Highway Occupancy Vehicle (HOV) System Analysis Tools – Statewide HOV Facility Performance Analysis

CALTRANS DRISI RESEARCH CONNECTION EVENT

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Presentation Outline

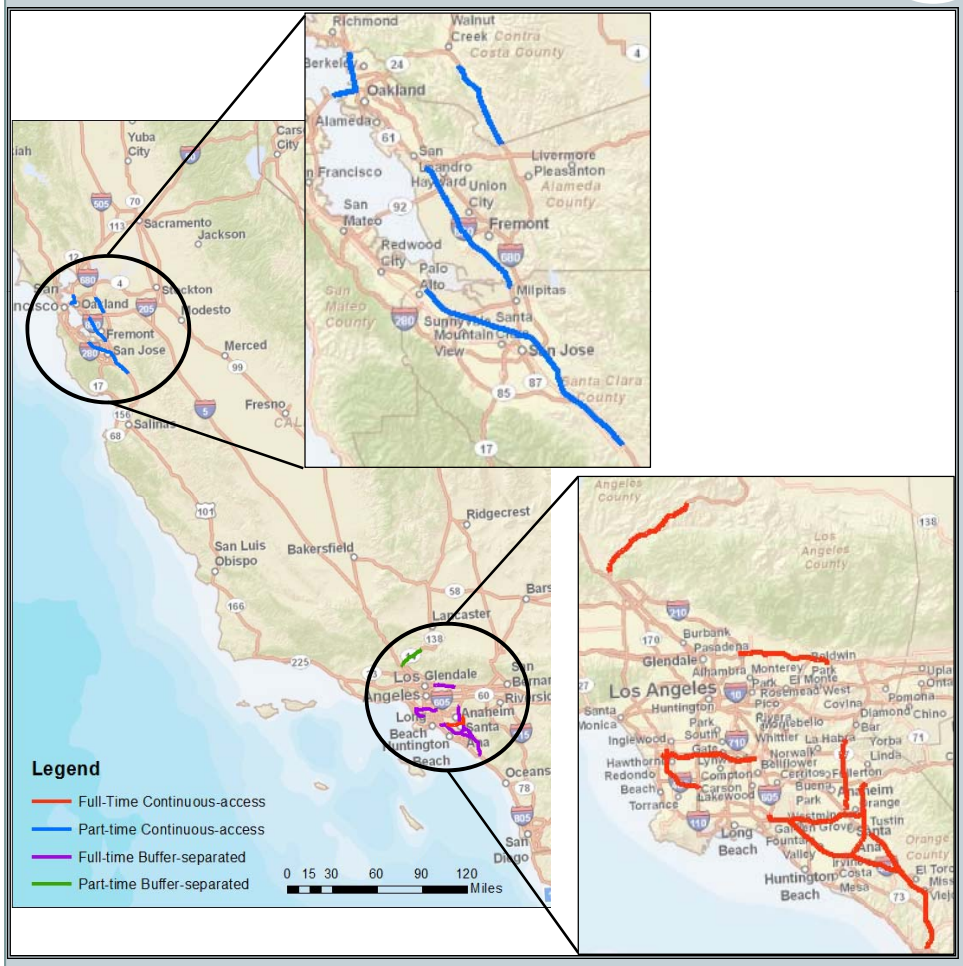
- Study Objectives
- State-wide Comparison
  - Study Sites and Performance Measures
  - Cross-sectional Comparative Study
- Before-After Analysis
  - Study Sites
  - Exemplar Results
- Concluding Remarks

Objectives

- Evaluate operational performance of High-Occupancy Vehicle (HOV) facilities.
- Explore potential effects of access type (continuous and limited access) on operational performance.
- Investigate differences
  - Cross-sectional analysis
  - Before-After analysis

Statewide Comparison

Study Corridors



Type	District (County)	Route
Full-Time Continuous	D12 (ORA)	SR-22 (both)
	D12 (ORA)	SR-55 (both)
Full-Time Limited	D7 (LA)	I-105 (both)
	D7 (LA)	I-210 (East)
	D7 (LA)	I-405 (South)
	D12 (ORA)	I-5 (both)
	D12 (ORA)	I-405 (both)
	D12 (ORA)	SR-55 (North)
	D12 (ORA)	SR-57 (South)
Part-Time Limited	D7 (LA)	SR-14 (both)
Part-Time Continuous	D4 (ALA)	I-80 (both)
	D4 (SCL)	SR-101 (both)
	D4 (CC)	I-680 (both)
	D4(ALA)	I-880 (North)

