Estimating Regional Visitor Travel Using Passive Data for Travel Demand Models

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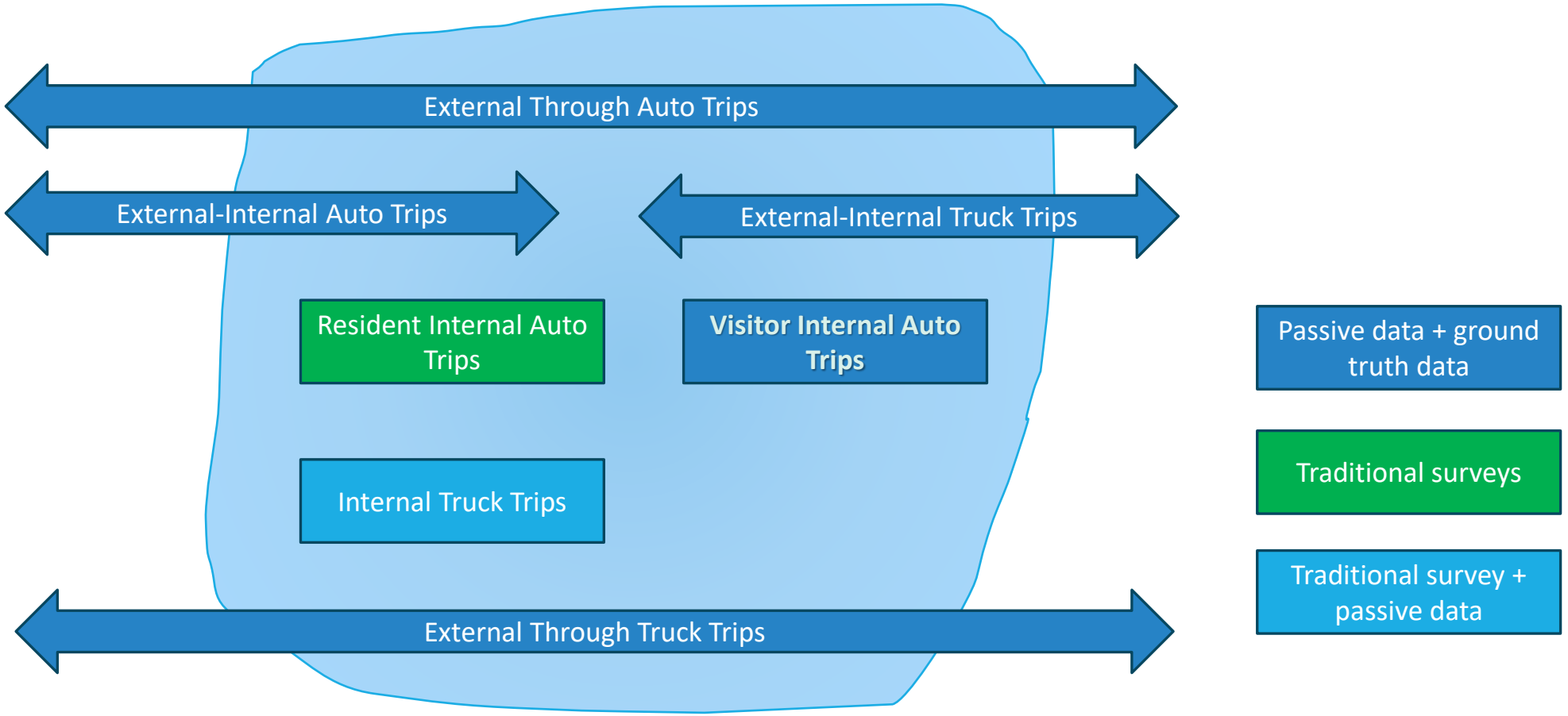
Research Motives

