Speed-Flow Curves for Arterials

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Research Objective

- To determine the appropriate speed-flow curves for predicting signalized arterial street speeds.

Data Collection

- 8 sites in City of Los Angeles
  - Principal and Minor Arterials
    - 15,000-55,000 ADT
    - 4-6 lanes, 2-10 signals/mile
  - Urban business districts to suburban

Data Collection (2)

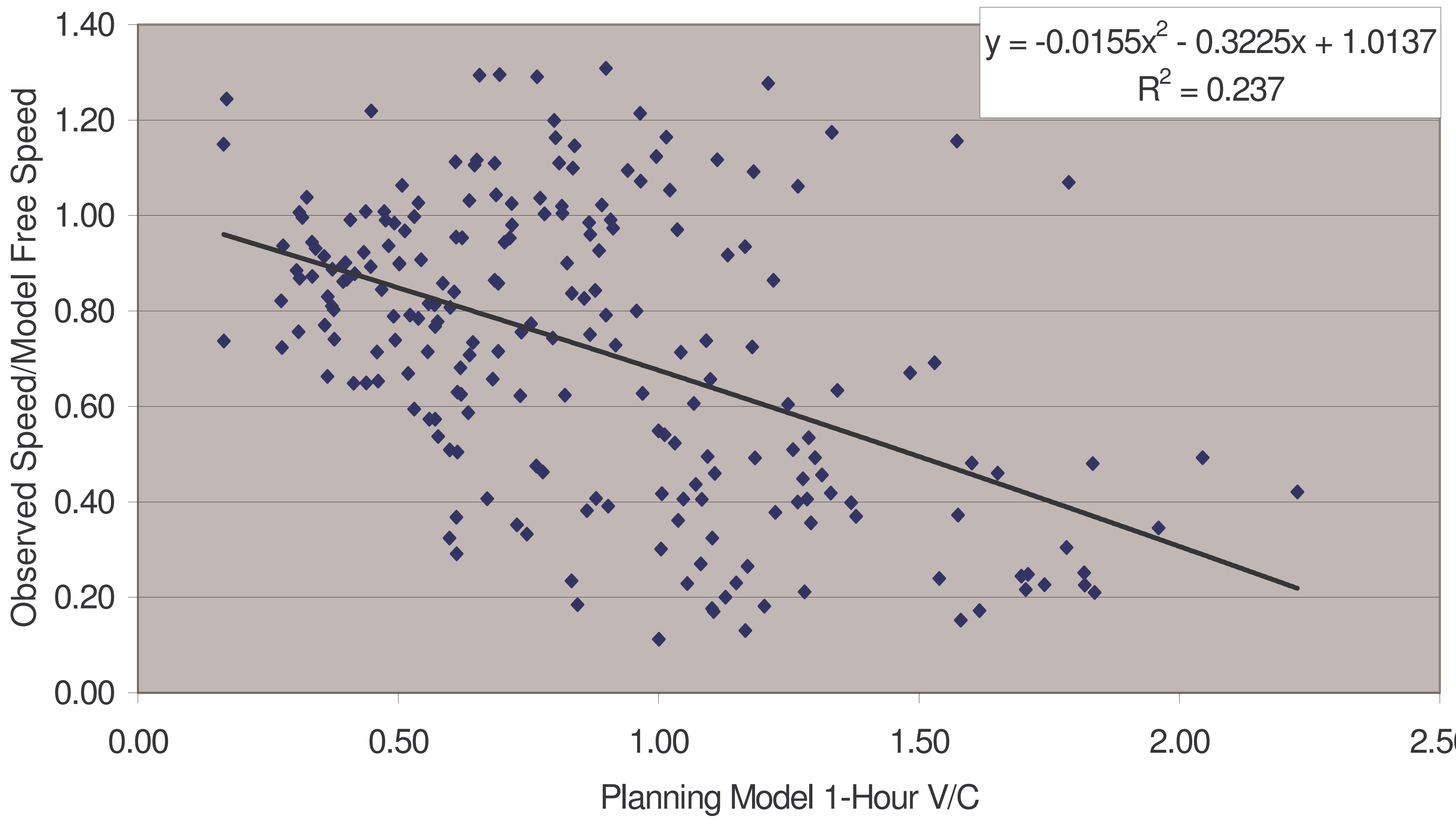
- Volume Data
  - Intersection Turn Counts
  - 15-minute volumes,
  - Every signalized intersection
- Speed Data
  - GPS equipped floating cars
  - 3-10 samples per hour

