

A data informed modeling approach in Fort Wayne, Indiana

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Project background

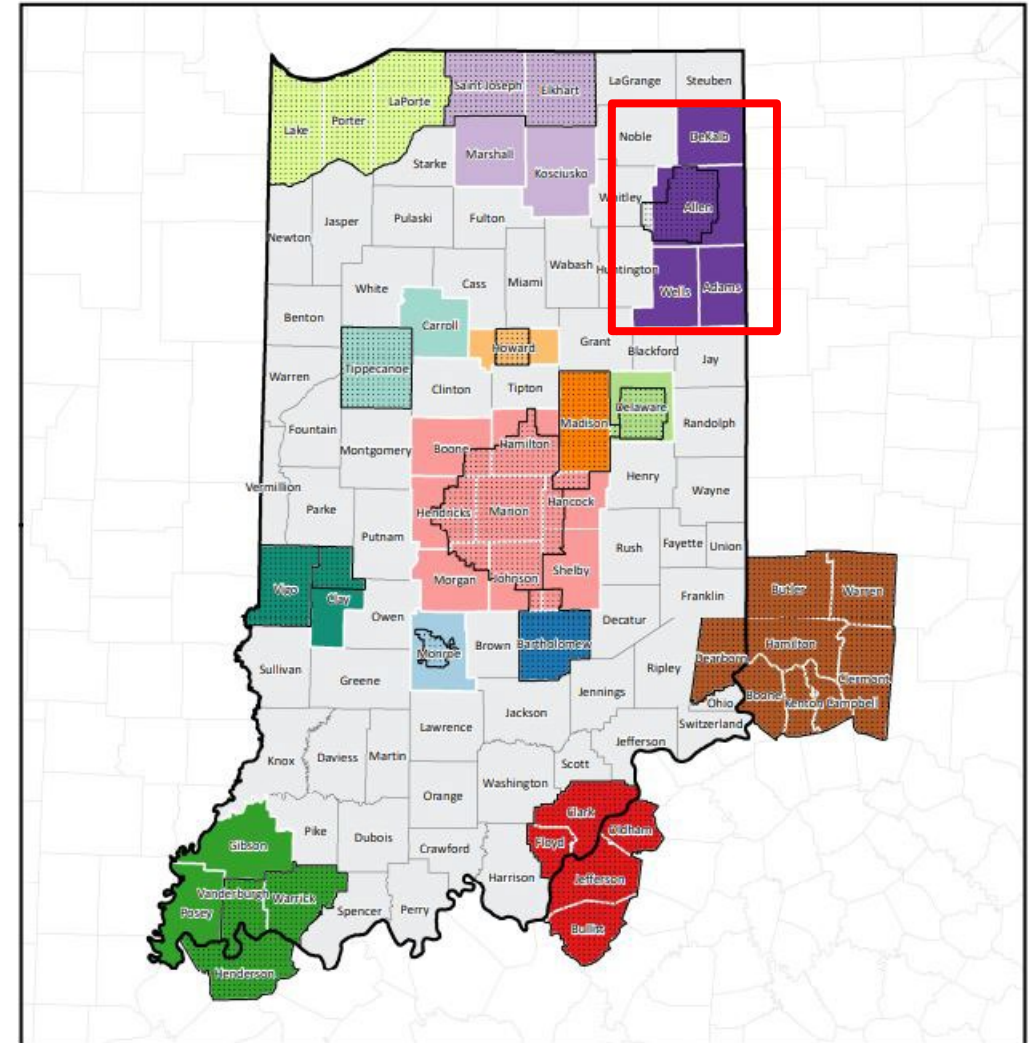


Project team

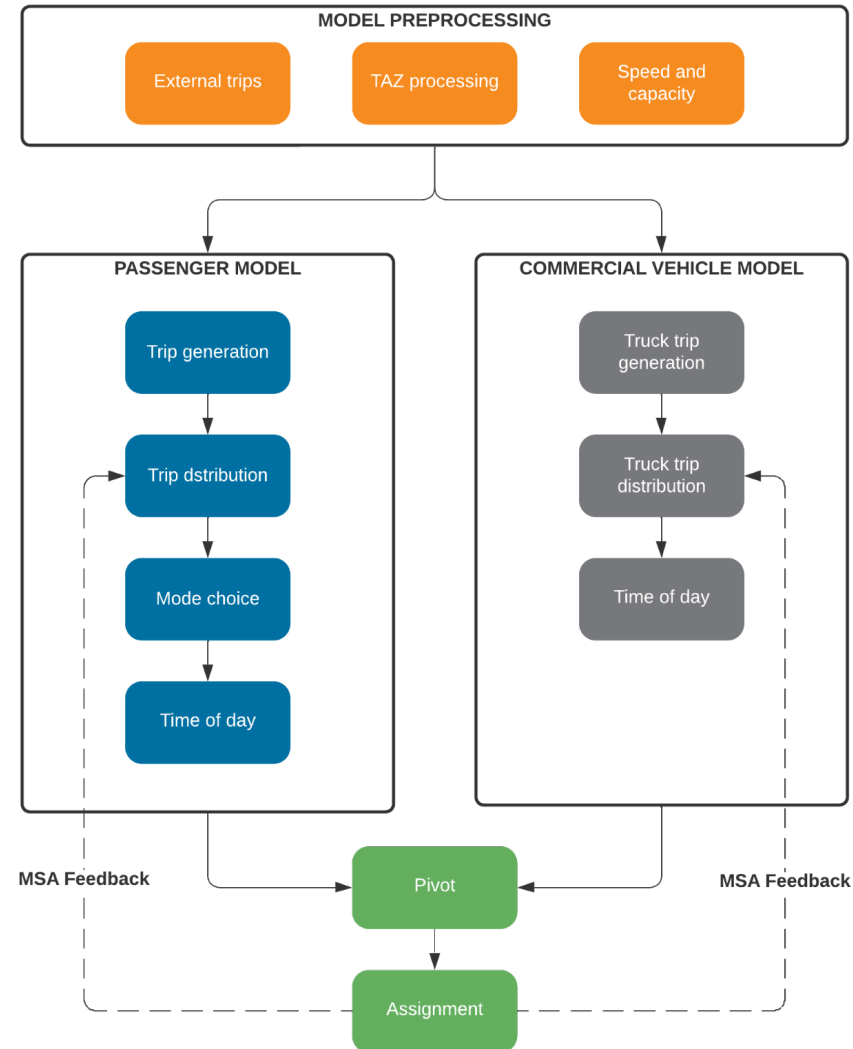


Project scope

- Update highway network
- Advise client on zone boundary changes and socioeconomic data
- Expand passive data provided by Streetlight
- Update trip generation to include segmentation by auto sufficiency
- Implement destination choice model segmented by auto sufficiency
- Implement updated mode choice model segmented by auto sufficiency
- Implement pivot procedure using passive data
- Update model code and scenario management framework
- Calibrate and validate model system to base year 2019 traffic counts



