary focus is on trend, seasonality or combination of both in time series data. Seasonality is considered for forecasting in techniques such as Repeatability and Similarity of graphs (Hou et al., 2016), Block regression model (Pan et al., 2015), Time-Aware Multivariate Nearest Neighbor Regression (TaM-NNR) (Dell'Acqua et al., 2015). In (Hou et al., 2016), similar and repeatable nature of traffic flow has been utilized with help of statistic average values of basic series and deviation series whereas (Pan et al., 2015) includes block regression model which consist of seasonal differentiation. (Dell'Acqua et al., 2015) takes into account TaM-NNR which is an extension of multivariate method. It utilizes time and day (i.e. seasonality) for fetching neighbors. However, these methods focus principally on periodic behaviors, thereby affecting the predicted results, as they may also