Evaluating Bus Stop Efficiency in Tallahassee

A Spatial Analysis of Transit Supply and Ridership Demand

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BACKGROUND

What is the problem?

Many transit agencies allocate bus service based on historical patterns rather than current demand. This creates **mismatches** where some stops are **over-served** while others with high ridership remain **under-served**.

Why does it matter?

Inefficient resource allocation wastes limited transit budgets and creates **inequitable access**. Identifying supply–demand gaps helps agencies make data-driven improvements without increasing costs.

Research Question

How efficiently does StarMetro's current bus service supply align with actual ridership demand at individual stops across the Tallahassee network?

METHODS

Data Sources

- GTFS static feed (routes, stops, schedules)
- StarMetro ridership data (average daily boardings)

Procedures

- Extracted stop-level service frequency from GTFS stop_times.txt
- Manually joined ridership records to stop IDs via spatial matching
- Computed quartile ranks (Q1–Q4) for both service and ridership
- Classified each stop into efficiency categories based on quartile combination
- Mapped results in QGIS for spatial analysis

Analytical Framework

Stops classified using a quartile-based system (see table below).

Service Quartile	Ridership Quartile	Classification
Q3–Q4 (High)	Q3–Q4 (High)	Efficient
Q1–Q2 (Low)	Q1–Q2 (Low)	Efficient
Q3–Q4 (High)	Q1–Q2 (Low)	Over-served
Q1–Q2 (Low)	Q3–Q4 (High)	Under-served
Q4 (Very High)	Q1 (Very Low)	Extreme Over
Q1 (Very Low)	Q4 (Very High)	Extreme Under

RESULTS

65.8% — **Efficient**
Service matches demand

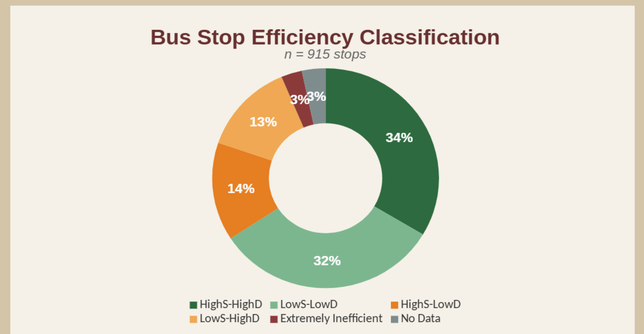
27.8% — **Slightly Inefficient**
One metric mismatched

3.1% — **Extremely Inefficient**
Strongest reallocation candidates

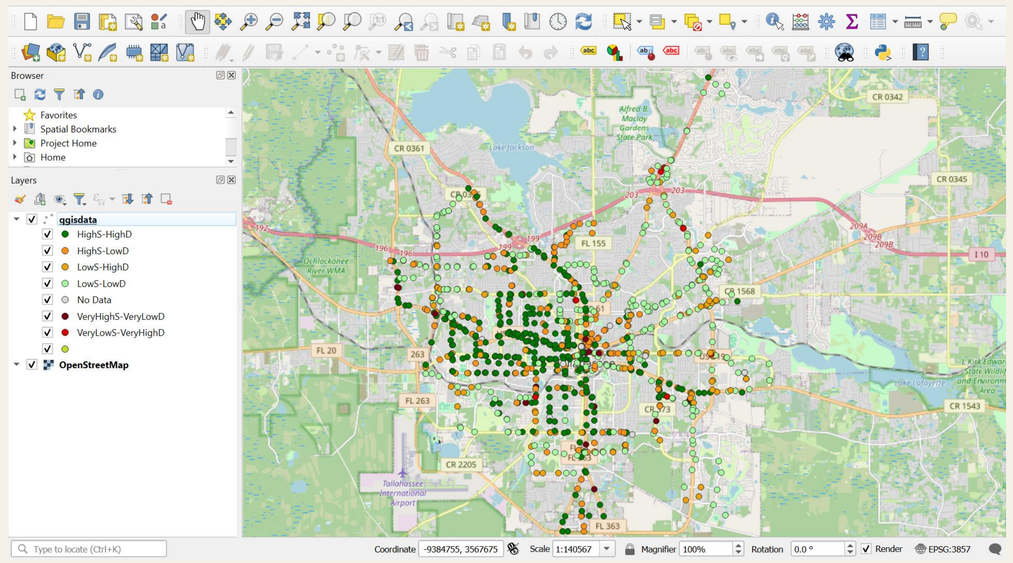
3.4% — **No Data**
Missing ridership records

EFFICIENCY CLASSIFICATION & SPATIAL MAP

HighS-HighD — High service + High demand	n=307
LowS-LowD — Low service + Low demand	n=295
HighS-LowD — High service + Low demand	n=132
LowS-HighD — Low service + High demand	n=123
VeryHighS-VeryLowD — Extreme over-service	n=15
VeryLowS-VeryHighD — Extreme under-service	n=12
No Data — Missing ridership	n=31



Key Findings:
C.K. Steele Plaza Gate 1 carries the highest demand (**3,133 riders**) but only an average service score — the network's most **undervalued** stop. Henderson Rd @ Grady Rd WB receives **33 scheduled services** with **zero recorded ridership** — the network's most over-served stop.



DISCUSSION

- The analysis reveals that **65.8%** of StarMetro bus stops show efficient alignment between service supply and ridership demand, while **27.8%** show a single-metric mismatch—either over-served or under-served along one dimension.
- The most concerning finding is the **3.1%** classified as Extremely Inefficient, where top-quartile supply meets bottom-quartile demand or vice versa. These represent the strongest candidates for service reallocation.
- Notably, HighS-HighD stops carry **81.3%** of total system ridership, confirming that the core network effectively serves high-demand corridors.

SIGNIFICANCE & IMPLICATIONS

- Findings suggest that targeted inefficiencies in StarMetro's network are addressable through **strategic, data-driven adjustments** rather than wholesale service redesign.
- This study offers a **replicable, low-cost analytical framework** suitable for mid-sized transit agencies seeking to optimize service delivery with limited resources.
- Strategic reallocation of service from over-supplied stops to under-served locations could improve **transit access and equity** without increasing overall operating costs.

FUTURE RESEARCH

- Incorporate time-of-day ridership patterns to identify temporal mismatches in service allocation
- Layer demographic and equity data (e.g., income, car ownership, disability status) to assess whether inefficiencies disproportionately affect vulnerable populations
- Expand analysis to full weekly schedule to capture weekend and off-peak service variations

References: GTFS data and Ridership Data provided by StarMetro, City of Tallahassee. | Acknowledgements: Thank you to my UROP section leaders, Kelly Grove, and Dr. Jelly Li for guidance and support.