Data Collection (3)

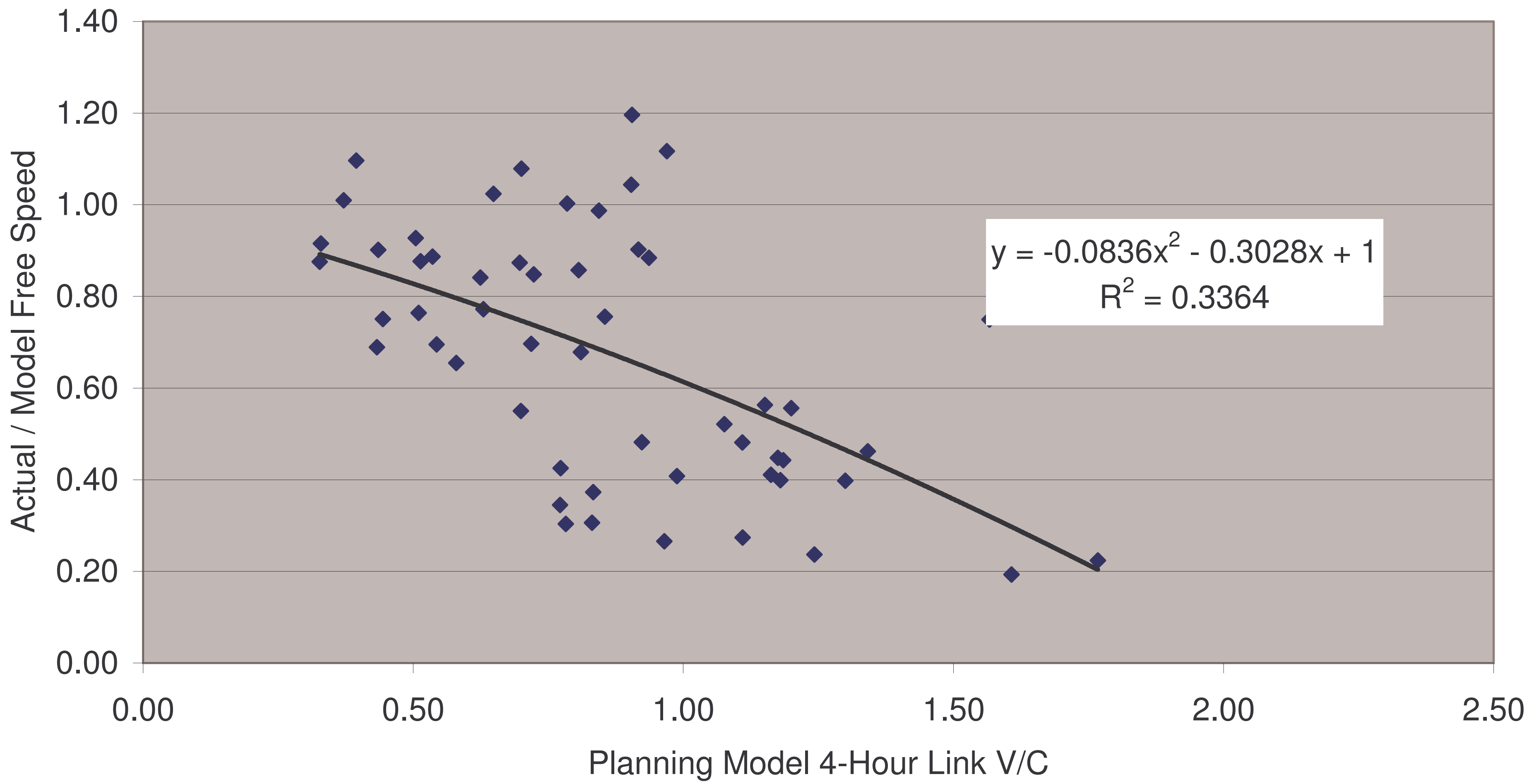
- The Data
  - 54 directional segments between signals
  - 4 hours observations each direction.
  - 216 hourly observations (volume, speed)

