Estimating Ridership of Rural Demand-Response Transit Services for the General Public

TRB 96th Annual Meeting

January 9, 2017

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Objective

Develop a model for estimating demand for rural demand-response transit services for the general public

Previous Demand Models

TCRP Report 161: *Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation*

- General public rural passenger transportation
- Passenger transportation specifically related to social services or other programs
- Fixed-route transit in micropolitan areas
- Commuter services from rural counties to urban centers

ADA Paratransit Research

- TCRP Report 119: *Improving ADA Complementary Paratransit Demand Estimation.*
- TCRP Report 158: *Improving ADA Paratransit Demand Estimation: Regional Modeling.*
- Goodwill and Joslin (2013) *Forecasting Paratransit Services Demand - Review and Recommendations.* National Center for Transit Research, University of South Florida.

TCRP Report 161: Demand for rural general public, non-program-related service

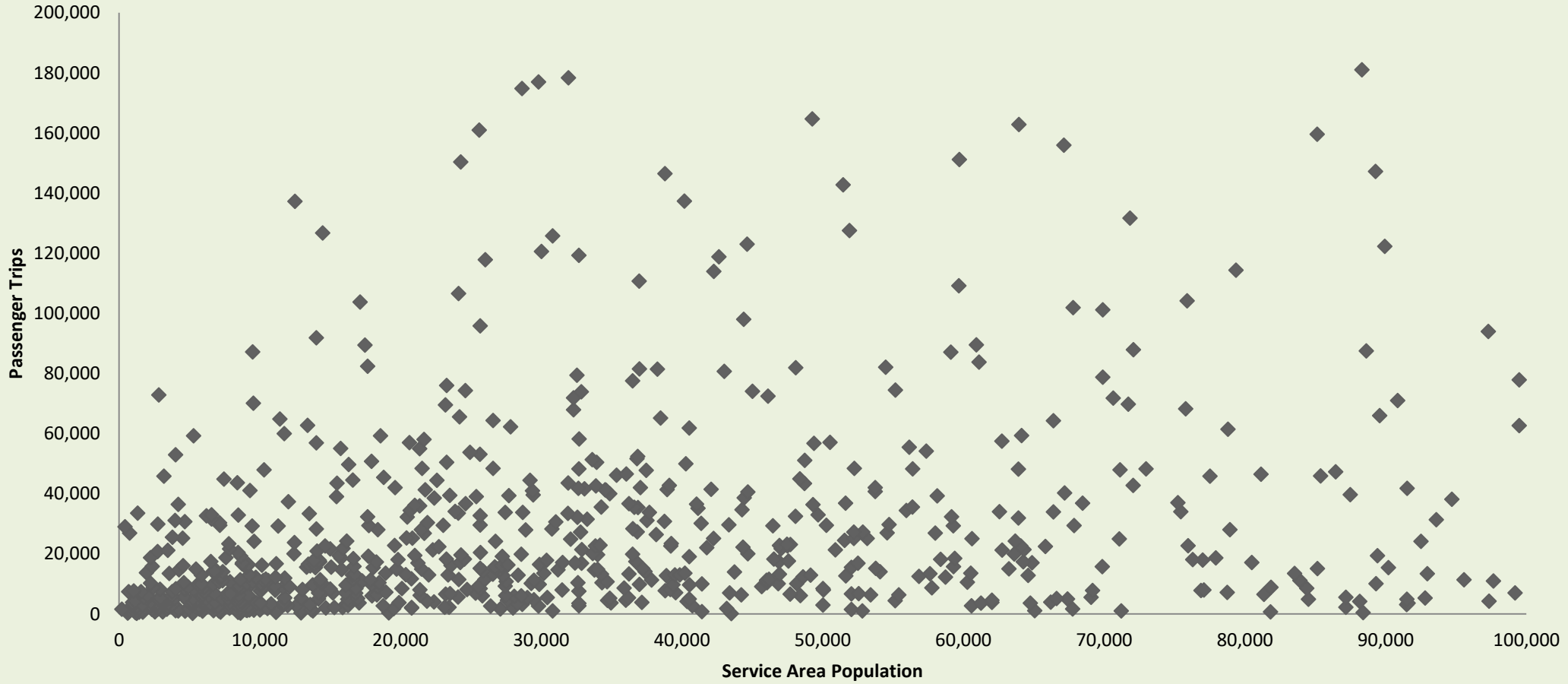
- Two methods
  - Peer data
    - Passenger trips per capita, passenger trips per vehicle mile, passenger trips per vehicle hour
    - Calculate mean, median, and ranges for systems in similar settings
  - Demand function developed based on 2009 rural NTD data
    - Based on the assumption that older adults, people with mobility limitations, and people without access to a vehicle represent the main users of these services