Model architecture



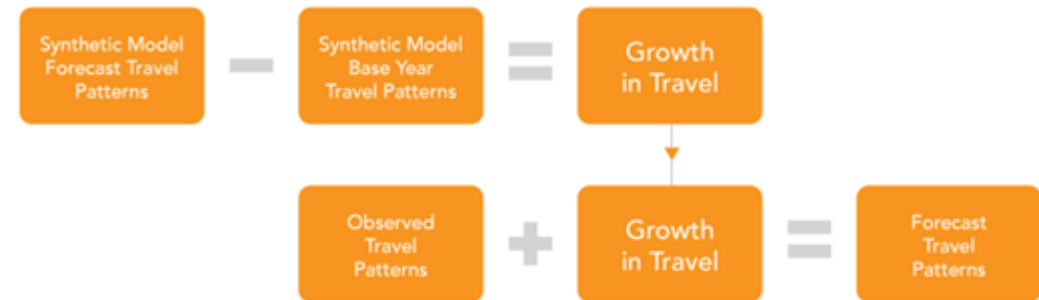
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Data informed modeling



What is pivoting?

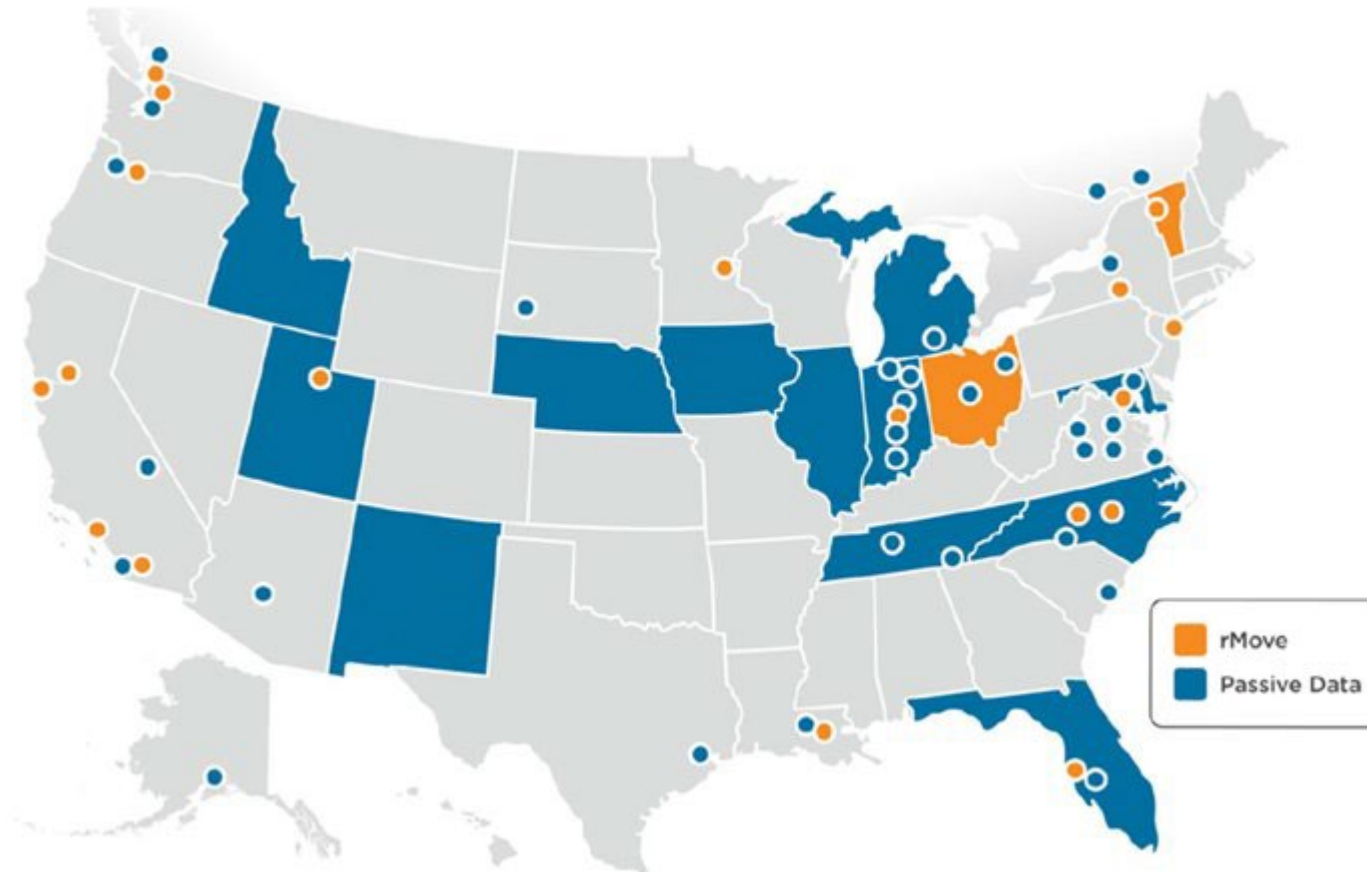
- Process of taking a fixed base point and making forecasts relative to that base
- Refocuses modeling effort on predicting *changes*
- Must have an accurately known base-year origin-destination pattern
- This process can significantly reduce expected forecasting error because forecasts are grounded in a known and observed reality



Incremental forecasting

- The rise of passive data is increasingly making it easier to develop approaches that directly use expanded big data
- Data driven forecast methods are motivated and rooted in an understanding of and limitations of synthetic modeling
- Data driven methods use models to predict likely changes in new travel origin-destination (O-D) patterns while relying more on the actual data of travel patterns from passive data rather than on the models.
- Data driven models excel where there is a higher degree of variability in trip lengths and O-D patterns, where synthetic models struggle to reproduce the observed O-D pattern