  - Counted v/c's ranged from 0.10 to 0.99
  - Speeds ranged from 4 mph to 41 mph
    - (some speeds in excess of 55 mph)

Results – One-Hour Data



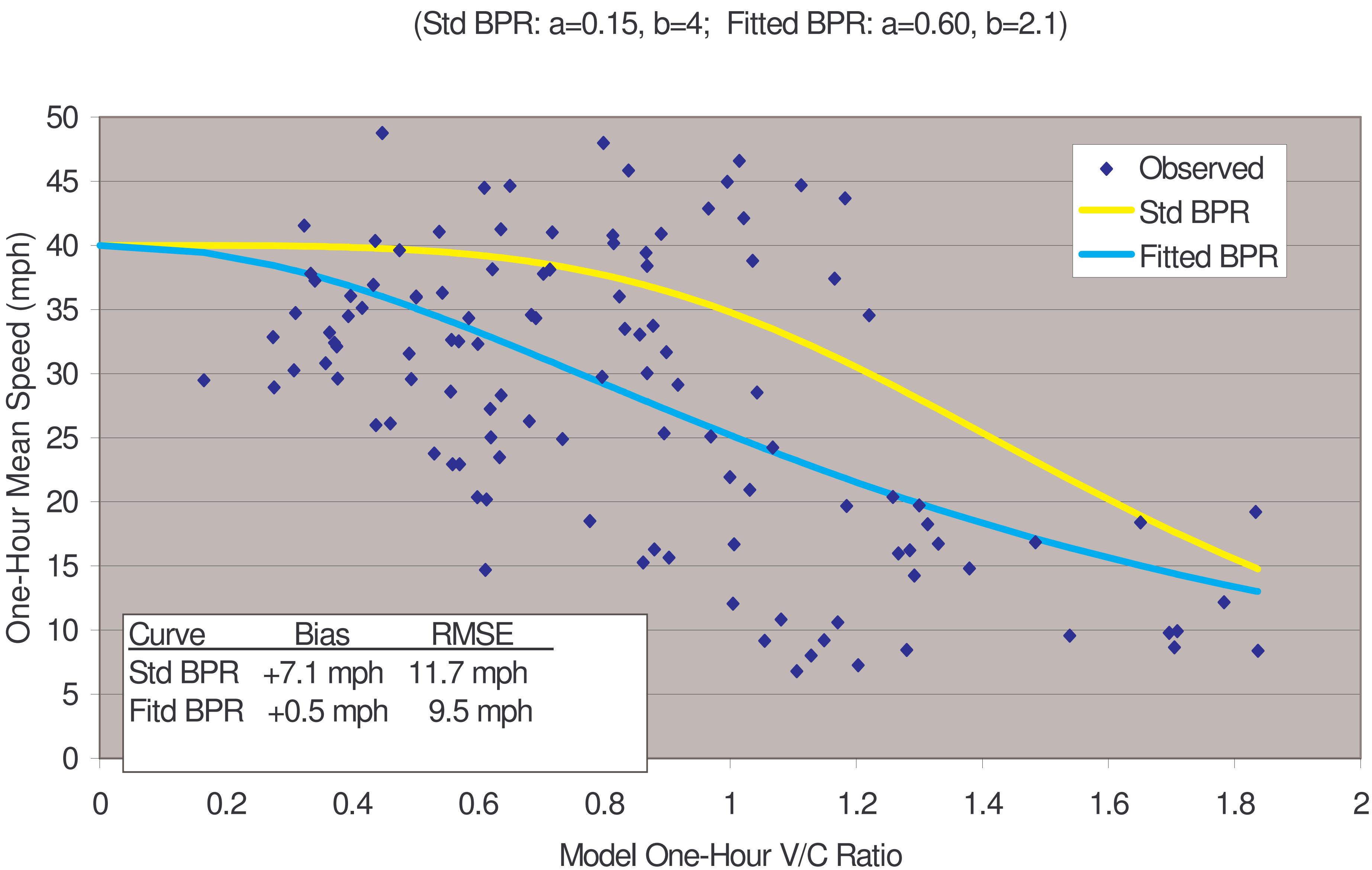
Results – Four-Hour Data



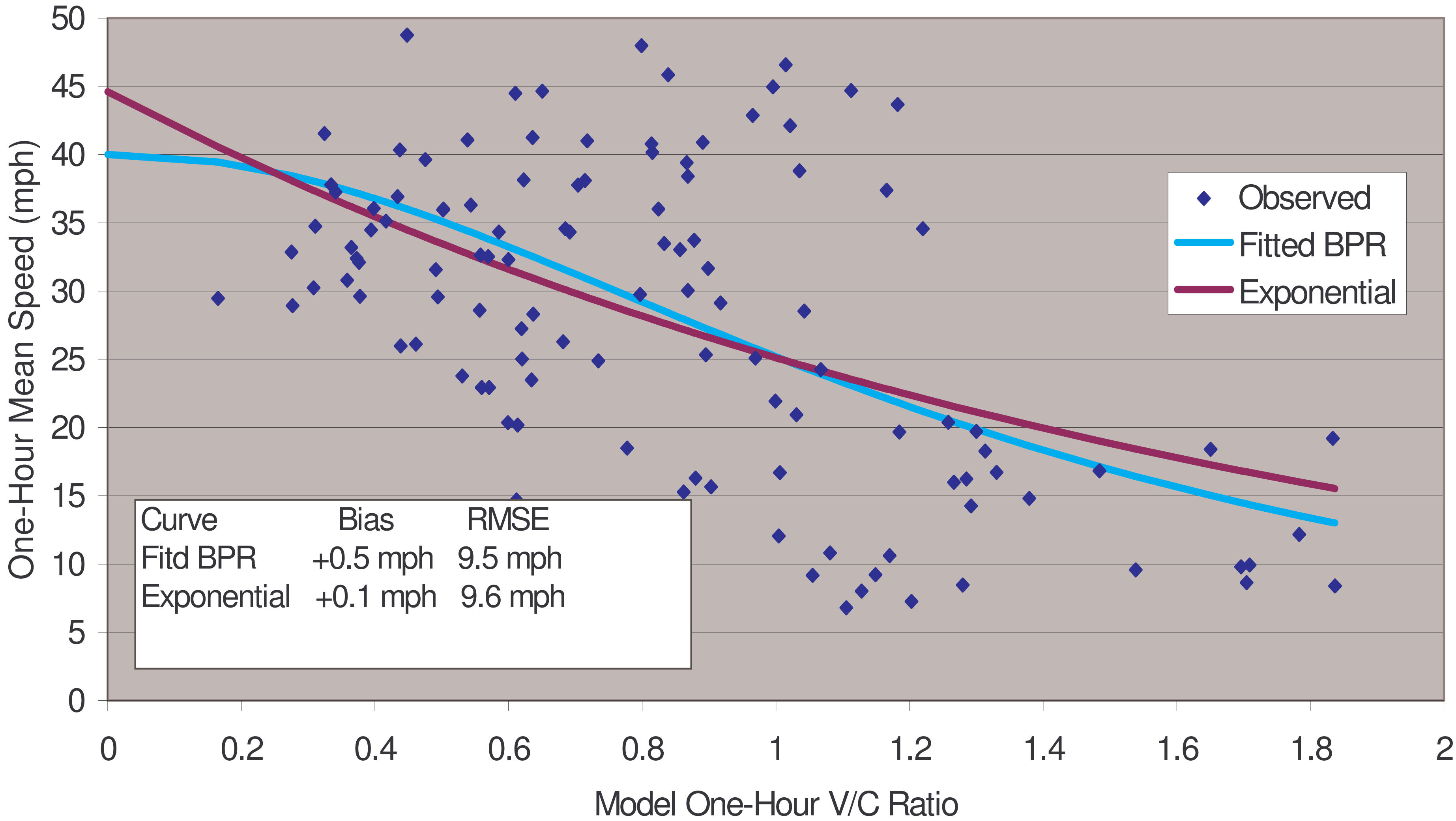
Function Alternatives

Function	Example	Comments
Linear	S = -ax + So	Goes below zero
Logarithmic	S = -a ln x+ So	Goes to infinity
Exponential	S = So*a*exp(-bx)	
Power	S = a/x^b	Goes to infinity
Polynomial	S = -ax^2 –bx + So	Goes below zero
BPR	S = So/(1+a*x^b)	
Akcelik	S = L/(To+f(x))	