Non-program Demand (trips per year) = (2.20 x Population Age 60+) + (5.21 x Mobility Limited Population Age 18-64) + (1.52 x Residents of Household Having No Vehicle)

Factors Affecting Ridership

- Demand for the service
  - Population
  - Demographics
- Level of service provided/Service characteristics
  - Days per week
  - Hours per day
  - Advance reservation requirements
  - Both demand-response and fixed-route?
  - Overlap in service area?
  - Regional or cultural differences, tribal transit?
- Cost of the service

Population and Demand-Response Transit Ridership



Models

- Two models
- Data sources
  - Model #1
    - Rural National Transit Database, 2013
    - American Community Survey (ACS) 2009-2013 5-year estimates
  - Model #2
    - Survey of rural transit agencies

Model #1

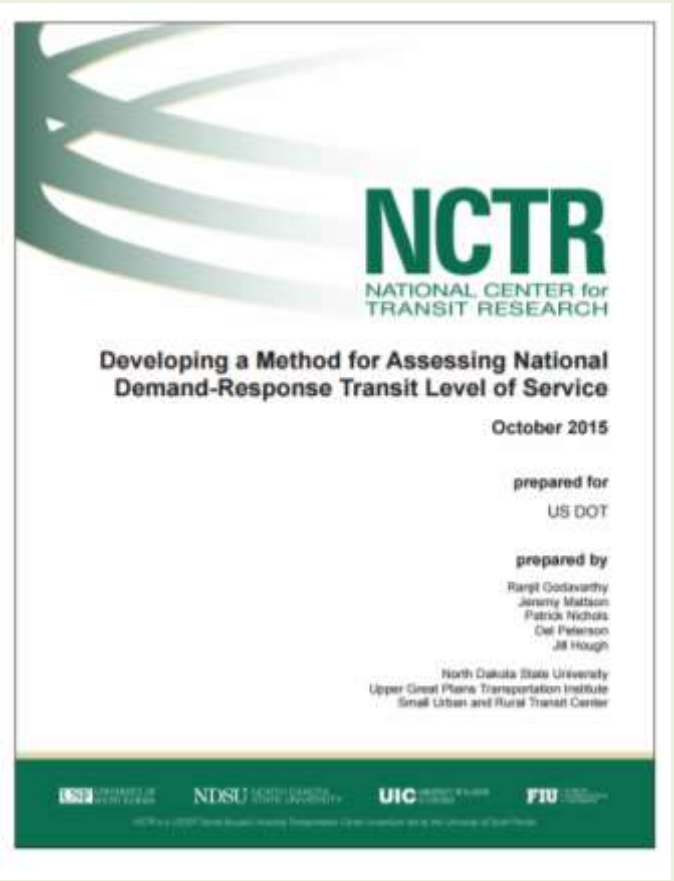
- Ridership is determined by:
  - Demand factors
    - Service area population
    - Demographic characteristics of service area
      - Percentage older adult (65 or older)
      - Percentage without a vehicle
      - Percentage with a disability
  - Service characteristics
    - Operates both fixed-route and demand-response
    - Service area overlaps
    - Serves only a municipality
  - Fare level
  - Other
    - Tribal transit
    - Region
- Data for 731 agencies for 2013

Limitations of Rural NTD Data

- Incomplete and imprecise service area information
- No data:
  - Hours per day
  - Days per week
  - Advance reservation requirements
  - Type of service provided

Survey of Transit Agencies

- Previous study conducted in North Dakota and Florida
  - ***Developing a Method for Assessing National Demand-Response Transit Level of Service.*** Ranjit Godavarthy, Jeremy Mattson, Patrick Nichols, Del Peterson, and Jill Hough. University of South Florida, Tampa: National Center for Transit Research, 2015.
  - Journal of Public Transportation, 18 (4): 1-15.