- **Travel Market Segments in Travel Demand Models**
  - Household
  - Commercial Vehicle (CV)
  - External (EE/EI/IE)
  - **Visitor - trips within the study area by non-residents, often hardest to measure**
- **Survey Challenges for Visitor Travel**
  - No survey sampling frame
  - Recruitment difficulties
  - Overall, hard to execute in practice
- **Location-based (LBS) data Opportunity**
  - LBS data can often infer home locations
  - Enable distinguishing residents from non-residents with reasonable accuracy

Research Goal

- Develop **<u>methods</u>** to estimate visitor trips using a comprehensive set of data sources
  - Passive data
    - LBS
    - Embedded-GPS vehicle locations
  - 'Ground-Truth' data
    - Traffic counts
    - HMPS Vehicle Miles of Travel (VMT)
    - Travel surveys, such as household travel survey and workplace survey
- **Consistent and Defensible Estimates - Preferred Estimate**

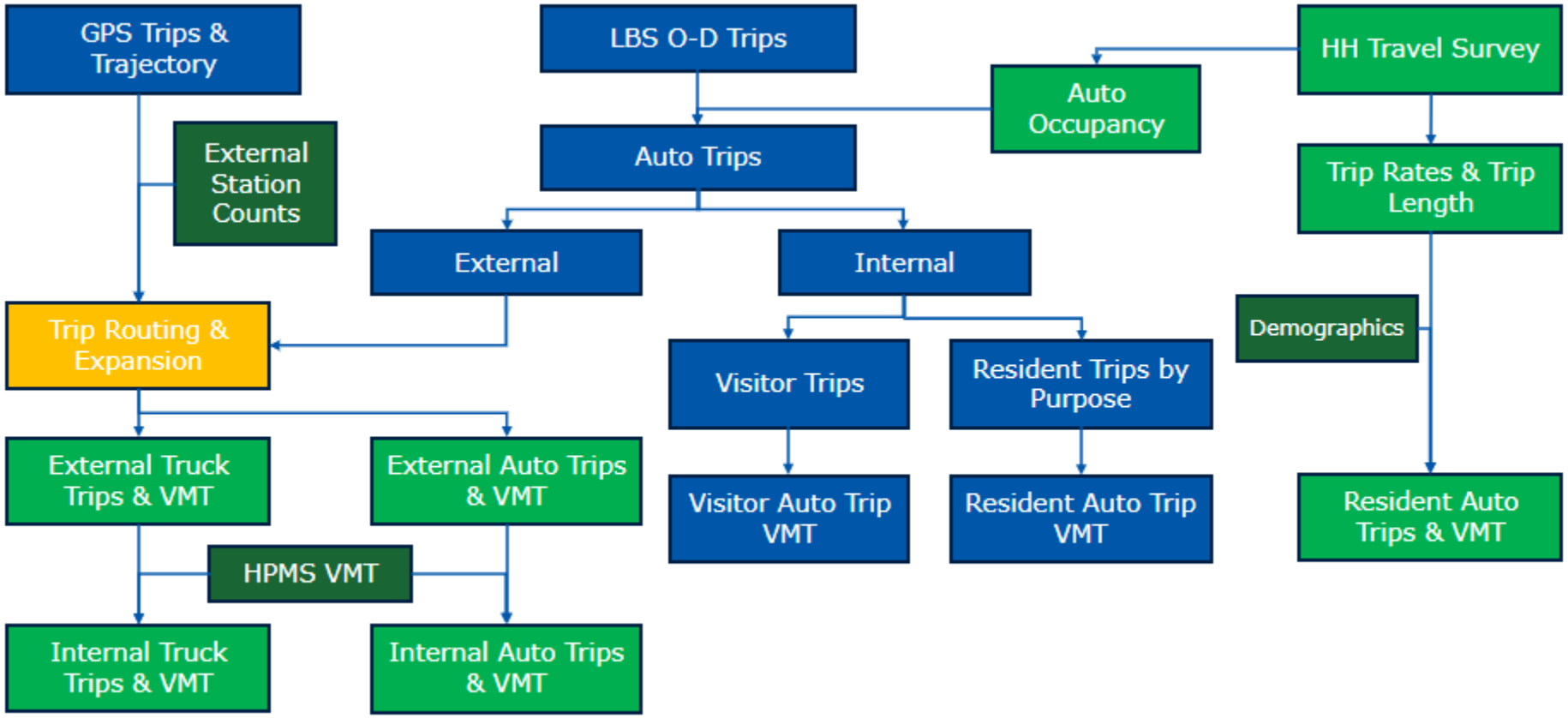
Travel Markets in a Typical Travel Demand Model



