Collection and Empirical Analysis of Demand and Travel Time Data for Agent-Based Mobility-on-Demand Simulations

Master‘s Thesis of Xuebo Ling

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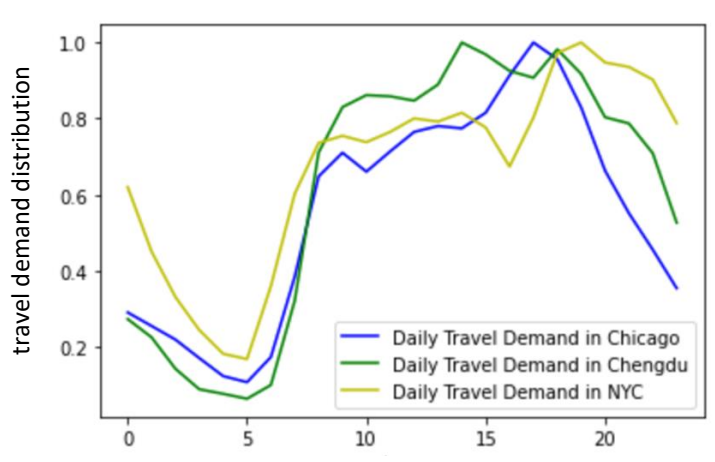
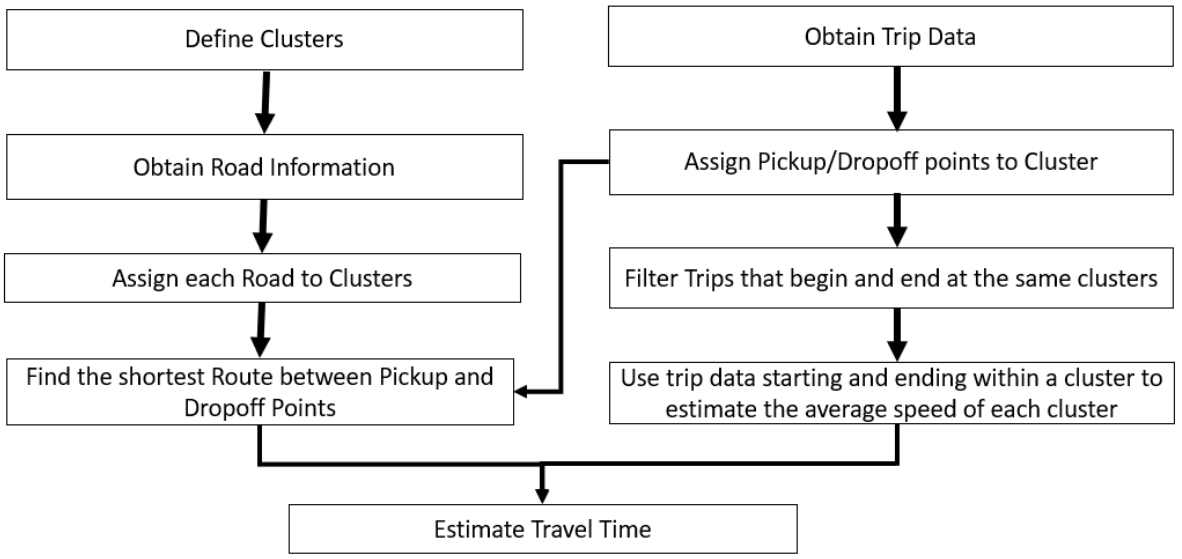
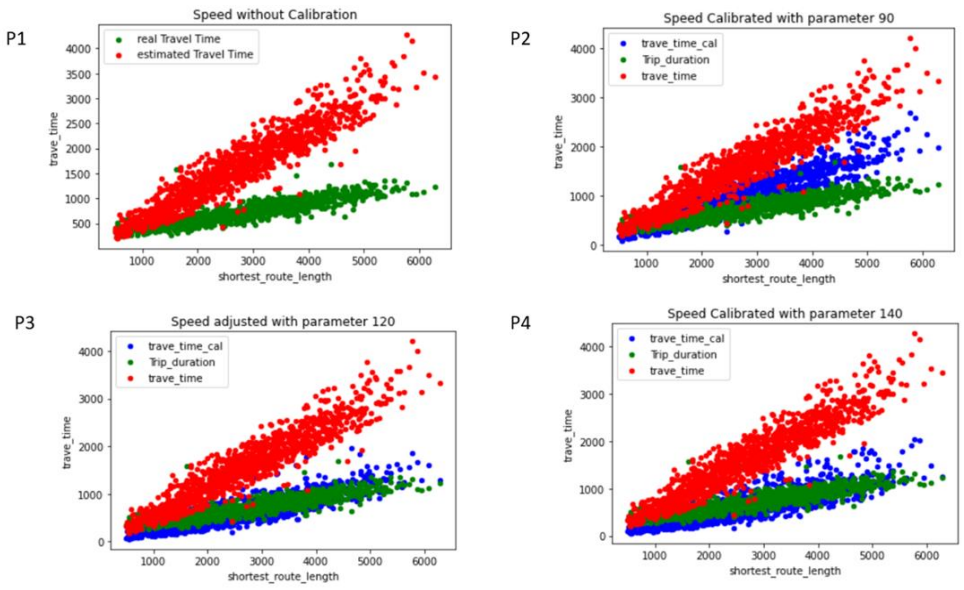


The two graphs above show the distribution of travel demand and travel time, respectively. The graph on the left shows us how travel demand varies from city to city throughout the day. In general, their travel demand distributions are similar, i.e., travel demand is low from nighttime to early morning, and travel demand rises sharply after about seven o'clock and continues into the evening. However, the peak phase of travel demand is different at different times of the day. The graph on the right shows us the distribution of the average travel time of different cities in recent years. It can be seen that before the impact of Covid-19 (by 2020), travel times increased slightly in most cities. However, some major cities such as London and Los Angeles have significant fluctuations in travel times in recent years.

The figure on the right shows a framework for predicting travel times. Given that travel data only contains the geographic location of pick-up and drop-off points, we need the additional road information from OpenStreetMap to make prediction. The basic idea of this methodology is to divide the pick-up and drop-off locations into appropriately sized regions by a clustering algorithm and use the average speed of the region as the speed of all roads within the region. Here we assume that the shortest path is the path they have travelled from origin to destination. Travel times are obtained by adding up the travel times of all roads on the path. The intra-reginal speed is obtained by using the trips that begin and end inside the cluster. If other external data are available, such as speed data measured by sensors, the speed of the regions can also be calculated from these data.





With constant information such as route length, the travel times are calibrated primarily by speed. Figure P1 on the left shows the distribution of predicted travel times and the actual travel times without speed calibration. The red dots represent the predicted travel times for different path lengths and the green represents the actual travel times. As can be seen, the predicted travel times are significantly overestimated. In other words, the actual traveling speed is faster than estimated value, so we introduce a calibration factor to adjust our speed. The blue dots in Figures P2 to P4 represent the predicted travel times with different calibration factors. It can be seen that when the calibration factor is 120, the predicted travel time is closer to the actual travel time. Realistically interpreted, this means that the start and end times of the trip are not the same as the actual travel time of the vehicle, which leads to a bias in the speed estimation.