Survey of Transit Agencies

- Collected detailed information
  - Geographic service area
  - Span of service
  - Advance reservation requirements
  - Service eligibility and type
- Additional surveys conducted nationwide
- Data collected for 68 rural demand-response transit agencies

Model #2

- Ridership is determined by:
  - Service area population
  - Hours of service per day
  - Days of service per week
  - Advance reservation time
  - Operates both fixed-route and demand response
  - Fare level

Results: Model #1

Independent Variable	Estimated coefficient	Standard error	p-value
Ln(Population)	0.83	0.02	0.000
Percentage elderly	7.99	0.99	0.000
Percentage with no vehicle	21.15	5.65	0.000
Percentage with disability	-0.46	1.20	0.703
Fixed-route	-0.65	0.11	0.000
Percentage overlap	-0.41	0.10	0.000
Municipality	0.77	0.10	0.000
Tribal	0.30	0.31	0.333
Ln(Fare)	-0.24	0.04	0.000
Region 1	-0.60	0.33	0.071
Region 2	-0.57	0.42	0.170
Region 3	-0.56	0.25	0.027
Region 4	-0.81	0.19	0.000
Region 5	0.50	0.20	0.012
Region 6	-0.15	0.22	0.480
Region 7	-0.36	0.19	0.057
Region 8	0.09	0.19	0.628
Region 9	0.16	0.25	0.523

Results: Model #1

- Population has a positive effect on ridership.
  - A 1% increase in population leads to a 0.83% increase in ridership.
- Demographics impact ridership.
  - Areas with a higher percentage of older adults or households without access to a vehicle have higher levels of ridership.
  - If the percentage of the population that is aged 65 or older increases by one percentage point, ridership increases by 8%.
  - If the percentage of the population without a vehicle increases by one percentage point, ridership increases by 21%.

Results: Model #1

- Agencies that provide both fixed-route and demand-response service have lower levels of demand-response ridership than agencies that provide just demand-response service, after accounting for all other variables.
- Agencies that serve areas where more than one transit provider is available have lower levels of ridership.
- Demand-response providers that strictly serve a municipality have higher levels of ridership than those serving a larger geographic area, after accounting for population and other factors.

Results: Model #1

- Fares have a negative impact on ridership. A 1% increase in fares leads to a 0.24% reduction in ridership.
- There are some regional differences in ridership not accounted for by these variables. Notably, region 5 agencies have higher levels of ridership, and agencies in regions 3 and 4 have lower levels.

Out-of-Sample Validation

- Results from the model were used to predict ridership for 2014
- Predicted ridership was compared to actual ridership

		Model #1	TCRP 161 Model
Population under 100,000 (n=688)			
	RMSE	55,579	73,941
	MAE	23,506	28,669
Population under 50,000 (n=544)			
	RMSE	48,231	71,439
	MAE	19,536	26,027

Results: Model #2

Independent Variable	Estimated coefficient	Standard error	p-value
Ln(Population)	0.69	0.07	<.0001
Percentage population with 6 or 7 days	1.65	0.80	0.0439
Percentage population with 5 days	1.41	0.69	0.046
Percentage population with 12 or more hours	0.50	0.43	0.2545
Percentage population with less than 5 hours	-0.40	1.20	0.7397
Same-day reservation	2.01	0.55	0.0006
Prior-day reservation	1.24	0.56	0.0321
Fixed-route	-0.65	0.39	0.1013
Ln(Fare)	-0.12	0.07	0.0843

Results: Model #2

- Population has a positive effect on ridership.
  - A 1% increase in population leads to a 0.69% increase in ridership.
- Ridership is impacted by the number of days that service is available.
  - As the percentage of service area population with service 5 days per week increases by one percentage point, ridership increases 1.41%.
  - Ridership increases 1.65% as the percentage of service area population with service 6 or 7 days per week increases by one percentage point.

