Traffic Flow Prediction using LSTM and the Impact of Climate Change

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Introduction

Transportation contributes about a quarter of energy-related CO2 emissions and it is essential to minimize transportation activity. In this project, we will build LSTM model to predict traffic flow and conduct comparative analysis with traditional machine learning models. The impact of Climate Change will be addressed through simulation and discussion under RCP8.5 projection.

Data

The dataset used in this project combines traffic, weather, and calendar data. It includes traffic information from the California Performance Measurement System (PeMS) for the eastbound lanes of the Ventura Highway in Los Angeles, covering the period from February 1 to May 31, 2020. The dataset contains 34,823 records across 17 columns, featuring common weather variables such as temperature, dew point, humidity, wind speed, and precipitation, as well as calendar-related attributes. The target is traffic flow.

Methods

Feature Engineering

The data requires cleaning and feature engineering, including imputing missing values, one-hot encoding categorical features, and standardizing the features before building models.

Linear Regression and LSTM Model

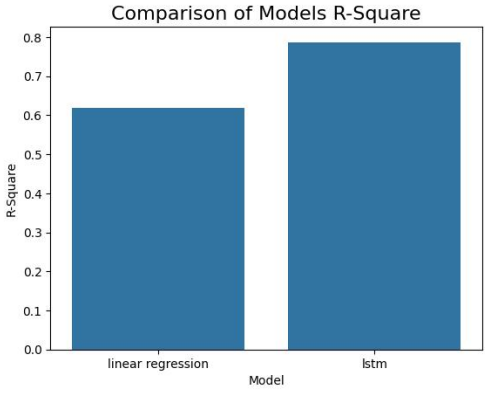
We will compare the performance of linear regression as a baseline model and an LSTM model for traffic flow prediction.

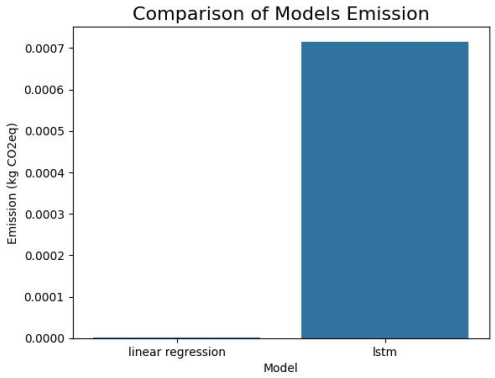
Simulation under RCP8.5 Projection

The impact of climate change for the traffic is addressed by simulating the traffic flow under RCP8.5 projection for year 2050 and year 2099 with visualization.

Metrics & Results

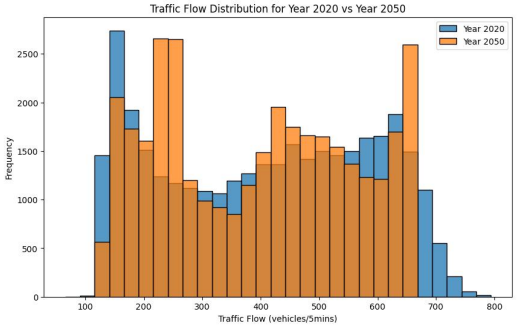
The metrics used to evaluate the model performance include: MAE, MSE, RMSE, R-squared. Carbon emissions are also tracked and compared for both models. LSTM model outperforms Linear Regression model with the cost of far more carbon emissions.

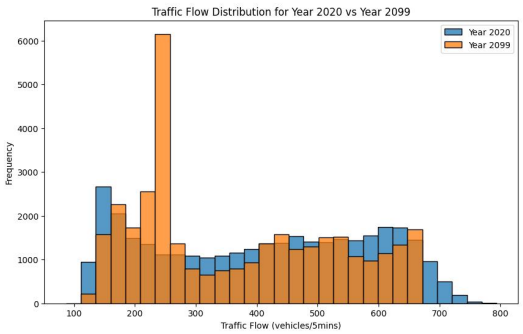




Simulation

RCP8.5 Projection data for Los Angeles is obtained from MACA website with temperature and precipitation for year 2024 to year 2099. Traffic data is simulated using LSTM model with updated temperature and precipitation for year 2050 and 2099.





Discussion

The shifts in the simulated traffic patterns highlight the impacts of climate change, showing a reduction in high traffic flows and an increase in more moderate traffic conditions. Future simulations could incorporate additional projected variables for a more comprehensive analysis.