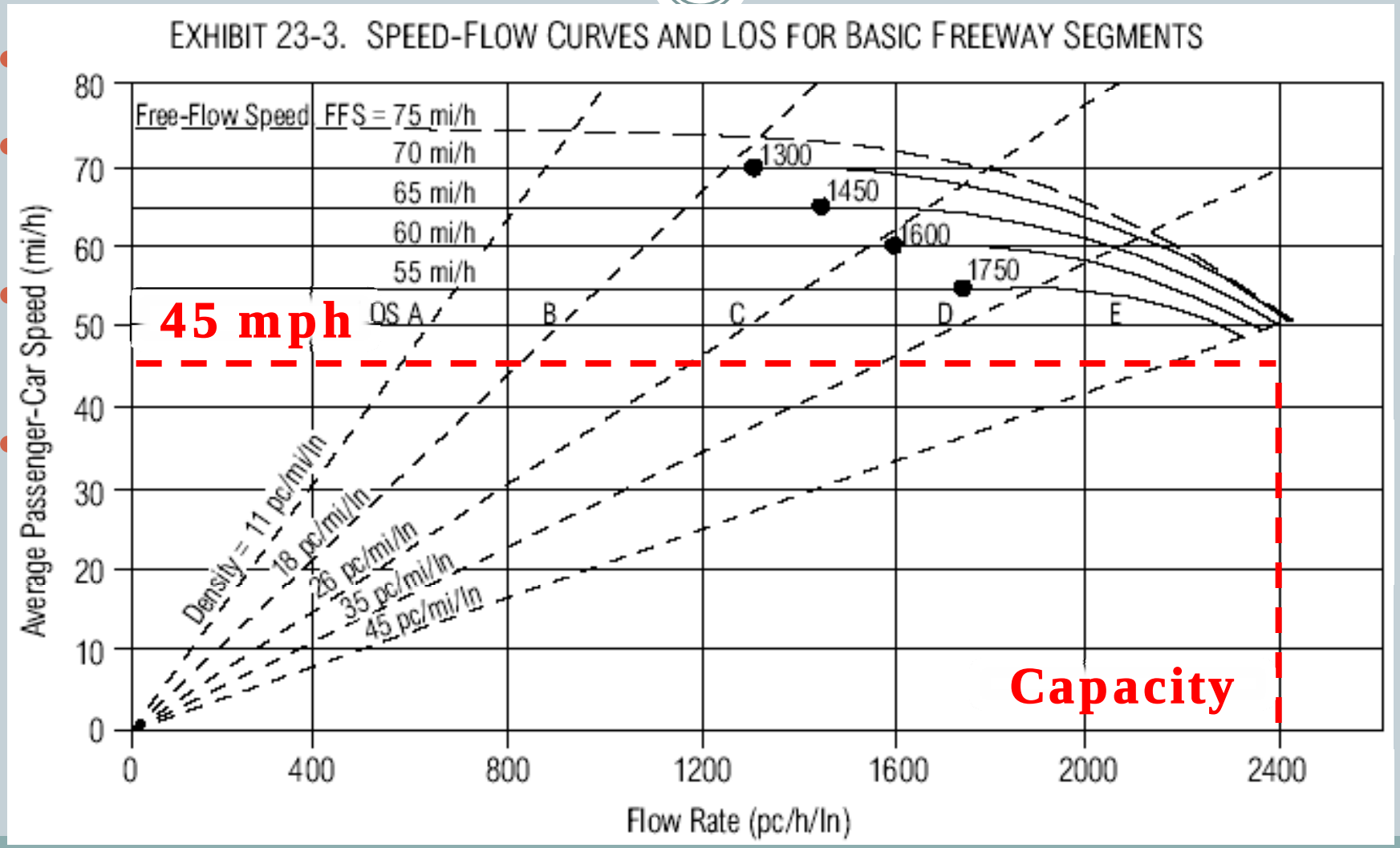
Performance Measures

- Select comprehensive, representative and ***comparable*** performance measures
  - Flow and Speed (HOV lane)
  - Speed differential (=Speed (HOV lane) – Average speed (GP lanes))
    - Surrogate measure of travel-time savings
  - VMT ratio (= VMT by HOV lane / average VMT by GP lanes)
    - Relative utilization of HOV lane by vehicles (with respect to GP lanes)
  - PMT ratio (= PMT by HOV lane / average PMT by GP lanes)
    - Relative utilization of HOV lane by people (with respect to GP lanes)

Conditions for computing performance measures

- HOV facility is considered a congestion management option, thus its performance should be evaluated in congested states.
- When freeways are free flowing, drivers have choices of travel lanes.
- When freeways are congested, it will desirable to see whether HOV lanes carry larger volume of traffic traveling at higher speeds.
- Data are filtered at a threshold of average speed in GP lanes below 45 mph.

Conditions for computing performance measures



Data and Samples

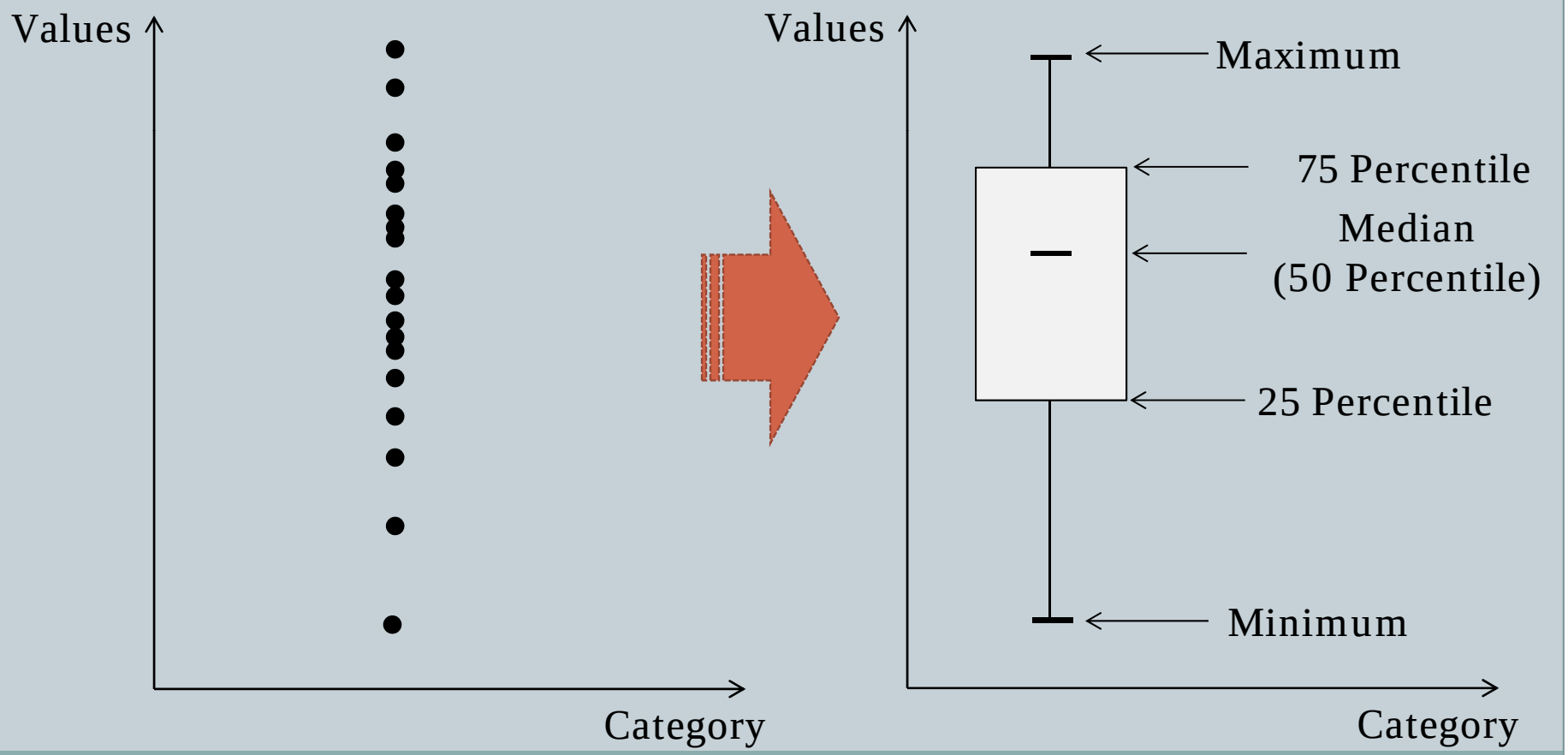
- Data Sources: Caltrans 2008 HOV annual report, Statewide HOV inventory (2008), detector data from PeMS (2009)
- Data Samples: traffic data (flow and speed) in every 5-minute interval (from May to Oct. 2009)
- Filtered Samples: traffic data from congested time periods when average GP speed < 45 mph
- Grouped samples: by segment, by corridor, ***by district***, and ***by access type***.