Results: Model #2

- Advance reservation time has a negative impact on ridership.
  - Compared to agencies that require reservation two or more days in advance, ridership is 124% higher for providers that require reservation one day in advance and 201% higher for agencies that allow same-day service.
- Agencies that provide both fixed-route and demand-response service have lower levels of demand-response ridership than agencies that provide just demand-response service, after accounting for all other variables.
- Fares have a negative impact on ridership.
  - A 1% increase in fares leads to a 0.12% reduction in ridership.

Applications

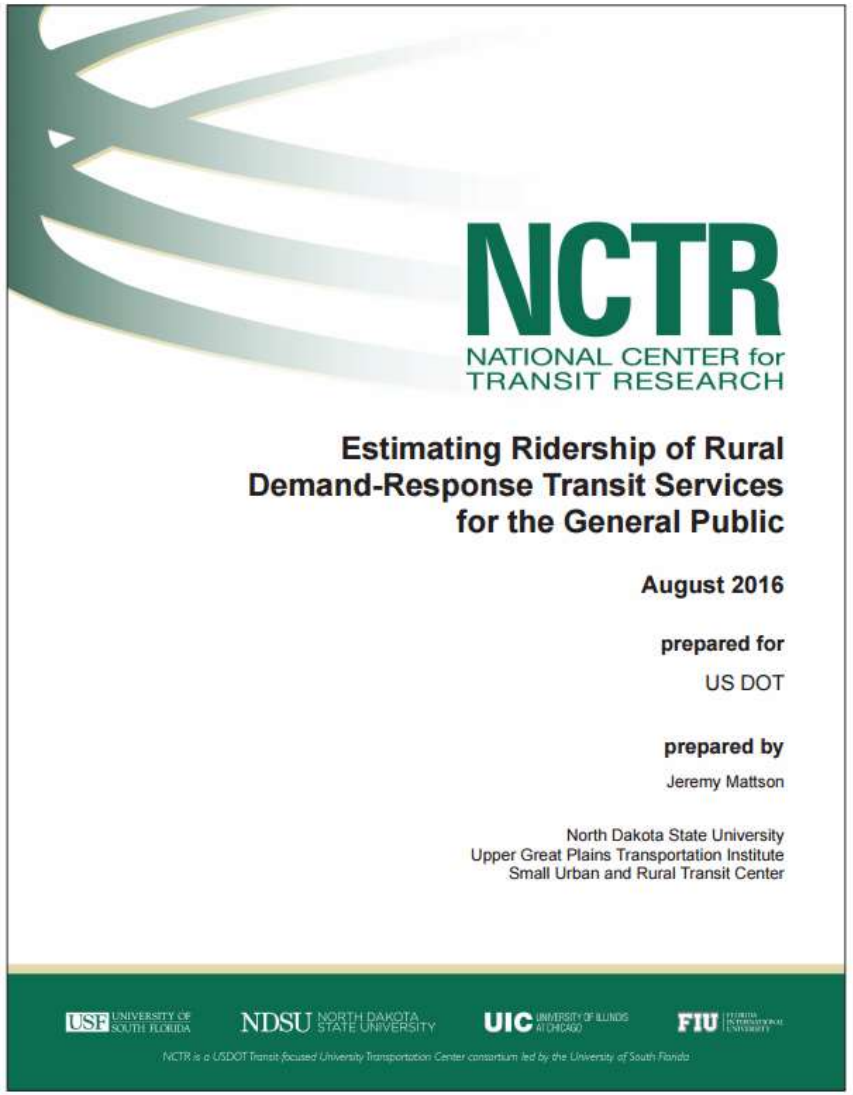
- Forecast demand for new service
- Estimate the impact of service changes
  - Geographic coverage
  - Span of service
  - Fares
  - Reservation requirements
- Project future ridership based on population and demographic changes

Conclusions

- Demographic characteristics are important
  - Older adults
  - People without access to a vehicle
- Geographic characteristics of service are important
- Fare elasticity estimated at -0.12 to -0.24
- Availability of service/quality of service impacts ridership
  - Agencies providing more days of service had higher levels of service
  - Advance reservation time is important

Conclusions

- Two new tools for estimating ridership
- A greater number of variables and more specific service information improves the performance
- Limited by data availability
- Identify high-productivity systems
- Many factors specific to each agency and community not captured by the model



Thank you!

Questions?

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