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Simple Open Data Measures of Public Transit Service Availability

Usecases for Closeness Centrality and Isochrones

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Contents

1 Introduction

In recent years, but for decades by now, the demand for a paradigm shift in transportation infrastructure and service has become louder and louder. While calls for a shift away from car centric mobility are nothing new and were a well established part of German Academic discourse in the 1990s already [1], it has become part of a widespread political discourse around the so called *Verkehrswende* [2]. With increased awareness and concrete experiences of climate change this discourse has reached states of heated debate. Benefits of

1.1 Transit Accesibility Equity and Equality

1.1.1 Terminology

1.1.2 Motivation

- Traditional transport planning centering on men?
  - German Transport Planning post world war 2?
- Transit planning and identifying demand in public transit networks is a complicated process, that takes into account a plethora of data that's hard to access or acquire [3].
  - statistical routing data based on conveyal engine [4]

1.1.3 Research Question

- How can an easy closenes centrality measure help asses transit service availability and equality

1.2 Related Work

- Network Centrality Measures
  - road networks
  - public transit networks
  - bipartite networks
- Transit Equity Studies
  - US
  - Network Planning [3]
- Traveltime Datasets such as [5] and [6]

1.3 Methodological Approach

1.3.1 Data Acquisition

- explorative data analysis

1.3.2 origins

- hexgrids from h3pandas

1.3.2.1 Transport Data

- osm files from geofabrik [7]
- gtfs files from various transit companies [8]–[10] vrs

1.3.2.2 Destinations

- Usage of openly available data, preferably from osm .. extracted with pyrosm [11]
- specific data if necessary, eg secondary school data not mapped in osm [12]

1.3.3 Data Processing

- Isochrones
  - available from openrouteservice [13], as used in [14], not used because:
- travel time matrices
  - enough for basic reach analyses, isochrone itself not important
  - calculated with r5py [15] as used in [5], based on the conveyal engine [4], [16]

1.4 Geographic Case Studies

- Selected based on data availability, personal familiarity.

2 Closeness or Reachability

2.1 Closeness Centrality

2.2 Reach

2.2.1 Isochrones as a Measure of Reach

- ors [13]
- cummulative or individual accesibility measures from [6]

2.3 Temporal Variability

- conveyal approach [16]
  - also used in [6] for metrics spanning the UK, but identified gap in temporal variability of transport choices

2.4 Comparison Use Cases

2.4.1 secondary schools

- see [6]

2.4.2 sports clubs

- osm data

2.5 Methods

2.5.1 Available Data

- school data from [12]
- sports data from osm

2.5.2 Processing

2.6 Results

3 Distinguishing Transit Footprints

3.1 Historical Urban Blueprints

3.2 Radial and Tangential Services

3.3 Methods

3.3.1 Visual Differences

3.3.2 Inequality Measures

- Lorenz Curves and Gini Coefficients being silly sometimes [17]

3.4 Results

3.5 Hub and Spoke Transit Planning

4 Comparisons with Non-Schedule-Based Modes

4.1 Cycling

4.1.1 Methods

4.1.2 Results

4.2 Cars

4.2.1 Methods

- added parking times

4.2.2 Results

4.3 Limitations

- limitations to car traffic estimations
  - temporal variability
- limitations to parking times

5 Recap of Results

6 Discussion

6.1 General Limitations

- Lack of real world measures as Comparisons
- Focuses solely on door to door travel times and neglects
  - reliability Data
  - delay data both for cars and public transit
  - public transit fare structures [18]
- *inequality* being silly at times [17].

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