Predicting mean travel time to traffic analysis zones from street network centrality measures

Yuhao Kang

Introduction

Street networks play an important role in urban transportation. The structure of the street networks, which is represented in topological and geographic metric measurements, has great impacts on dynamic urban transportation patterns and traffic flows. With a recent dataset released by Uber, this study aims at exploring the influences of network structures on traffic patterns, and prediction on mean travel time in different cities from a large scale.

Data

Public dataset: Uber Movement, which is released by Uber (https://movement.uber.com/). I downloaded the data in four cities: Washington D.C., Boston, Pittsburgh, and San Francisco. The data contains the mean travel times of each traffic analysis zones (TAZ) by month.

Methods

Between centrality: a measure of centrality in a graph based on shortest paths.

Closeness centrality: a measure of centrality in a network, calculated as the reciprocal of the sum of the length of the shortest paths between the node and all other nodes in the graph.

Multiple linear regression: a statistical technique that uses several explanatory variables to predict the outcome of a response variable.

Results and Findings

Here are the correlation coefficients between mean travel time, and closeness and betweenness individually. For most of the coefficients, they are negative correlated with the mean travel time.

Table 1 Correlation coefficients between mean travel time and centrality measurements.

	Boston	Washington D.C	Pittsburgh	San Francisco
Closeness	-0.2832	-0.6835	-0.1273	-0.4613
Betweenness	-0.0375	-0.2138	0.0516	-0.1408

Here are the multiple linear regression results. For most cities, the goodness of the model are higher than 0.92. And the closeness has positive impacts on mean travel time calculation while the betweenness has negative impacts on mean travel time.

Table 2 Multiple linear regression results of mean travel time and centrality measurements.

	Boston	Washington D.C	Pittsburgh	San Francisco
Closeness	9,407,000	8,806,000	7,542,000	8,721,000
Betweenness	-0.00002383	-0.00005388	-0.00003674	-0.0001
R^2	0.940	0.927	0.957	0.928

mean_travel_time