Mobile data experience



Over 50 projects in 25 states

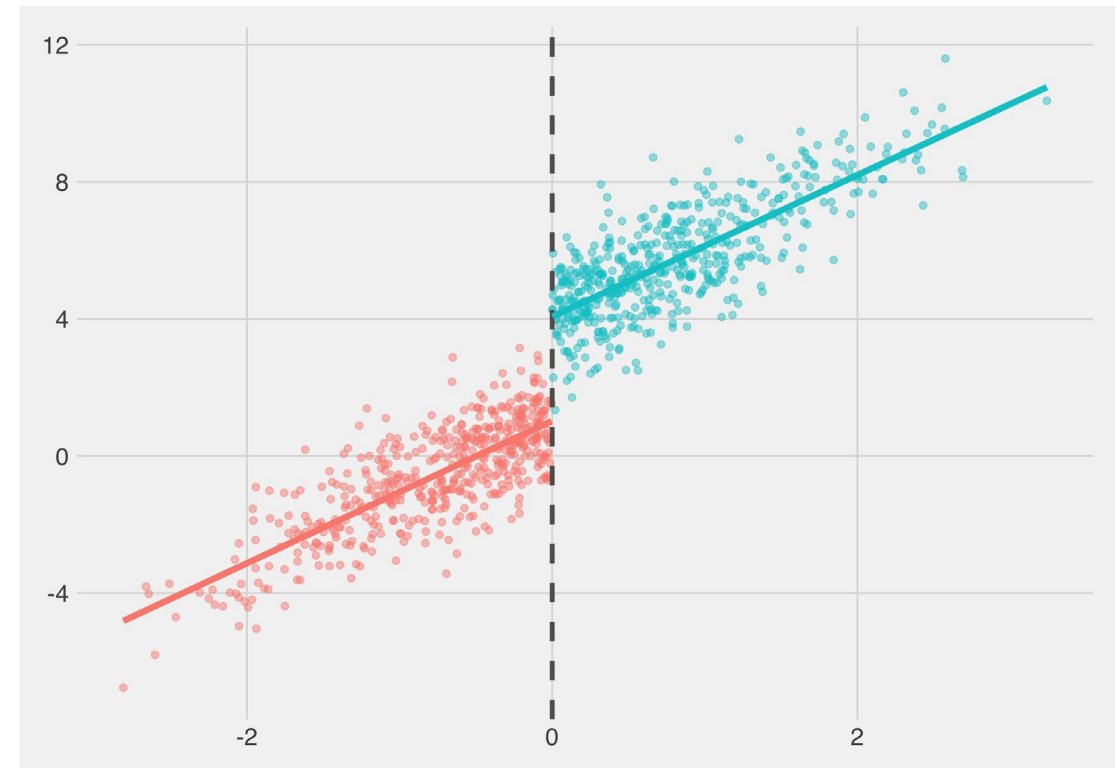
Types of pivoting

- FHWA TMIP webinars by RAND Europe for Australia Forecasting (2015)
 - Pivoting in Travel Demand Models (Daly, et al., 2012)
 - Pivoting combine model synthetic forecasts for base (S_b) and Future (S_f) with base information (B) on flows
- Multiplicative: $P = (\frac{S_f}{S_b})B$
 - Additive: $P = B + (S_f - S_b)$
 - Mixed/ Average of above

Base (B)	Synthetic Base (S_b)	Synthetic Future (S_f)	Predicted (P)		Cell Type
0	0	0	0		1
0	0	>0	S_f		2
0	>0	0	0		3
0	>0	>0	Normal growth	0	4
			Extreme growth	$S_f - X_1$	
>0	0	0	B		5
>0	0	>0	$B + S_f$		6
>0	>0	0	0		7
>0	>0	>0	Normal growth	$B (\frac{S_f}{S_b})$	
			Extreme growth	$B (\frac{X_2}{S_b + (S_f - X_2)})$	

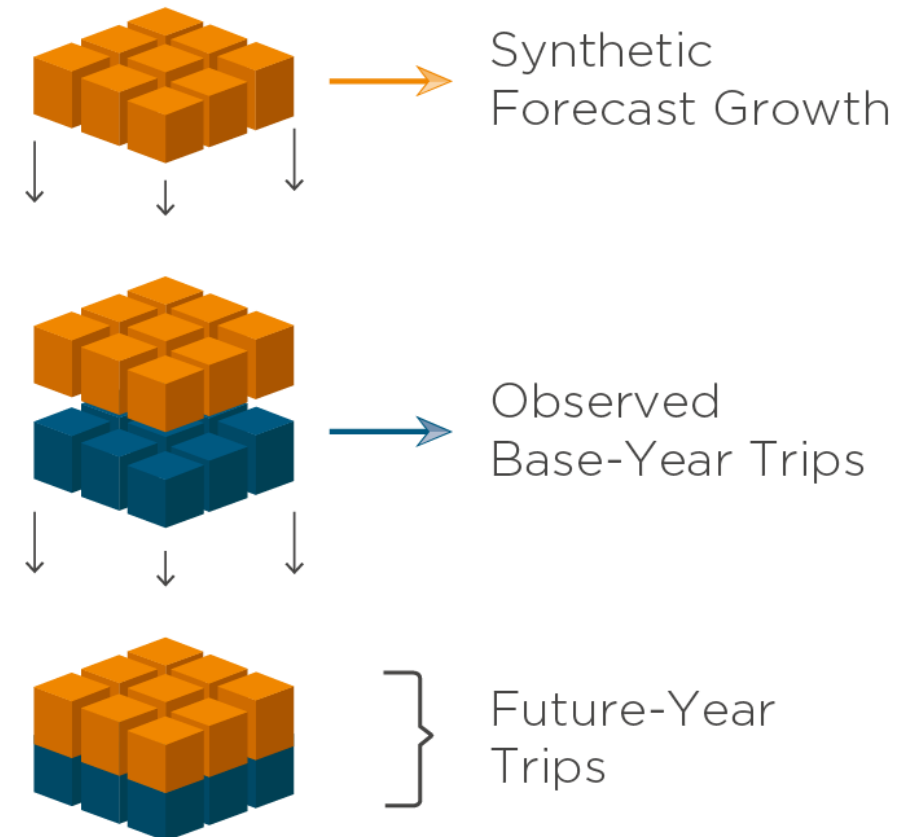
Pivoting challenges

- Multiplicative pivoting can be extremely challenging
 - Defining and calibrating switching points in cases of extreme growth
 - Base year model & passive data alignment
 - Base year errors amplified by future-year socioeconomic conditions
 - Identification of potential discontinuity between cases
- Greenfield development carries large risk of producing absurd growth
- Model growth is often interpolated and applied uniformly

