Applying a Time Continuous Schedule Based Transit Analysis to Determine Transport Gaps

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Steven Farber, PhD
Department of Human Geography
University of Toronto Scarborough

Koos Fransen, Tijs Neutens, Phillipe De Maeyer,
Greet Deruyter, Frank Witlox
University of Ghent
Background
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- Spatial access to public transport is guaranteed by law in Flanders, irrespective of place of residence.

- De Lijn, the region-wide public transportation authority (bus and tram), is seeking ways to ensure this service.

- The first step is to understand where the current gaps in the system, from the particular perspective of who may be most “in need” of additional services.
Measuring Public Transport Gaps

- Growing interest in understanding social disparities in mobility and accessibility to essential goods and services

- Common to construct and compare two indices:
  1. An expression of public transport needs
  2. An expression of transit accessibility

- Needs $\rightarrow$ Area-based measures of transit dependence

- Accessibility $\rightarrow$ Measures of transit access, or transit-based access to destinations
Background

- Transit travel times are variable
Background

- Measures of transit accessibility need to account for variability in OD travel times.

- Dynamic measures of accessibility:
  - Temporal variability in jobs-accessibility impacts the mode choice decision (Owen and Levinson).
  - Temporal variability in OD travel times means that most trips demanded in a region are not provided with adequate transit coverage (Polzin et al.; Ritter & Farber).
  - Temporal variability in transit coverage can lead to precarious food accessibility with racial disparities (Farber et al.)
Method
Method Overview

- Public Transit Travel Times
- Facilities and Services Locations
- Residence Locations
- Demographics
- Social Subsistence Pay
- Automobile Ownership

Compute Accessibility Scores → Compute Needs Indices → Compare Supply Index with Needs Index
Public Transit Travel Time Cube

\[ T = \{ t_{i,j,m} \} \]

\( T \) is a 3D matrix of public transit travel times from origins, \( i \), to destinations, \( j \), at times, \( m \).
Computing the Cube

- GTFS Package(s)
- Pedestrian Network File
- Add GTFS to Network Dataset
- Transit Network Dataset
- Transit Evaluator
- Compute OD Cost Matrix
- For Each $m$
- Administrative Zone Centroids ($i, j$)
- Public Transit Travel Time Cube
Index of Public Transport Needs

Individual “Needs” Variables

Principal Components Analysis

Index of Public Transport Needs (IPTN)
Index of Public Transport Supply
Index of Public Transport Supply

Cumulative Opportunities Accessibility Score

\[ A_{i,S,T} = \sum_j G(t_{ij})F_{S,j} \]

The number of facilities of type \( S \) that are reachable from location \( i \) within a travel time threshold, \( T \)
Index of Public Transport Supply

Gravity Based Accessibility Score

\[ A_{i,s} = \sum_{T=1}^{n} A_{i,s,T} W_T \]

A single accessibility score that gives higher weight \((W_T)\) to shorter distance thresholds
The IPTS was created by adding the individual service scores and standardizing them into a 0-1 range.

Scores were generated for different time periods: weekday rush-hour and midday, Saturday, Sunday.
Results
IPTG = IPTN – IPTS
Results

- Higher gaps are suburban and rural
- Lower gaps are primarily found in city centers

Relative stability between time periods
Customization

- Additional capabilities for analysis
Conclusions

- There are 242,000 living in zones in the highest gaps decile, and almost no occurrences of large gaps in the larger urban areas.

- Focussing in on a single metro area may reveal more inequalities within a city.

- Are there people currently receiving transit subsidy, despite having “good” access to services?

- Are there people currently needing a subsidy despite having “good” spatial access to bus stops?
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