Notes on Results

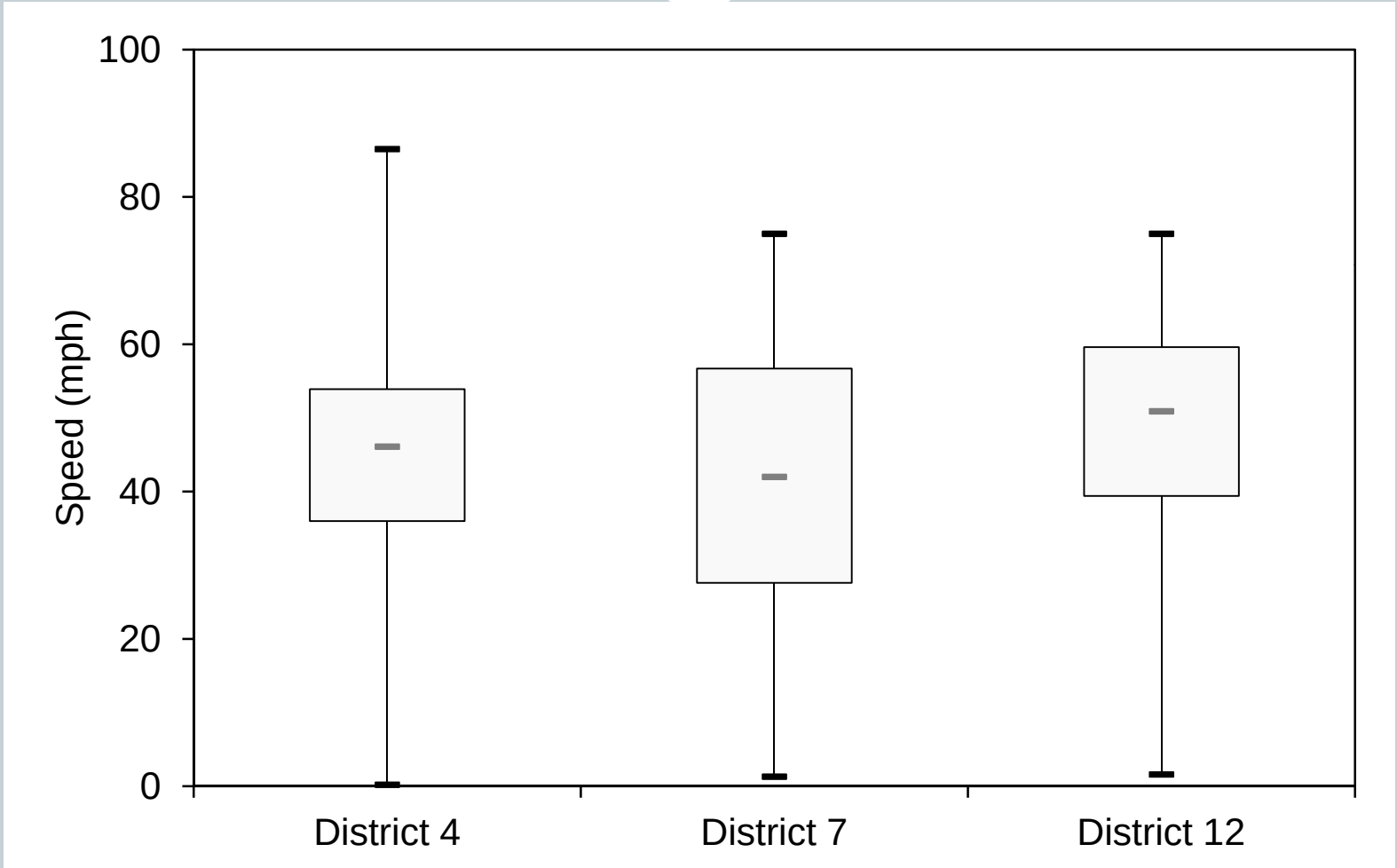
- What you see depends on what you include!
- What you do not see depends on what you do not include!
- For example,
  - PMT numbers are influenced by the HOV requirements
  - Violation rate studies likely differ at different sites, but data are only infrequently sampled.

Box Plot (Box-and-Whisker Plot)

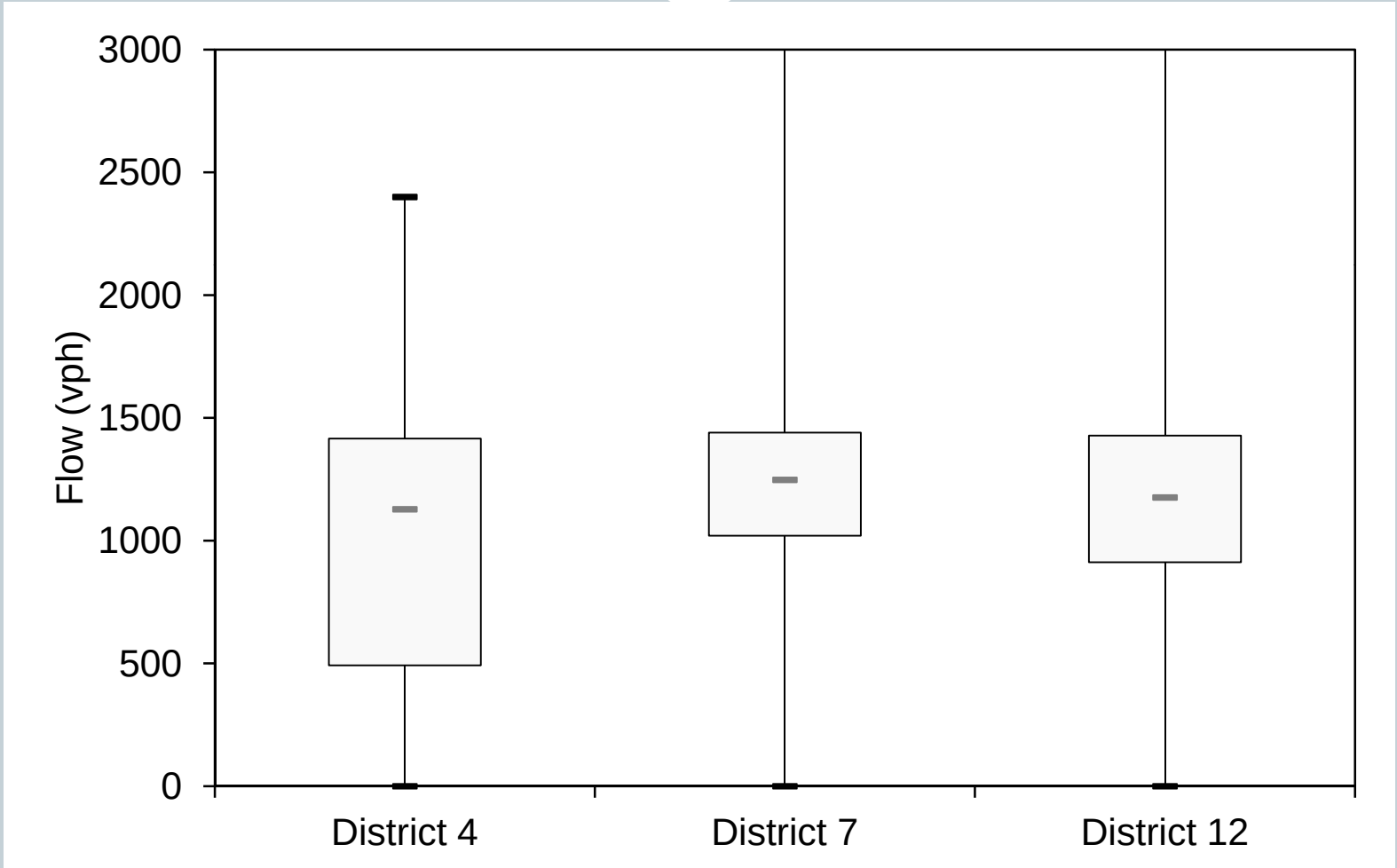
- Provide summary statistics of collected samples