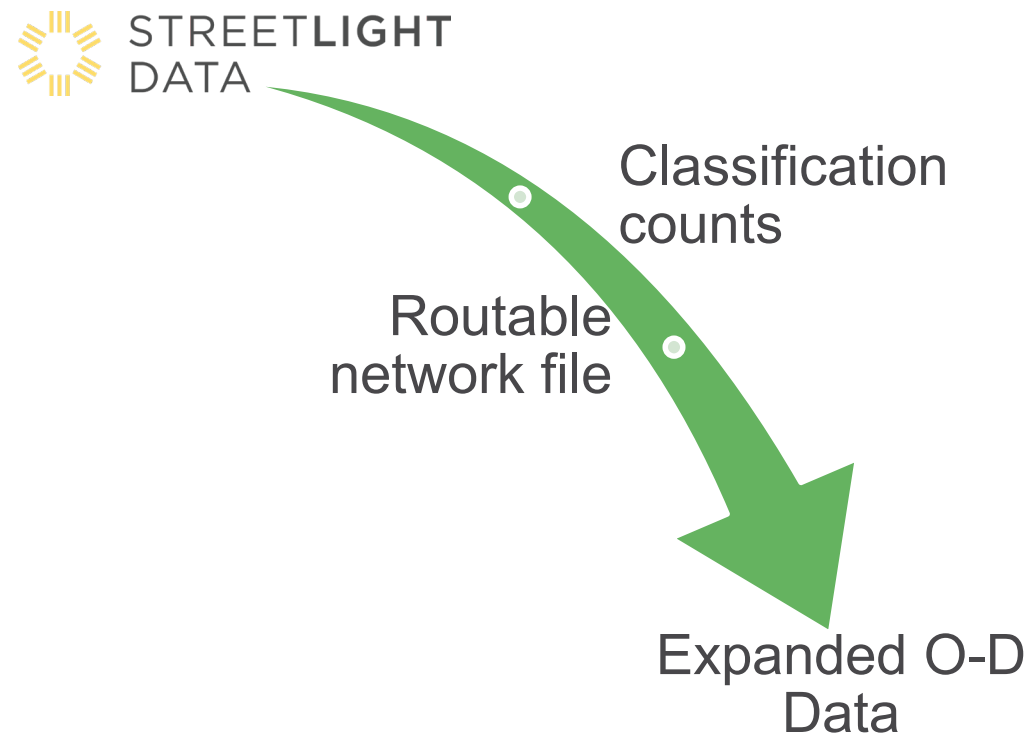


Additive pivoting approach

- Additive pivoting layers synthetic growth on top of the observed base
- Additive pivoting carries less risk and is a simpler approach to implement than pure multiplicative pivoting
- Additive pivoting may add growth to O-Ds with little or zero demand observed in the base year

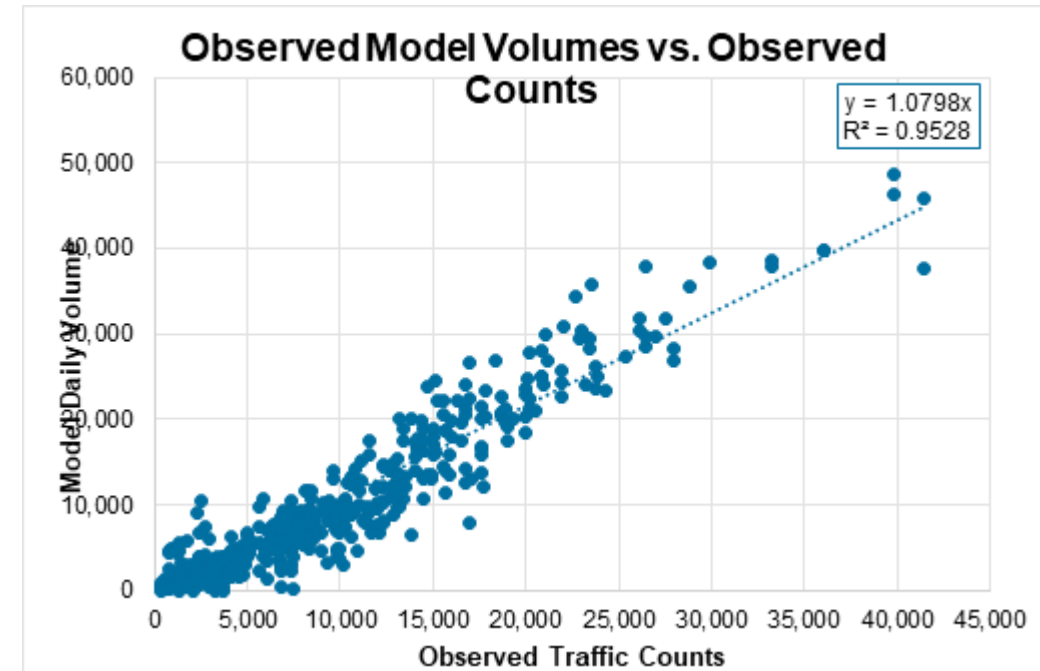
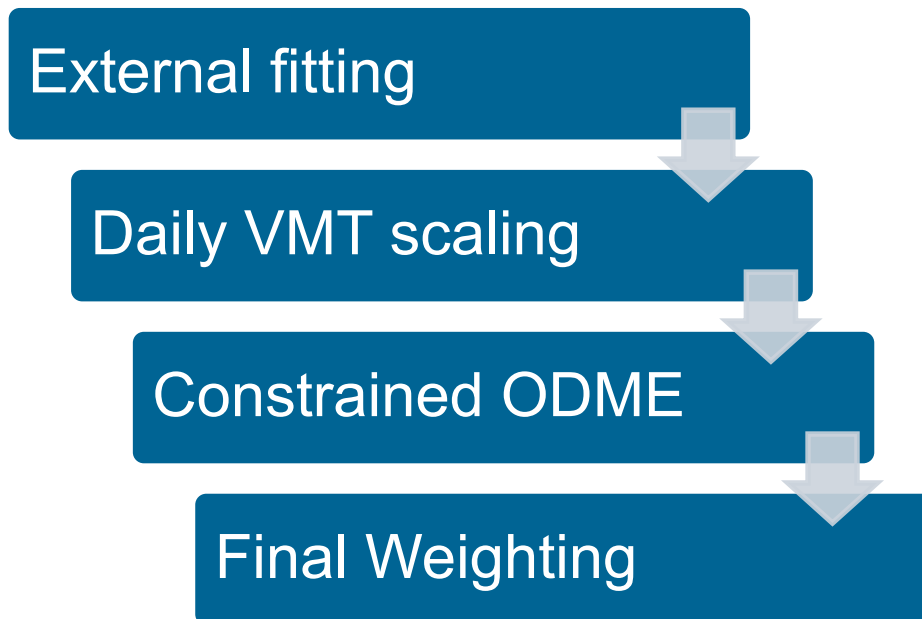


