Determining Transit Accessibility From a User Perspective

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Overview

• Background
• Objectives
• Accessibility Characteristics Model
• Transit Accessibility Software
• Software Performance
• Applications
• Conclusions
Background

• Public transit plays an important role in urban areas
  – Reduce congestion, improve the environment, & provide alternative transport

• Need to better understand ridership to help transit grow
  – Declining ridership & social inequalities

• Important aspect is accessibility
  – Ease of use, convenience, & service

• Previous research focuses on efficiency-related variables
  – Frequency, passenger loads, service coverage, speed

• Need for customer-oriented analysis
  – Population characteristics, ease of access, & trip purposes

Objectives

• Identify and Model the user-perspective factors that affect a transit user’s most likely trip route.

• Develop a universal software program that allows transit operators to evaluate the current transit system, identify critical areas, and understand how changes will effect user transit accessibility.
Accessibility Characteristics

• Data Sources
  – 1998 Dallas Transit Survey
  – 1998 Dallas Transit Network

• Extracted Data
  – 13 Random Possible Paths
  – Path Characteristic Data

Model Structure

• Utility Function
  
  \[ U_{ni} = V_{ni} + \epsilon_{ni} \]
  \[ V_{ni} = \beta_i X_{ni} \]

  where: 
  \( n \) - identifies an individual
  \( i \) - identifies an alternative

• Probability of Choosing Alternative \( i \)

  \[ P_{ni} = \text{Prob}( U_{ni} > U_{nj} ) \text{ for all } j \neq i \]
Model Structure

• Multinomial Nested Logit (MNL)
  – Assumptions
    • Independent and Identically Distributed (IID)
      – No Correlation
      – Equal Variance
    • Error Terms are Gumbel(0,1) Distributed
  – Probability of Choosing Alternative $i$

$$P_{ni} = \frac{\left[ e^{V_{ni}} \right]}{\sum_{j=1}^{I} \left[ e^{V_{nj}} \right]} = \frac{e^{\beta_n X_{ni}}}{\sum_{j=1}^{I} e^{\beta_n X_{nj}}}$$

Accessibility Characteristics

$U = -13.29 \times \text{WalkAccess} - 51.90 \times \text{TransitTime} - 29.22 \times \text{Transfer} - 19.45 \times \text{TransitTime} \times \text{Female}$

Where:
• WalkAccess = Distance walked between origin and boarding point and distance walked between alighting point and destination (in 2 mi.s)
• TransitTime = Time spent riding on the bus (in 50 min.s)
• Transfer = Dummy (1 if path includes a transfer, 0 otherwise)
• Female = Dummy (1 if respondent is female, 0 otherwise)
Transit Accessibility Software

• TransCAD GISDK Application
  – Adaptable for any area
  – GIS Layer-based
  – Intuitive User Interface

• Program Manual
  – Explanation of Data Needs
  – Guide to Program
  – Example Scenarios

Transit Accessibility Index (TAI)

Zone Legend

- 92nd percentile
- 84-92nd percentile
- 76-84th percentile
- 68-76th percentile
- 60-68th percentile
- 52-60th percentile
- 44-52nd percentile
- 36-44th percentile
- 28-36th percentile
- 20-28th percentile
- 12-20th percentile
- 0-12th percentile
Other Indices

• Transit Dependency Index (TDI)
  – Low Car Ownership/ Low Income Areas

• Transit Need Index (TNI)
  – High TDI & Low TAI
  – Critical Need Areas

Applications

• Identify & Compare Transit Accessibility for:
  – Different Areas
  – Different Land Uses
  – Different Travel Purposes
  – Different User Groups

• Analyze Effects With Changes In:
  – Transit Stop Placement
  – Route Design and Placement
  – Efficiency of Transit
Conclusions

• Need to better understand transit ridership

• This research offers a unique perspective on measuring accessibility

• Main factors include access distance, travel time, and transfers

• Comprehensive program available that helps transit providers better understand system performance

Questions?

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