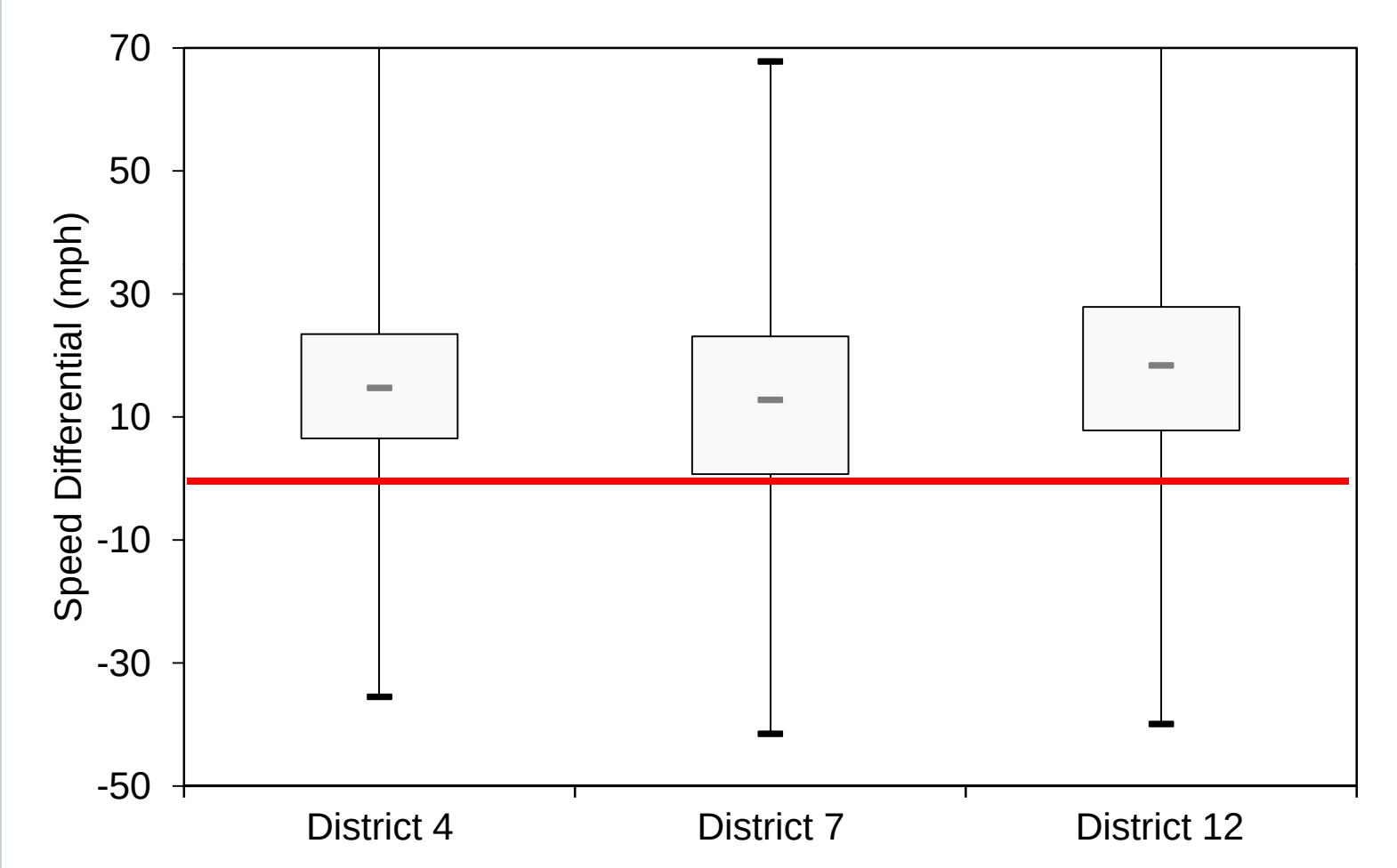
By District (HOV Lane Speed)



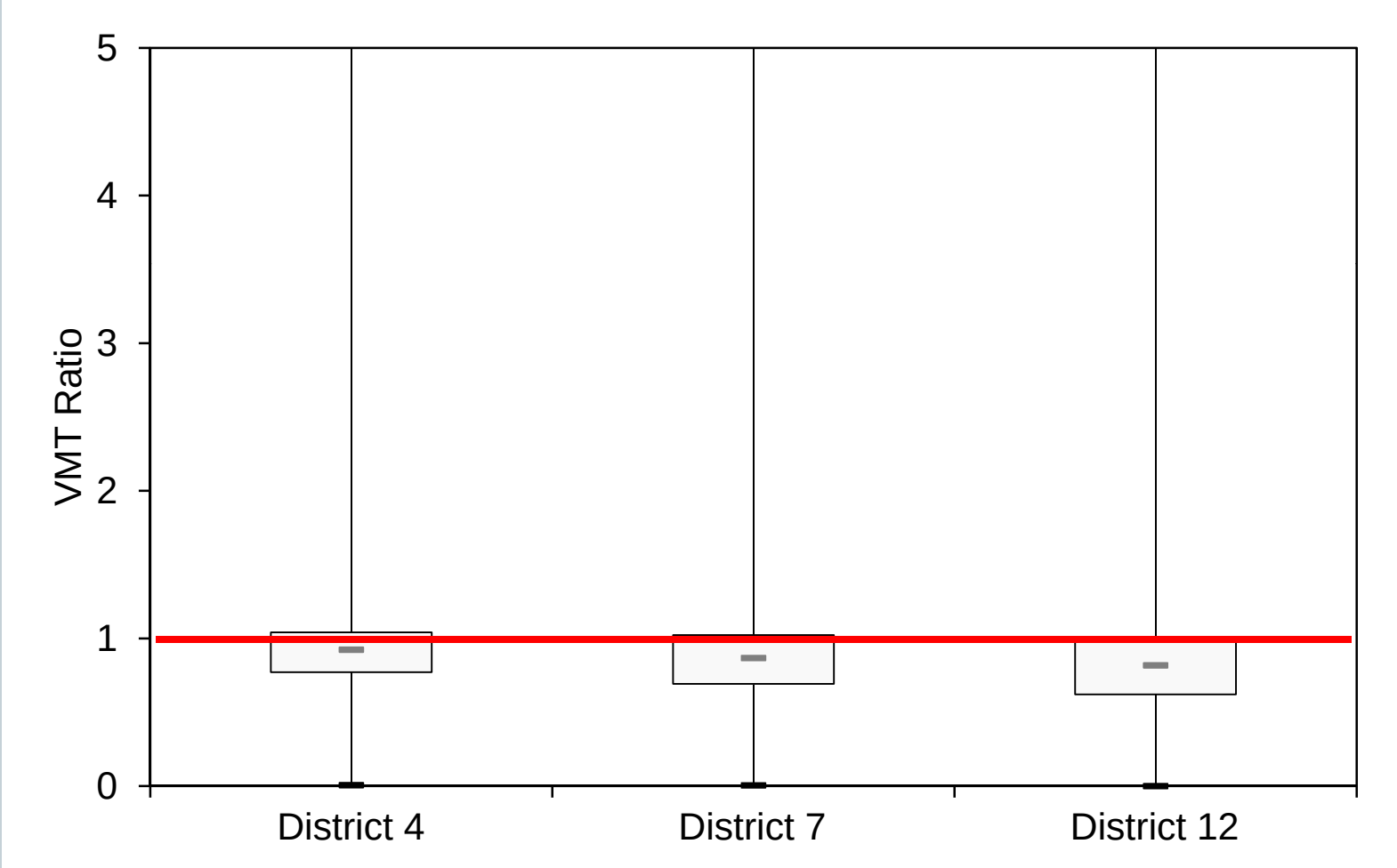
By District (HOV Lane Flow)