Big data expansion

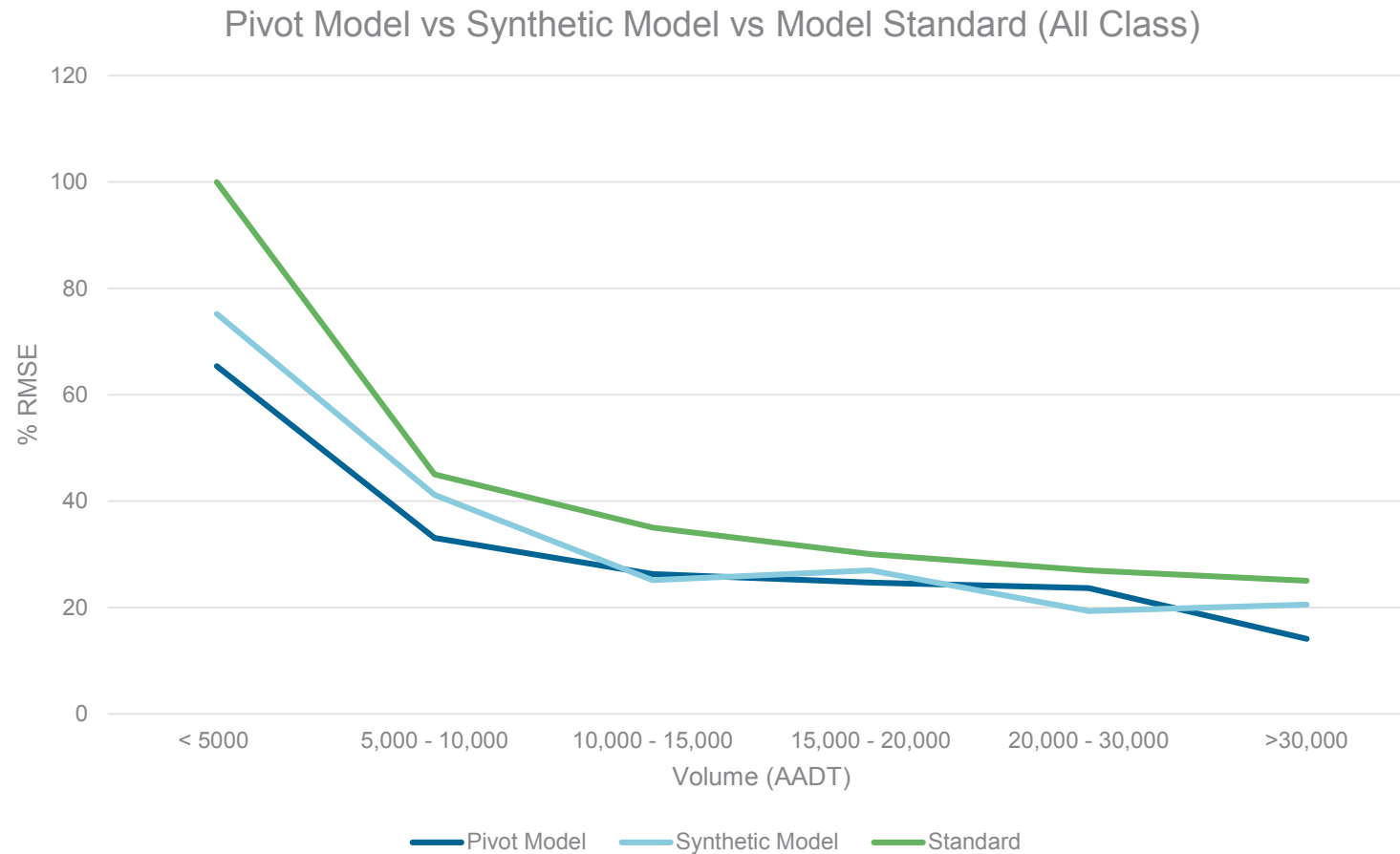


Big data expansion

Ensemble expansion process



Pivot model vs. Synthetic Model vs Standard

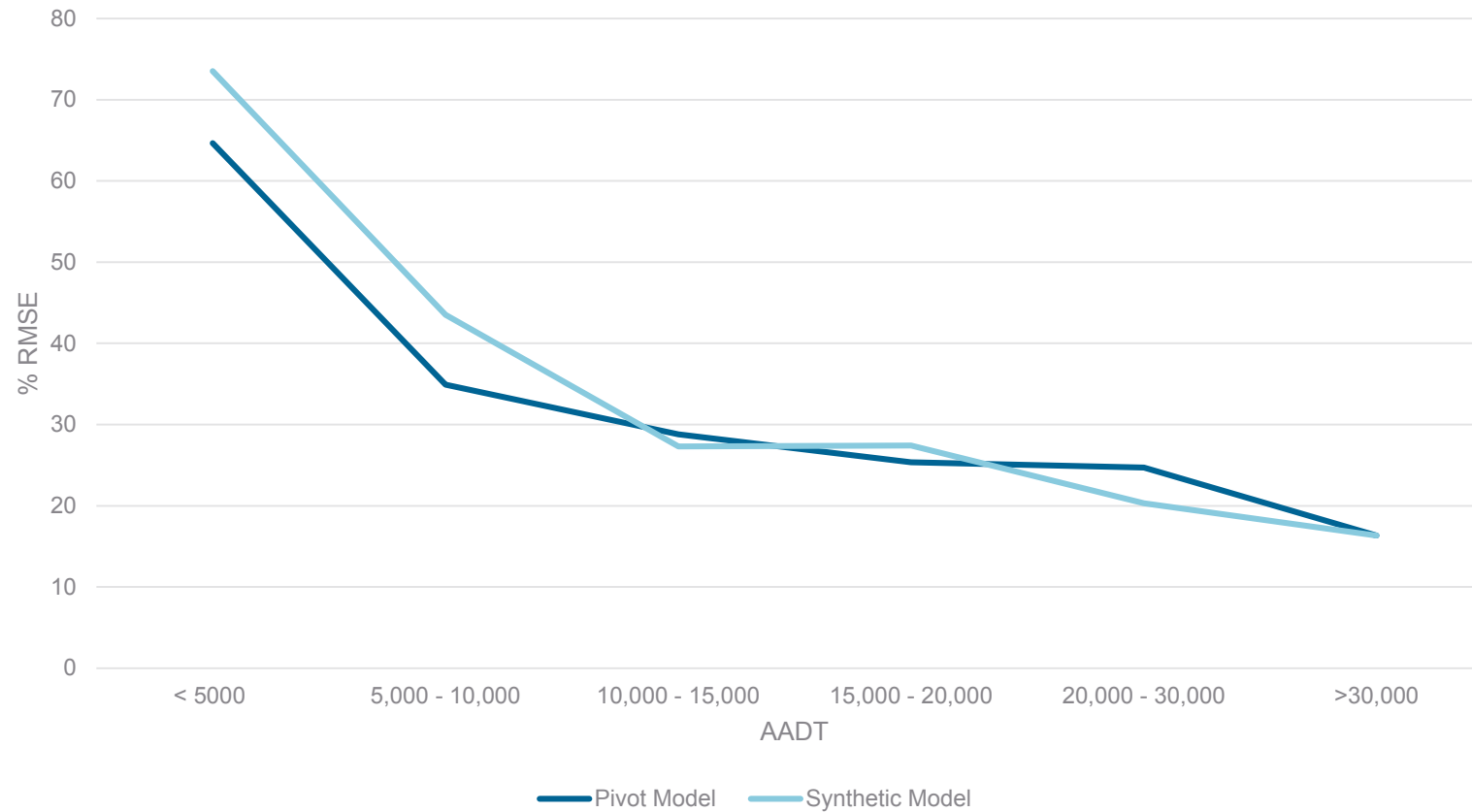


Areawide