Data Source

Data Source	Usage
LBS O-D Data	Estimated using LBS, provide trip estimates by trip purpose and resident/visitor, and external travel
Household Travel Survey	Provide estimates of regional trips by trip purpose
HPMS	Provide regional VMT estimates, and traffic counts
Highway Skim	Travel impedance between TAZs from travel demand models
GPS Trips and Trajectory Data	Provide sample data for external travel analysis

Data Preprocessing



LBS Data Biases

- **Location Reporting**: Reporting rate varies by devices and Apps
- **Trip Definition**: Derived from time-stamped locations using proprietary algorithms with defined spatial and temporal rules
- **Demographic Representation**: App user base may over/underrepresent certain populations; app user base can shift significantly over time
- **Data Expansion**: Aggregated to census tracts based on inferred home locations; expanded with Census/ACS population
- **Source Variability**: Data pool may change over time due to evolving privacy regulations

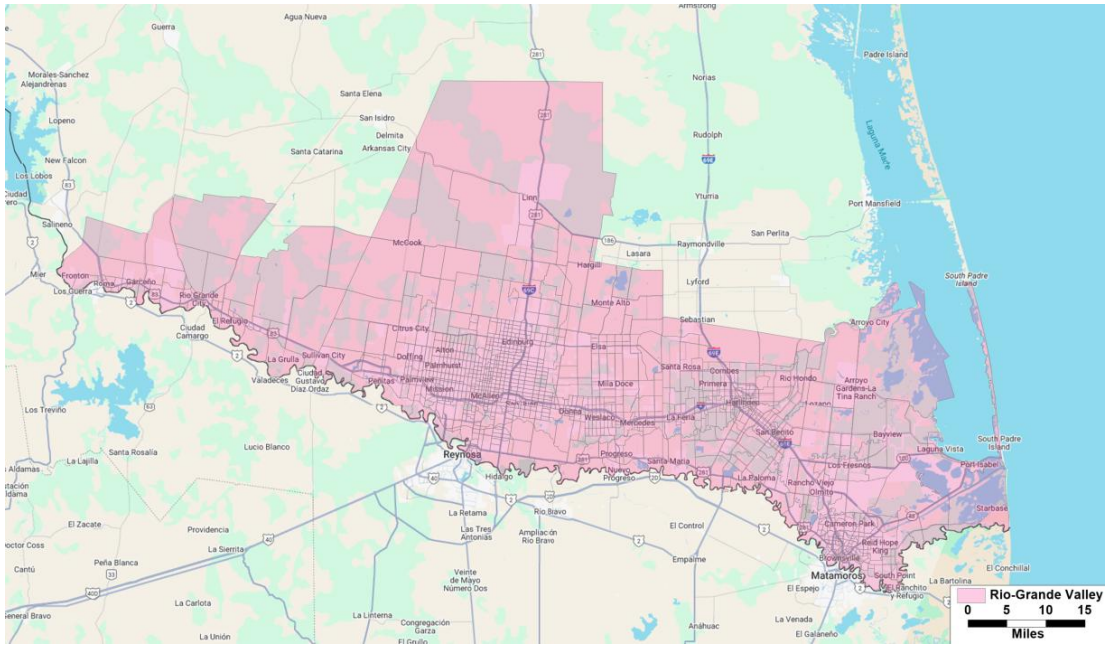
Visitor Trip Estimation Approaches

- **Objective**: Develop adjustment factors to scale raw LBS visitor trips to estimate total visitor trips for modeling