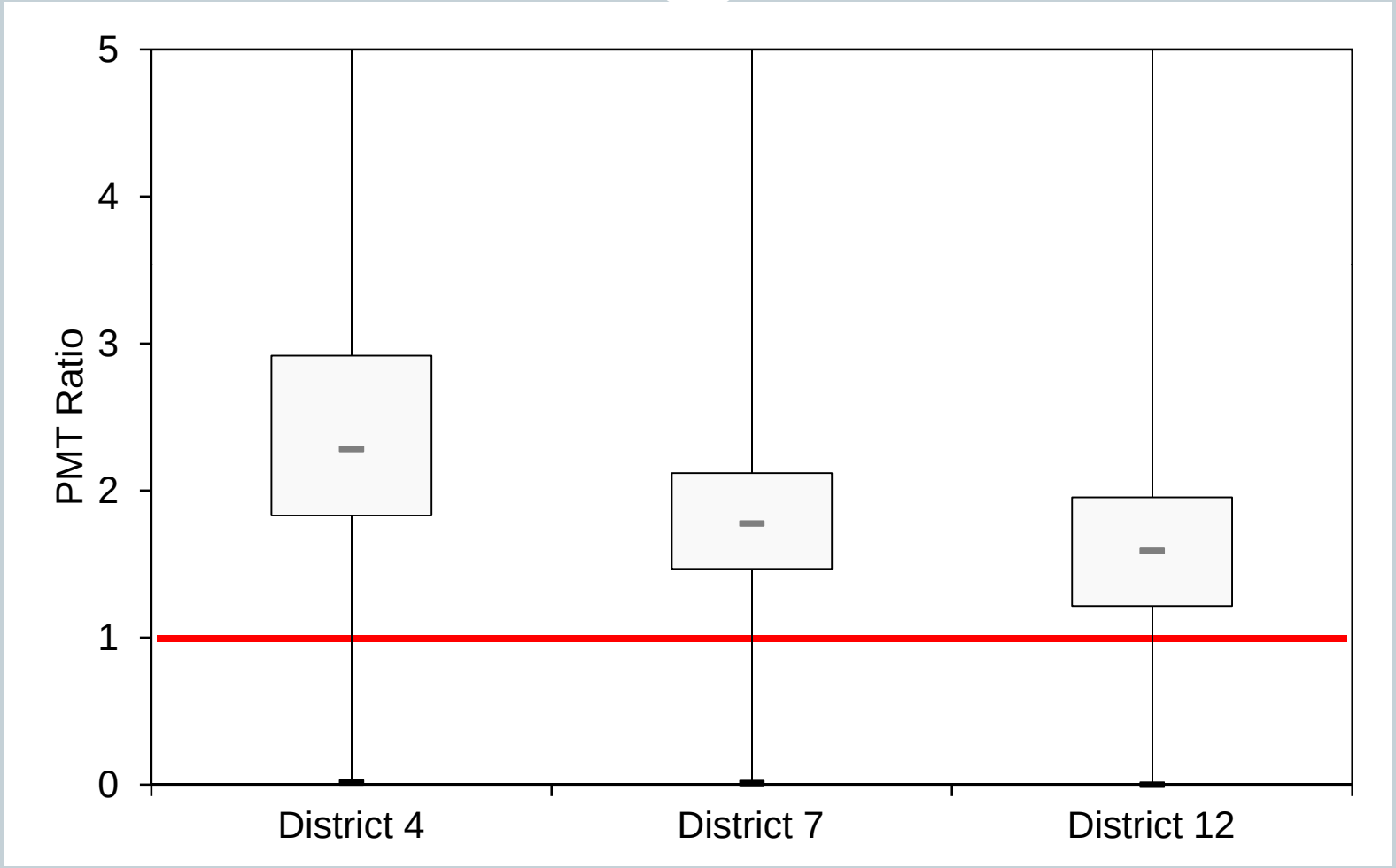
By District (Speed Differential)



By District (VMT Ratio)



By District (PMT Ratio)

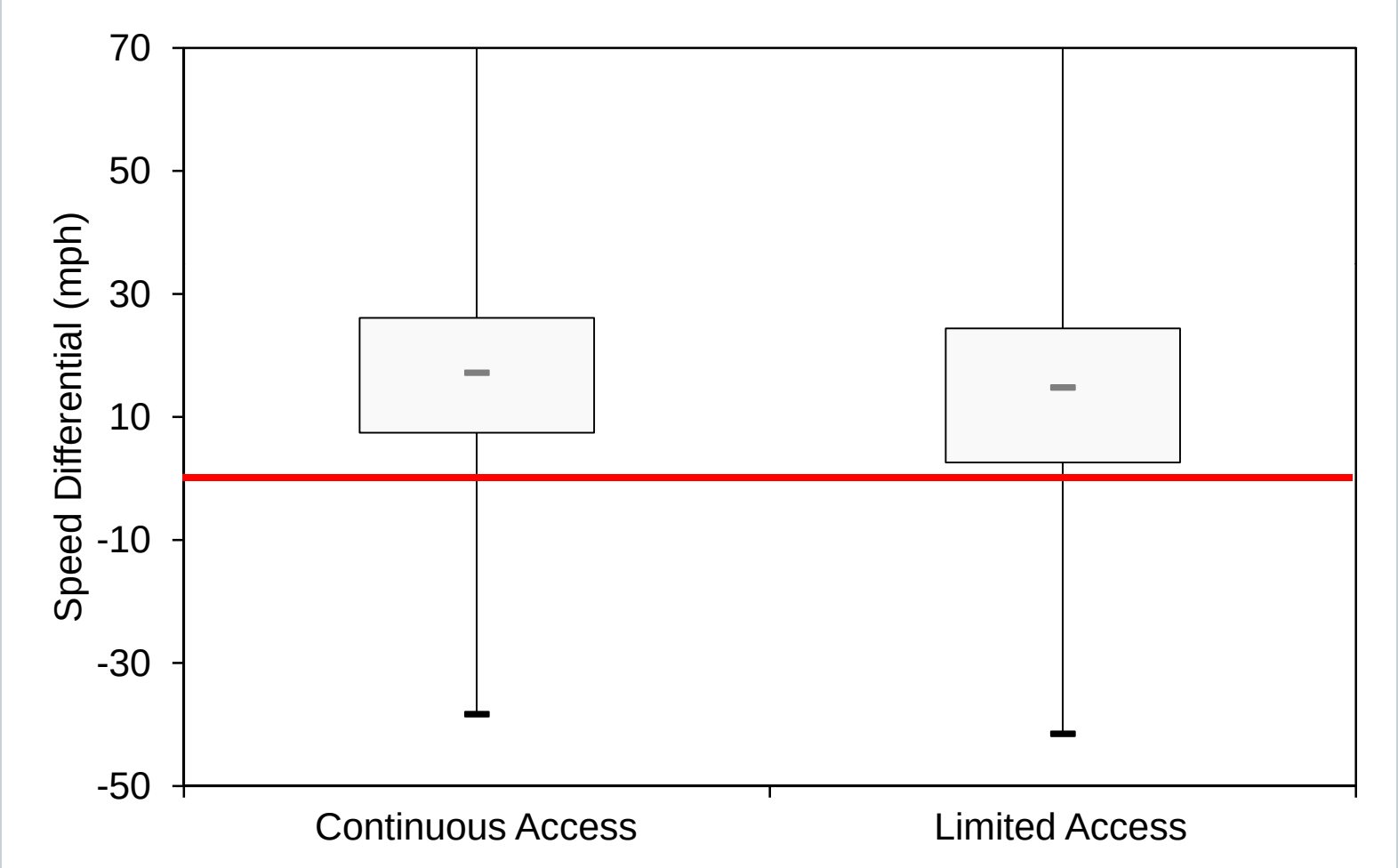


By District (Summary)