Pivot	32.79
Synthetic	34.83
Standard	45.00

Auto

Pivot Model vs. Synthetic Model (Auto)

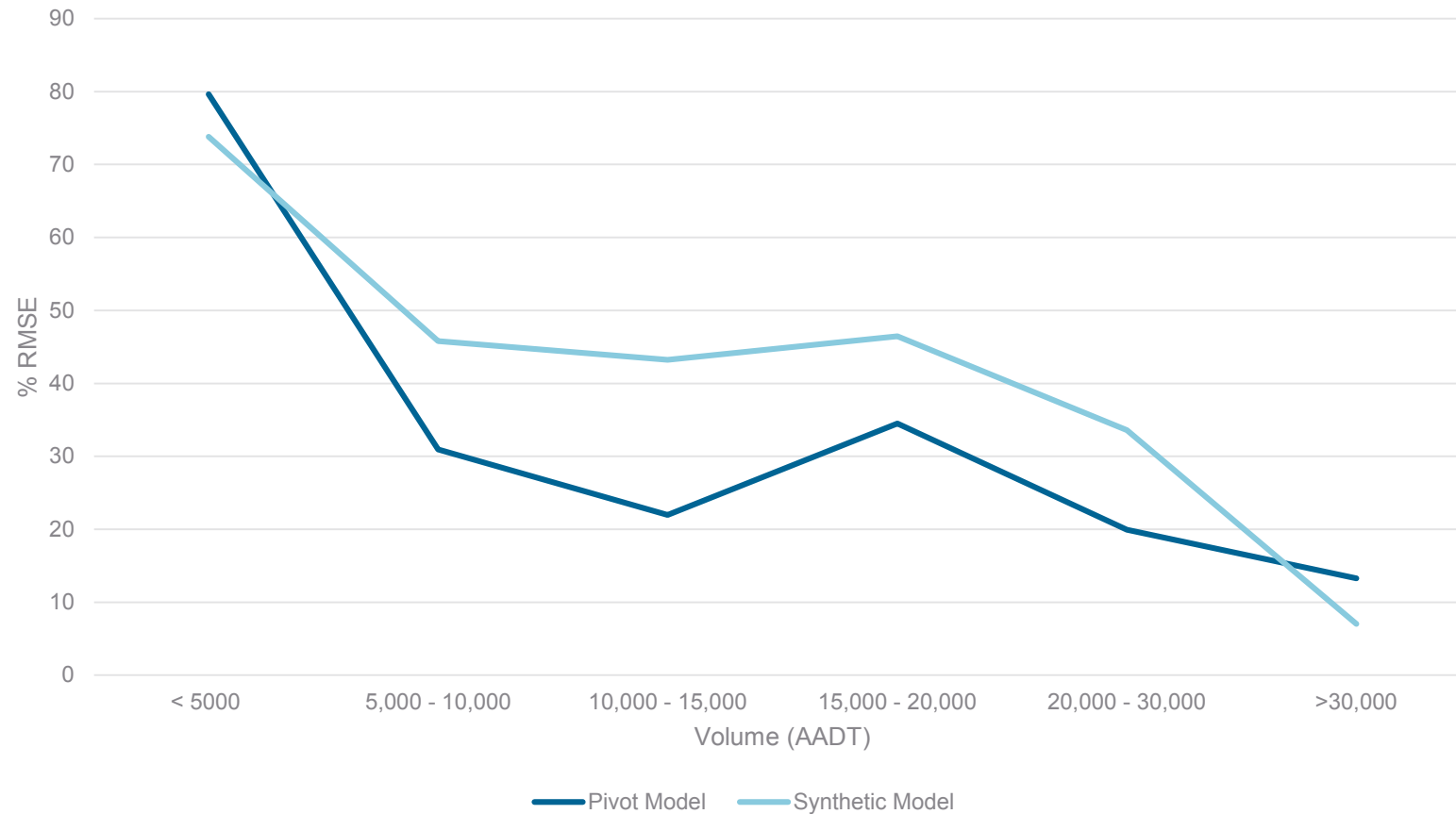


Areawide

Pivot	34.62
Synthetic	36.70

Truck

Pivot model vs. Sythetic model (Truck)

