A High Performing, Scalable Framework for Computing and Visualizing Public Transit Accessibility

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Introduction

Transportation network analysis is fundamental to urban planning for it determines how resources are distributed across a population. Resources come in the form of amenities such as grocery stores, schools, parks, and hospitals. Our client, Statistics Canada produces data to better understand Canada's population, resources, economy, society, and culture. They have previously developed network accessibility measures based on distance of driving and walking to compute proximity scores for various types of amenities.

Problem

Accessibility measures based on time using transit have not yet been incorporated into proximity scores due to its multi-modal complexity and computational intensity. In 2016, 22.3% of Canadians depended on public transit in large cities; thus, incorporating transit accessibility measures is paramount to not under-represent large segments of the population which can inevitably worsen pre-existing inequalities in the urban landscape.

Objective

The aim of this project was to establish a first iteration of an open-source scalable framework for data collection and analysis of transit accessibility measures. We validated our framework on Metro Vancouver, raising the question of, "How accessible are Metro Vancouver's cultural amenities (libraries, museums, art galleries, and theatres) using the current transit system?"

Methodology/Results:

To address the computational intensity of multimodal shortest path routing, we used Conveyal's R5 realistic routing algorithm available in R as r5r. It allows us to compute over 5.3 million transit routes repeatedly, 360 times in a day over 3 days, in just a matter of one hour. The travel time matrix was then used to develop three accessibility measures: one based on time, one on scores, and one on percentiles which were visualized with Leaflet and Kepler.gl and embedded in an R shiny dashboard.

Conclusion

This project provides a high performing and scalable framework for producing three unique transit accessibility measures for network analysis using Metro Vancouver as an initial use-case scenario. The framework can be further developed and adopted by urban developers to ensure equitable, sustainable, and optimal urban design for years to come.