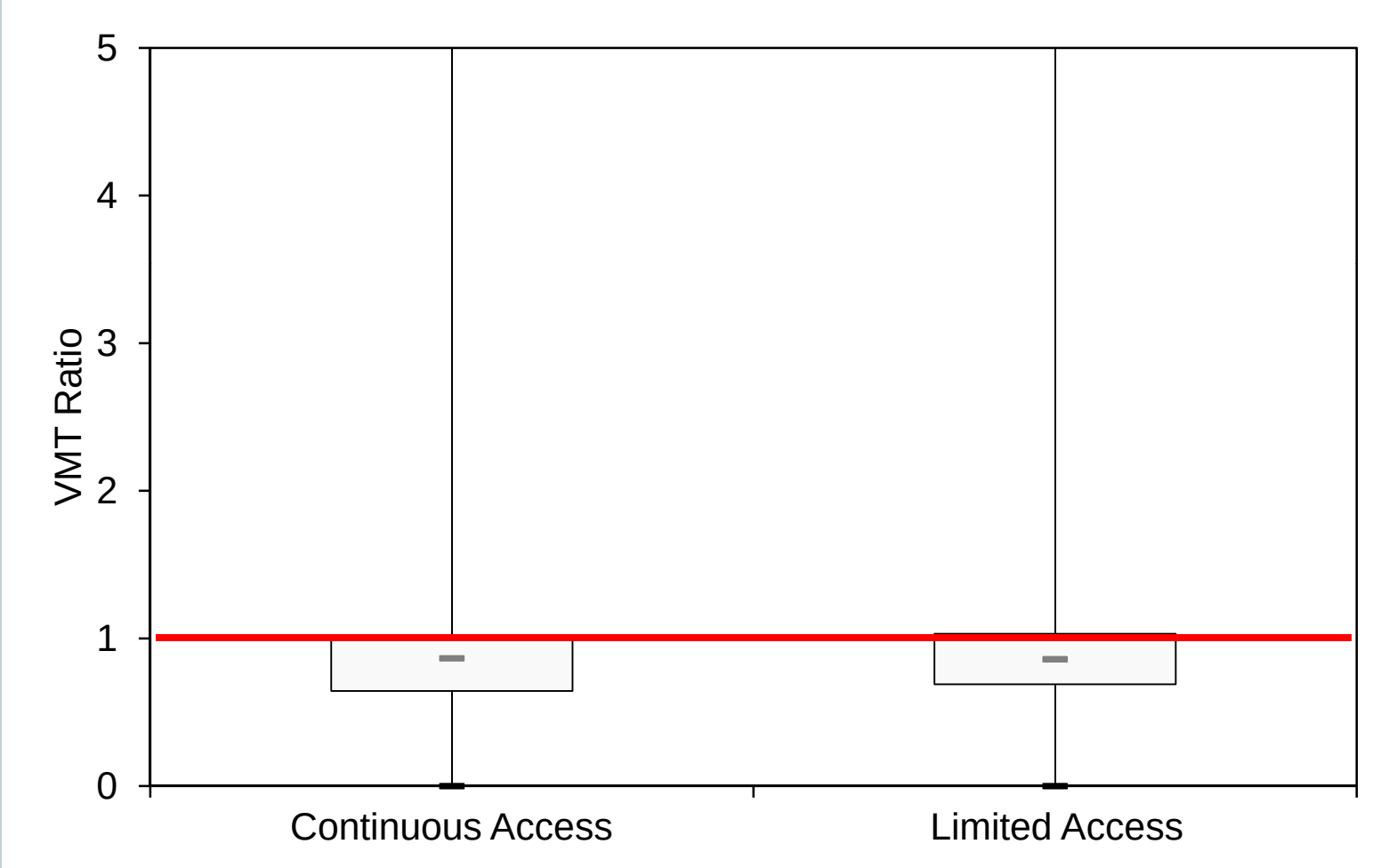
When GP lanes were congested,

- Median operating speeds in HOV lanes were between 40 and 50 mph.
- Median average flow in HOV lanes were between 1000 and 1300 vehicles per hour.
- Compared with GP lanes, HOV lanes
  - Provide faster travel (greater than 10 mph).
  - Serve more passenger-miles traveled (PMT) with fewer vehicle-miles traveled (VMT).

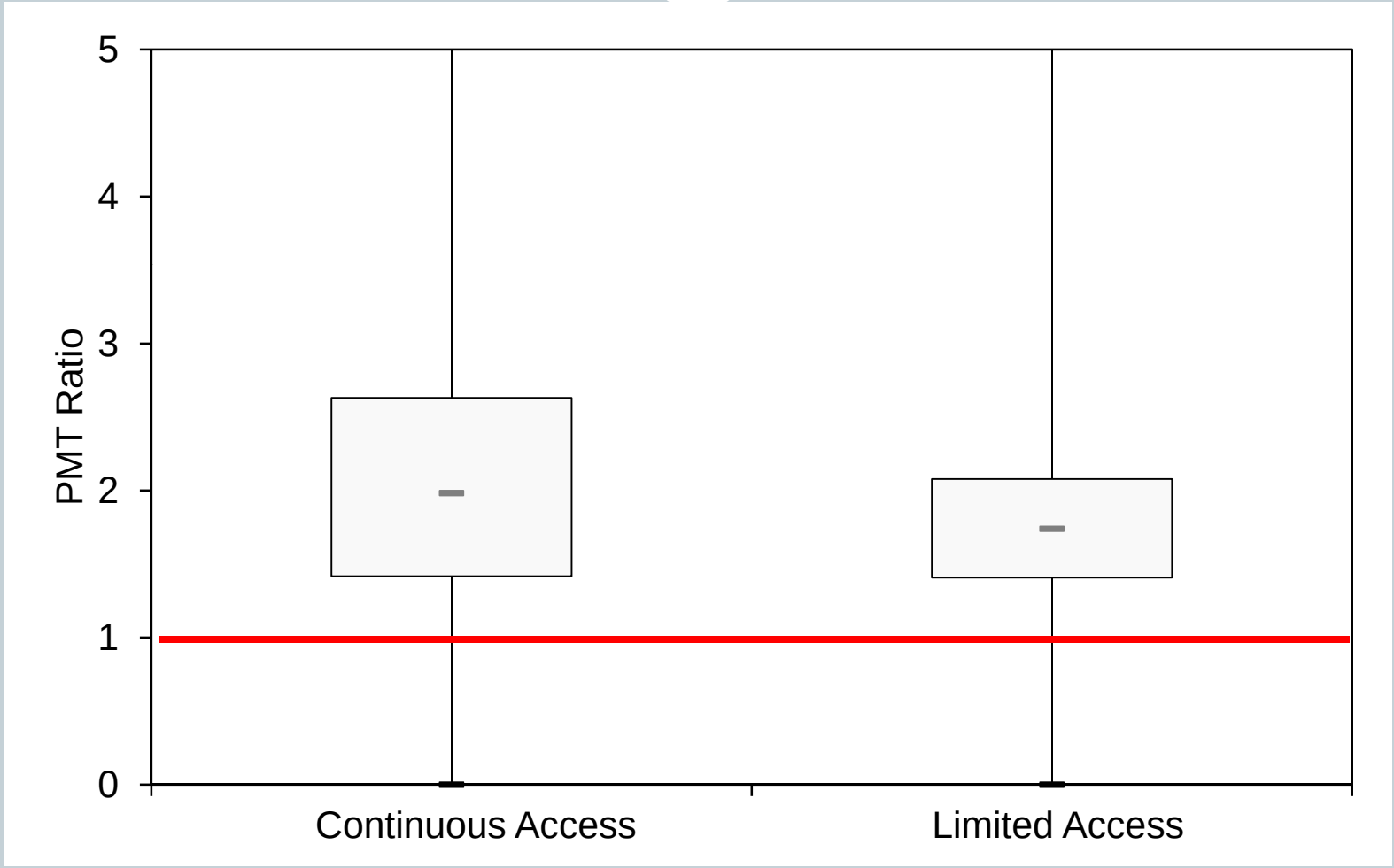
By Type (Speed Differential)