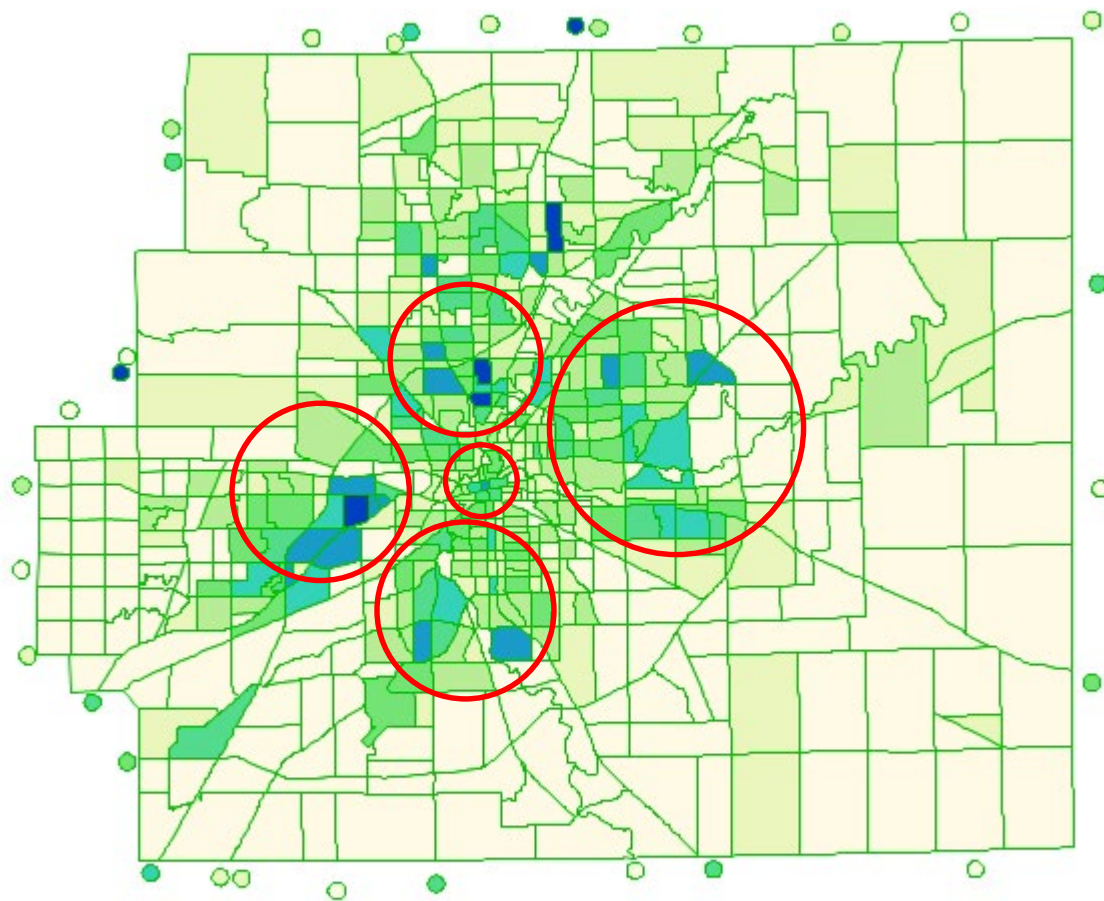


Areawide

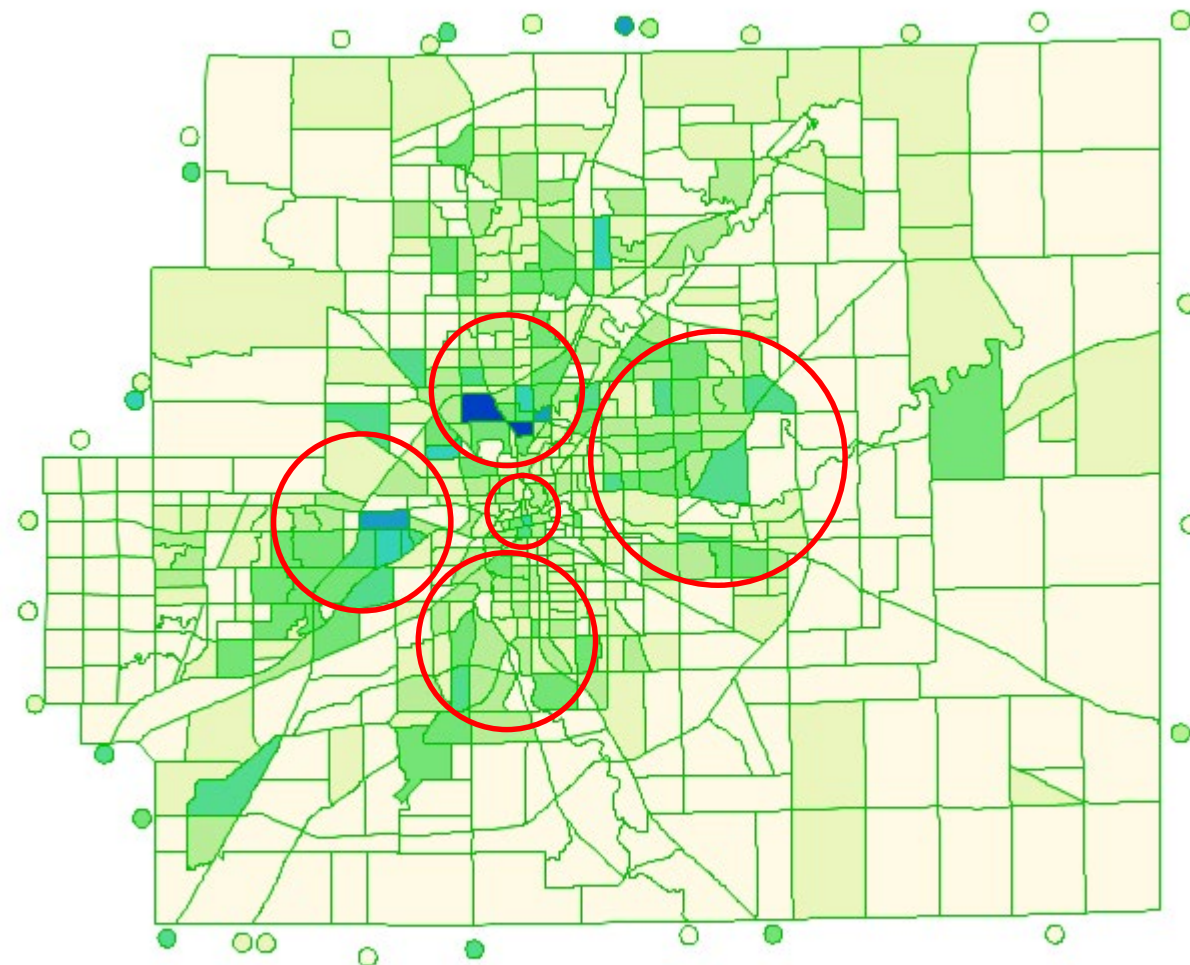
Pivot	30.57
Synthetic	46.28

Pivot vs. Synthetic O-D Trips (Auto)