Approach	Adjustment Factor	Reliability
1: Intra-Regional VMT (Resident + Visitor) Based	***Internal Auto VMT / LBS (resident auto VMT + visitor auto VMT)***	Depends on the quality of external travel analysis and resulted internal auto VMT. LBS data may include commercial vehicle trips.
2: Intra-Regional VMT (Resident Only) Based	***HTS resident auto VMT / LBS resident auto VMT***	Relies exclusively on HTS results. HTS results are critical.
3: Count Based	***Count adjusted external auto trips/ LBS original external auto trips***	Relies on the accuracy of traffic counts at external stations, and the external analysis results.

Case Study 1

- **Rio-Grande Valley MPO Area (2019)**
  - Population: 1.36 million
  - Households: 391k
  - Median HH income: $39k
  - Regional E/P ratio: 0.32
  - Regional VMT: 27 million
  - HTS auto trips per HH: 8.3



Approximately:

- About 1.7-1.8 visitor auto trips per external auto trip
- Visitor VMT is 6% of regional auto VMT

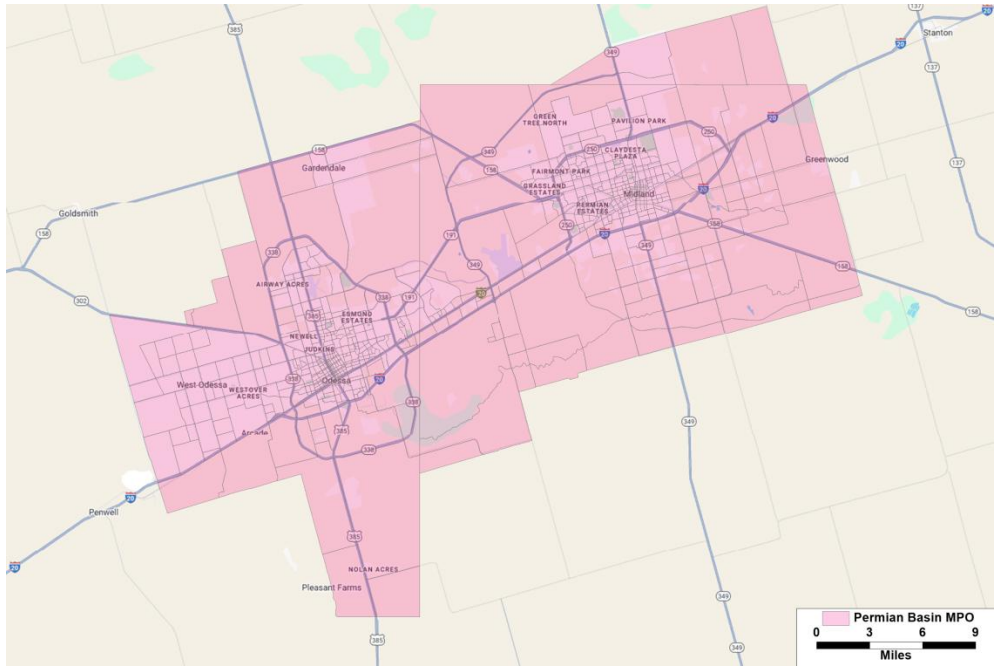
Approach	Adj. Factor	Resulted Visitor Auto Trips	% of Internal Auto Trips
1	1.44	176,000	5.2%
2	1.29	189,000	5.5%
3	1.42	174,000	5.1%

Case Study 2

- **Permian Basin MPO Area (2017)**
  - Population: 317k
  - Households: 111k
  - Median HH income: $68k
  - Regional E/P ratio: 0.52
  - Regional VMT: 9 million
  - HTS auto trips per HH: 8.6