By Type (VMT Ratio)



By Type (PMT Ratio)



By Type (Summary)

Compared with Limited Access (mean comparison),

- Continuous access provides higher speed differential. (17.77 vs. 14.39)
- Continuous access has lower VMT ratio. (0.83 vs. 0.94)
- Continuous access has higher PMT ratio. (2.06 vs. 1.85)

Analysis indicates that the differences observed between the two access types are statistically significant.

Summary (Statewide Comparison)

1) HOV lanes, in general,

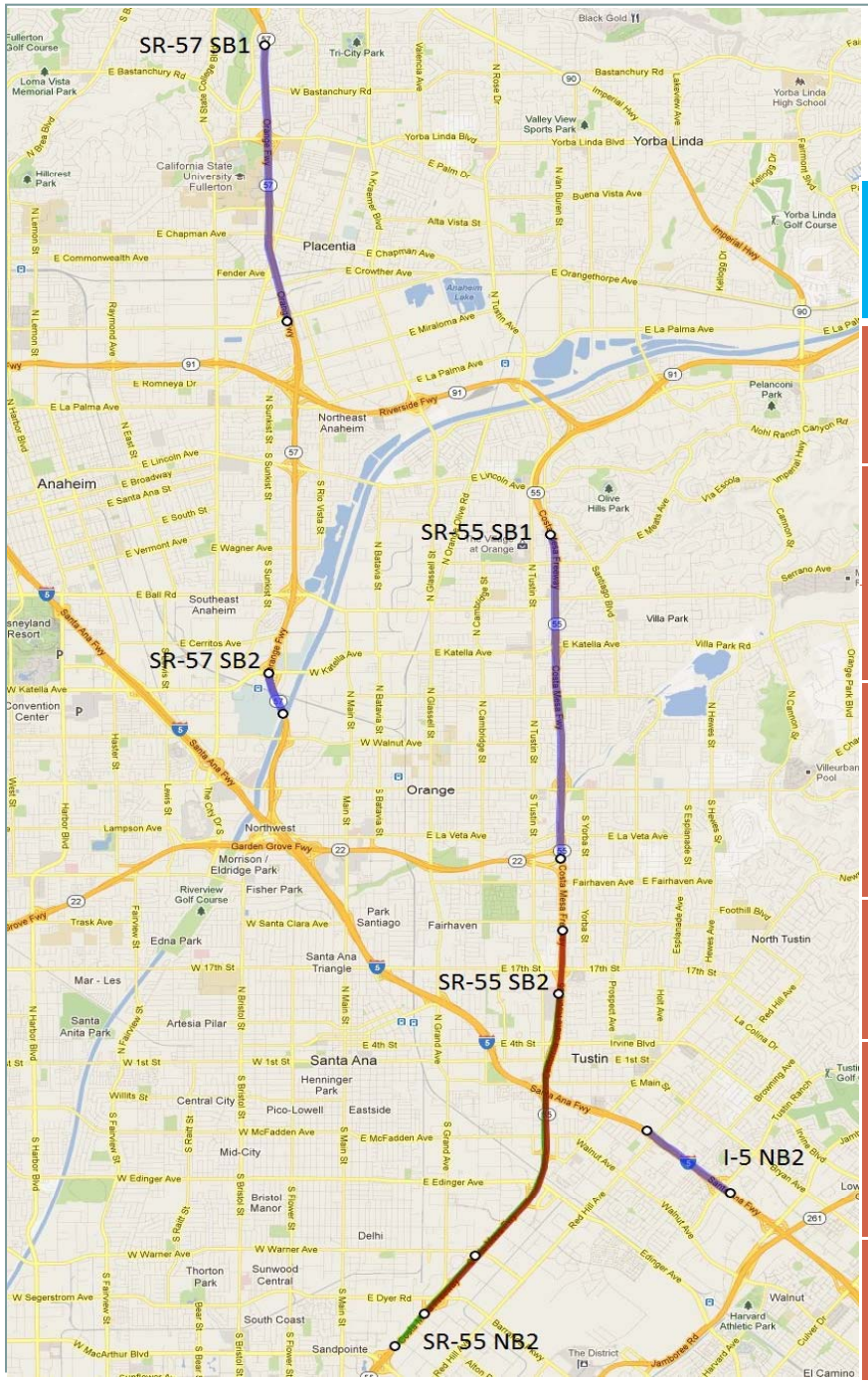
- allows higher speeds.
- serves more PMT with fewer VMT, compared with GP lanes.

2) Continuous access offers higher speed differential, compared with limited access.

3) Multiple variables are involved in highway operations, thus the cross-sectional analysis is not sufficient for completely “fair” comparisons.

4) Before-after analysis can offer a fresh perspective on performance changes on the same corridor due to access conversion.