PIVOT

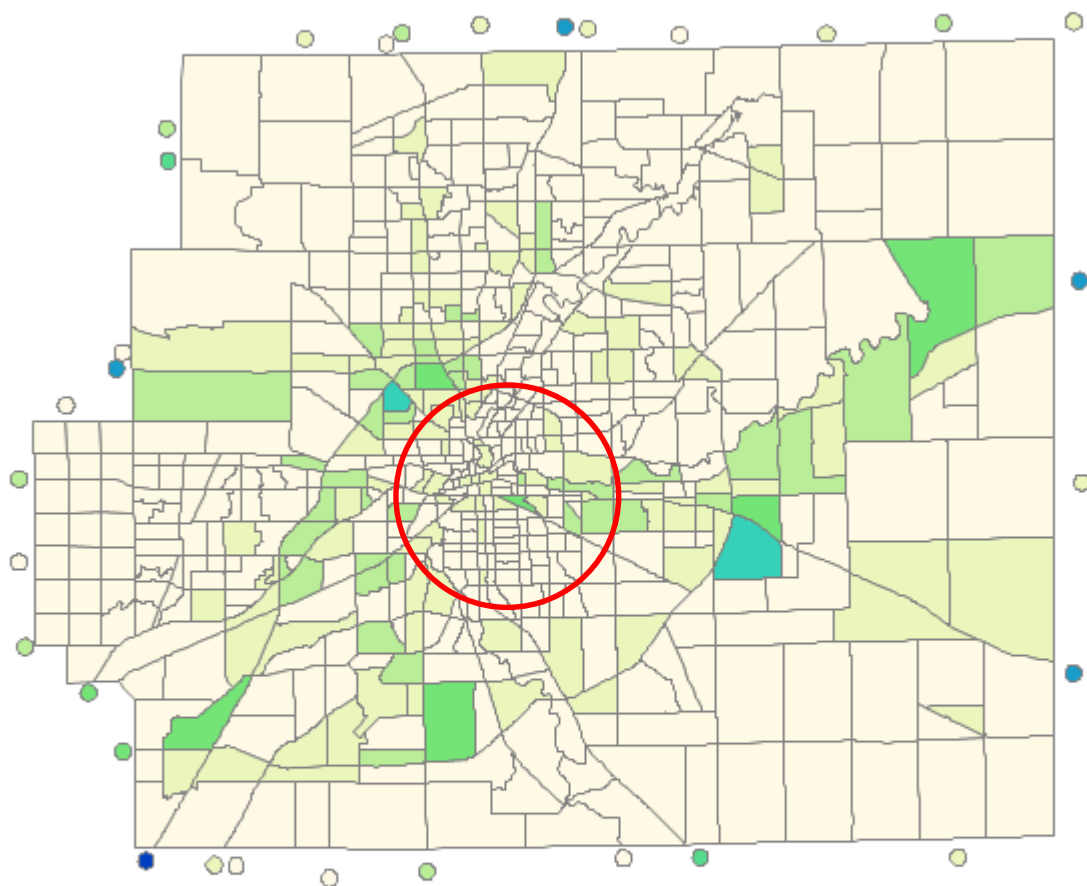


SYNTHETIC

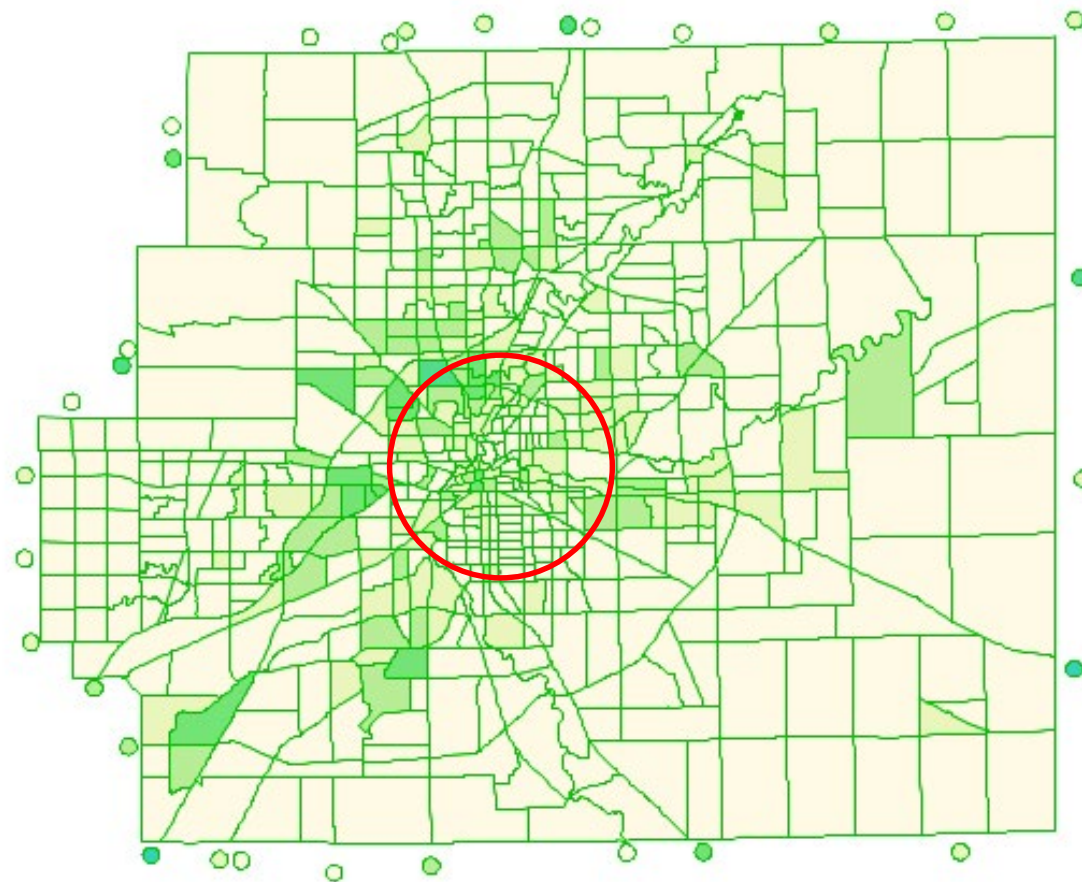


Pivot vs. Synthetic O-D Trips (Truck)

PIVOT



SYNTHETIC



Thank you

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