Approximately:

- About 3.1-4.3 visitor auto trips per external auto trip
- Visitor VMT is 27% regional auto VMT



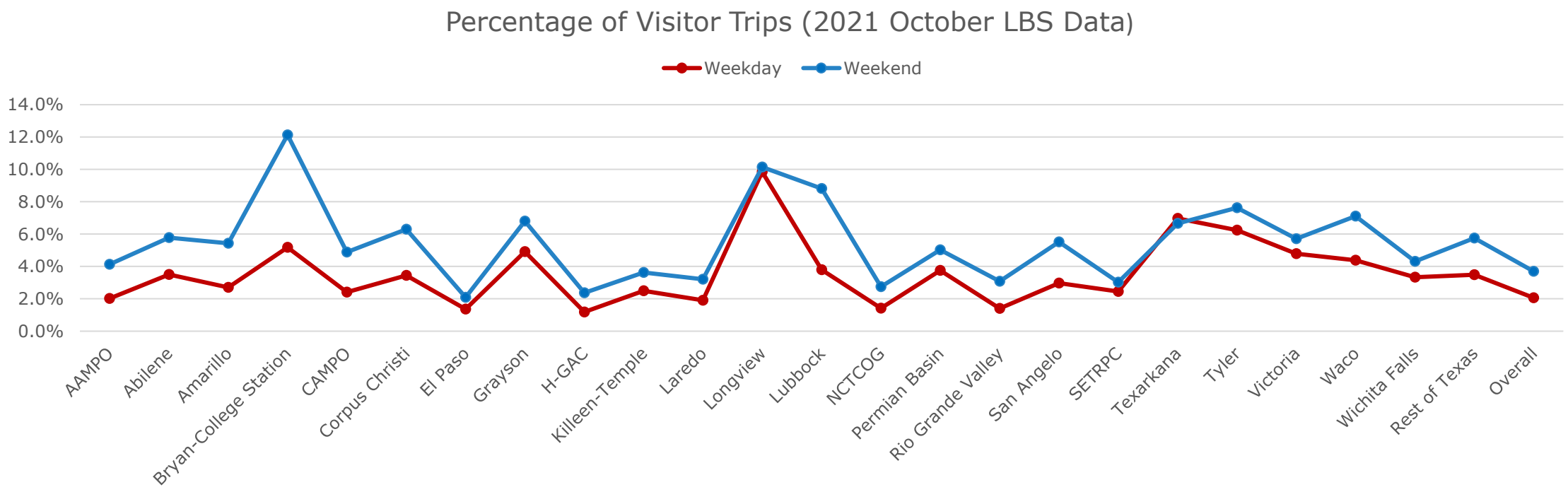
Approach	Adj. Factor	Resulted Visitor Auto Trips	% of Internal Auto Trips
1	0.78	244,000	20%
2	0.74	236,000	20%
3	1.02	321,000	25%

LBS (2019 & 2017)

	Visitor Trips	Resident Trips	% Visitor
RGV(2019)	146,410	2,619,023	5.3%
PB(2017)	352,083	1,440,278	20%

2021 October LBS

	Visitor Trips	Resident Trips	% Visitor
RGV	62,032	4,370,997	1.4%
PB	39,544	1,014,138	3.8%



Conclusions

- **LBS Data's Value**
  - Offers a unique opportunity to assess visitor travel patterns, a traditionally challenging area for conventional surveys
  - Need to exercise caution when using LBS data
- **Key Findings & Considerations**
  - VMT-based approach appear to yield comparable results
  - Count-based results could be very different from VMT-based results
  - Results are sensitive to specific area travel characteristics
- **Influencing Factors & Next Steps**
  - Many variables impact results (e.g. auto occupancy, weekly factors, HTS data, LBS data quality)
  - Additional case studies are need to comprehensively assess these approaches

Thank you!

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