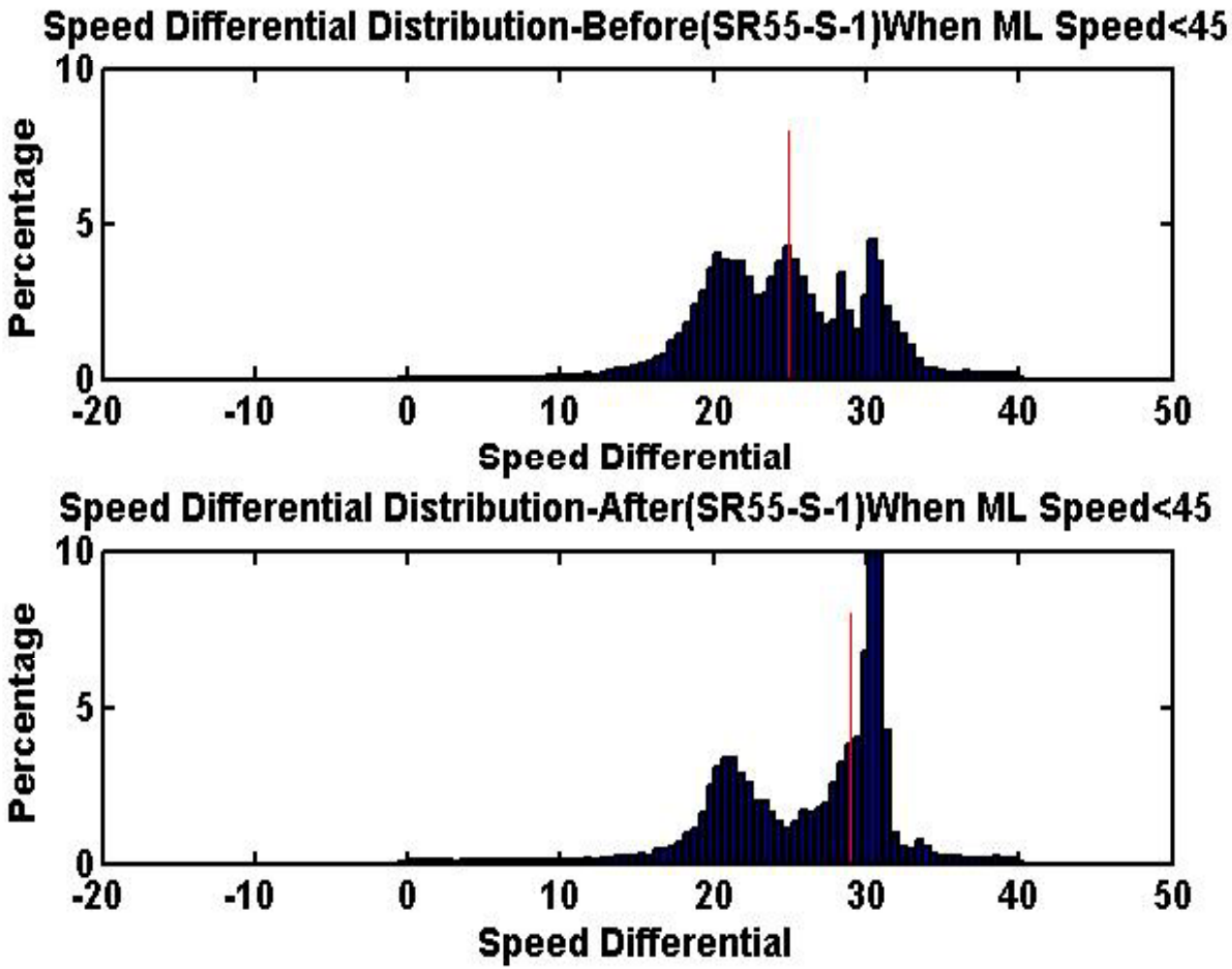
Before-After Comparison



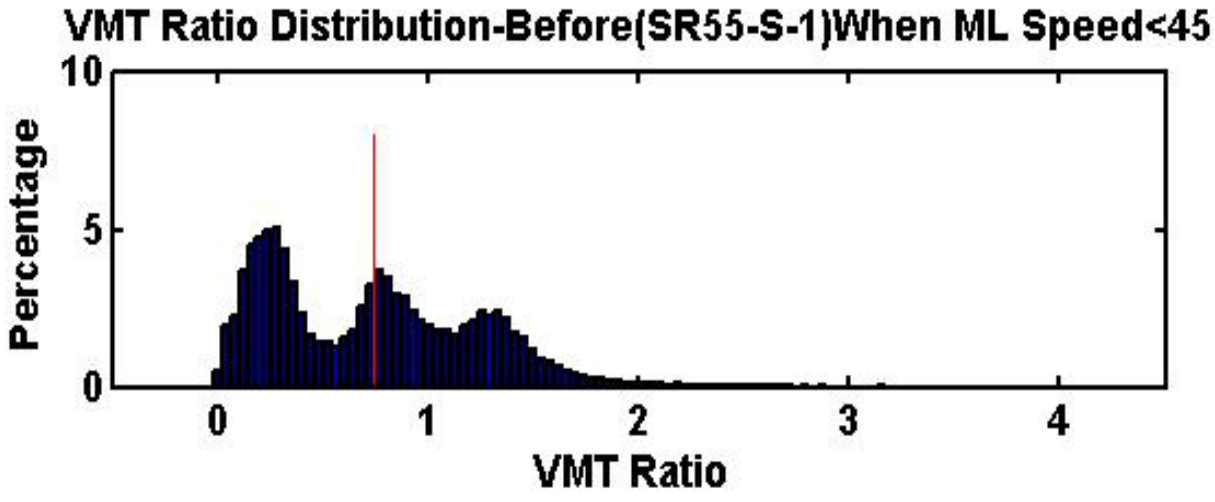
Study Corridors

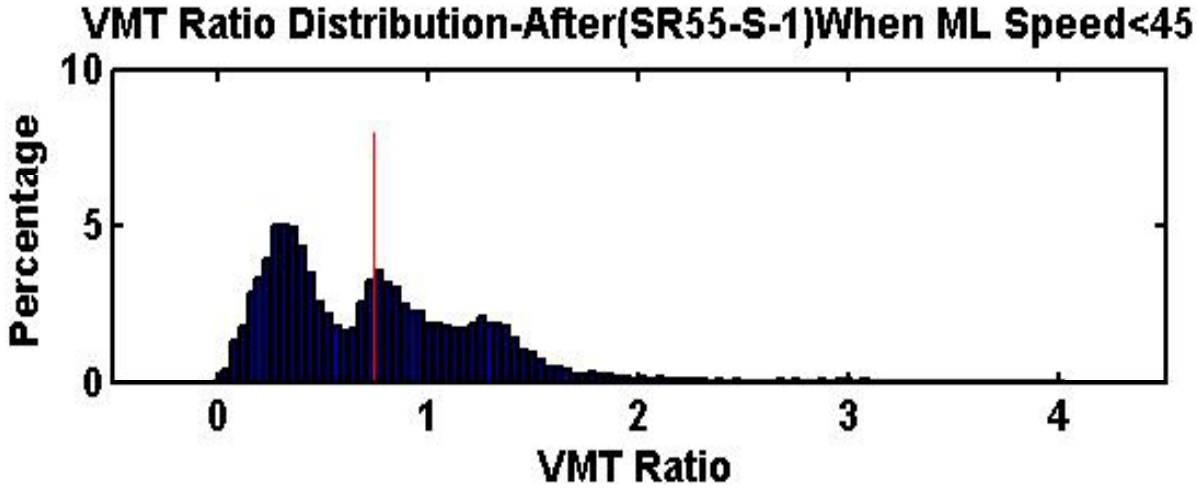
Location (postmile range)	Conversion Date
SR-55 SB1: Lincoln to SR-22 (15.8 - 13.2)	Aug 2008
SR55 SB2: 17th St to MacArthur (11.6 - 7)	April 2011
SR-57 SB1: downstream of Imperial to Orangethrope (8.5 - 5.8)	Sep 2009
SR 57 SB2: Katella to Orangewood (1.93 – 1.4)	December 2010
SR55 NB2: Dyer to 17th St. (7.8 - 12)	April 2011
I5 NB2: Tustin Ranch to Redhill (100.4 – 101.5)	December 2010

Speed Differential, SR-55, SB1, GP < 45 mph



VMT Ratio, SR-55, SB1, GP < 45 mph





Summary (Before-After Comparison)

1) Operational performances, after conversion, improve or deteriorate at some sites, and remain unchanged at others.

2) The differences in performance , while site specific, appear to be marginal or modest.

3) The benefits or dis-benefits are likely influenced by local geometric attributes and associated traffic patterns, such as on- and off-ramps and merge/lane-change maneuvers.

4) The before-after study can benefit from an evaluation based on longer periods of data.

Future Research

- Incorporate broader source of data (such as more corridors, more samples, different years, other data types, etc.)
- Allow longer, extended periods of before-after analysis
- Investigating other dimensions: travel reliability, environmental impacts, demand management, etc.
- Examine performance of HOT lanes and their impacts.

Thank you!!