Modeling Ride-Hailing Demand for Any Census Tract in the United States Using Open Data: Validation and Application to Autonomous Vehicles in Rural Kentucky

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- **Autonomous vehicle ride-hailing services could fill this gap.**

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- AV ride-hailing reduce the cost of labor, but other costs remain. How does this balance out?

Applying an existing demand model out-of-sample.

- We apply an existing TNC demand model developed for Chicago[4] (base year 2019) out-of-sample, **with the idea that TNC ride-hailing and AV ride-hailing are substitutes.**

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- Outputs: ride-hailing demand for an average weekday by Census tract, broken out by private and shared (matched/unmatched) demand.

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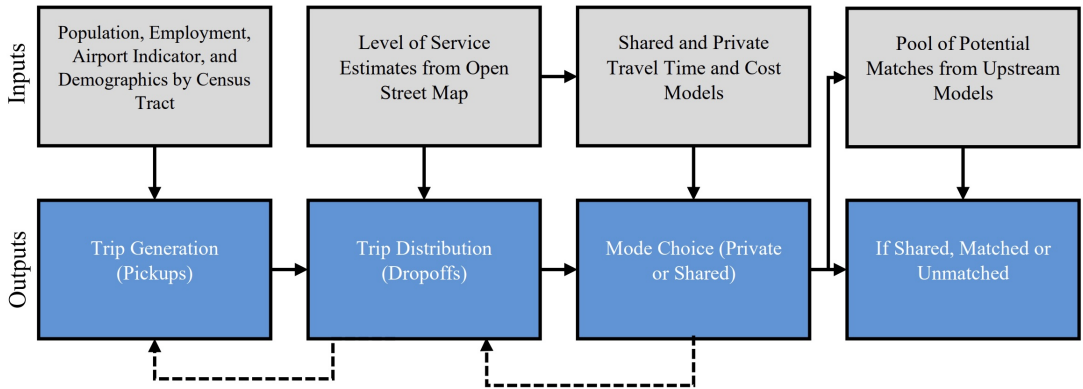
Model Flowchart



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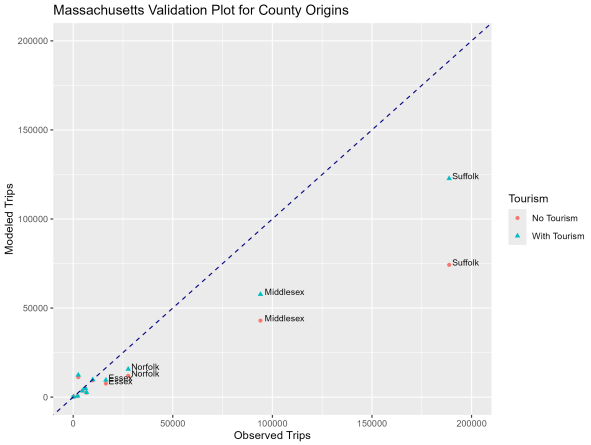
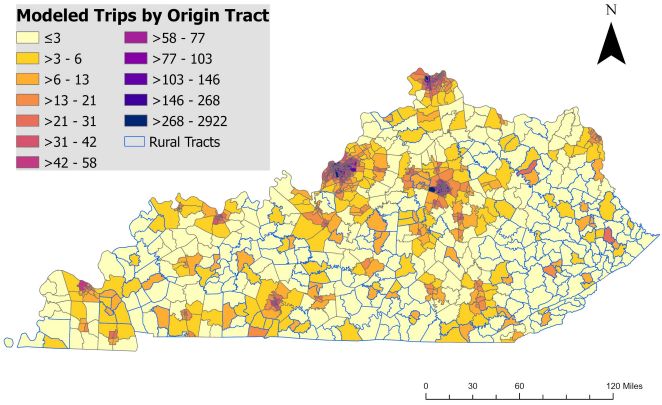
  - Two model runs were done to test the effects of tourism in Massachusetts.
  - Tourism areas: Boston Common and Downtown Salem.

We have assurance that the model can be applied out-of-sample to rural areas.



County	Modeled Trips from Origin (No Tourism)	Modeled Trips from Origin (With Tourism)	Observed Trips from Origin
Barnstable	11,226	12,438	2,565
Berkshire	332	332	215
Bristol	3,539	3,559	4,618
Essex	7,625	9,586	16,407
Franklin	120	120	55
Hampden	4,865	4,865	6,127
Hampshire	628	628	2,231
Middlesex	42,946	57,692	94,022
Norfolk	11,953	15,692	27,640
Plymouth	2,490	2,671	6,700
Suffolk	74,246	122,726	188,754
Worcester	9,397	9,818	9,821

In the baseline scenario, 31,560 trips originate from non-rural tracts and 759 trips originate from rural tracts[5].



[5]We use the US Department of Agriculture's Rural-Urban Commuting Codes to classify tracts as rural or non-rural.

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State: Kentucky	Baseline	Half-Fare	Quarter-Fare
Total Rides	**32,319**	**46,555**	**58,459**
Non-Rural Origin	*31,560*	*45,502*	*57,090*
Rural Origin	*759*	*1,052*	*1,369*
Private Rides	**17,647**	**28,700**	**39,120**
Non-Rural Origin	*17,141*	*28,016*	*38,220*
Rural Origin	*506*	*684*	*900*
Matched Rides	**12,292**	**16,497**	**17,849**
Non-Rural Origin	*12,143*	*16,189*	*17,442*
Rural Origin	*149*	*308*	*407*
Unmatched Rides	**2,381**	**1,359**	**1,490**
Non-Rural Origin	*2,277*	*1,298*	*1,428*
Rural Origin	*104*	*61*	*62*
Average trip-weighted average fare (rides ≤ 1 hour)			
Private	*$8.88*	*$5.31*	*$2.99*
Shared	*$8.01*	*$4.28*	*$2.27*
Total Fare Revenue	**$799,231**	**$520,486**	**$325,710**
Non-Rural Origin	*$795,240*	*$515,651*	*$321,207*
Rural Origin	*$3,991*	*$4,835*	*$4,503*

Note: components might not sum to totals due to rounding.

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- Provides the necessary outputs to complement supply-side models such as FleetPy, which is of use to anyone who wants to do driver simulations.
- In addition to testing fare sensitivity, end-users can also make changes to other model inputs (including but not limited to employment density, employment type, and/or vehicle ownership by income) to see how ride-hailing demand is affected.

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  - But the alternative is knowing nothing because we have no data.
- Analysis is performed within-state, which omits trips that cross state lines.

Main takeaway: autonomous vehicle ride-hailing has the potential to reduce transportation barriers in rural communities.

- 6% of rural households don't have access to a car, with these households being most common in the southeastern United States[1].

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- While our model shows that rural demand is quite low (roughly 2% across all scenarios), this opens the door for a funding mechanism where non-rural riders subsidize rural riders.

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  - Non-rural ride-hailers could be taxed $0.126 per ride ($3,991 ÷ 31,560) to cover rural riders' fares.

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