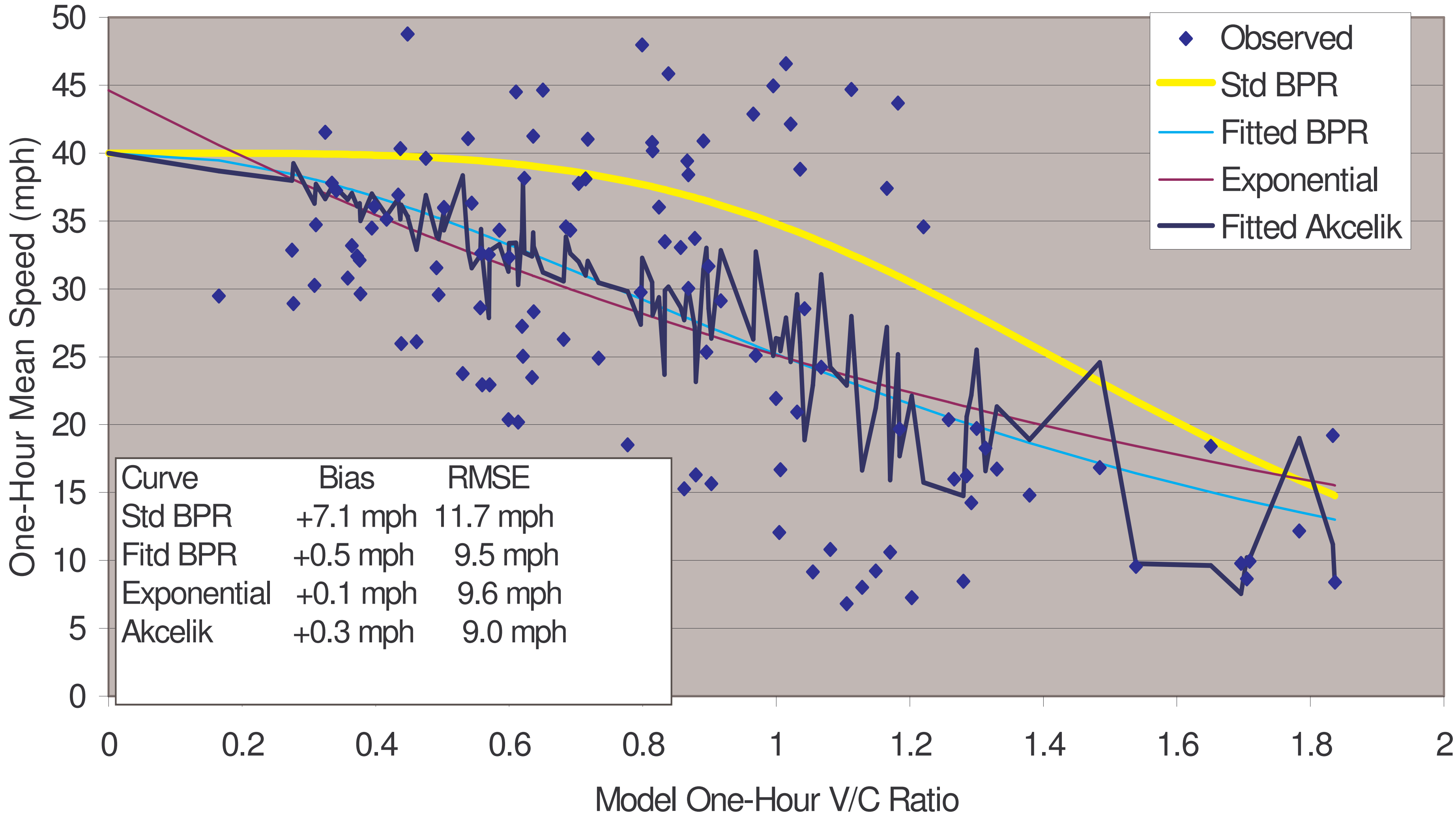
Std. BPR vs. Fitted BPR



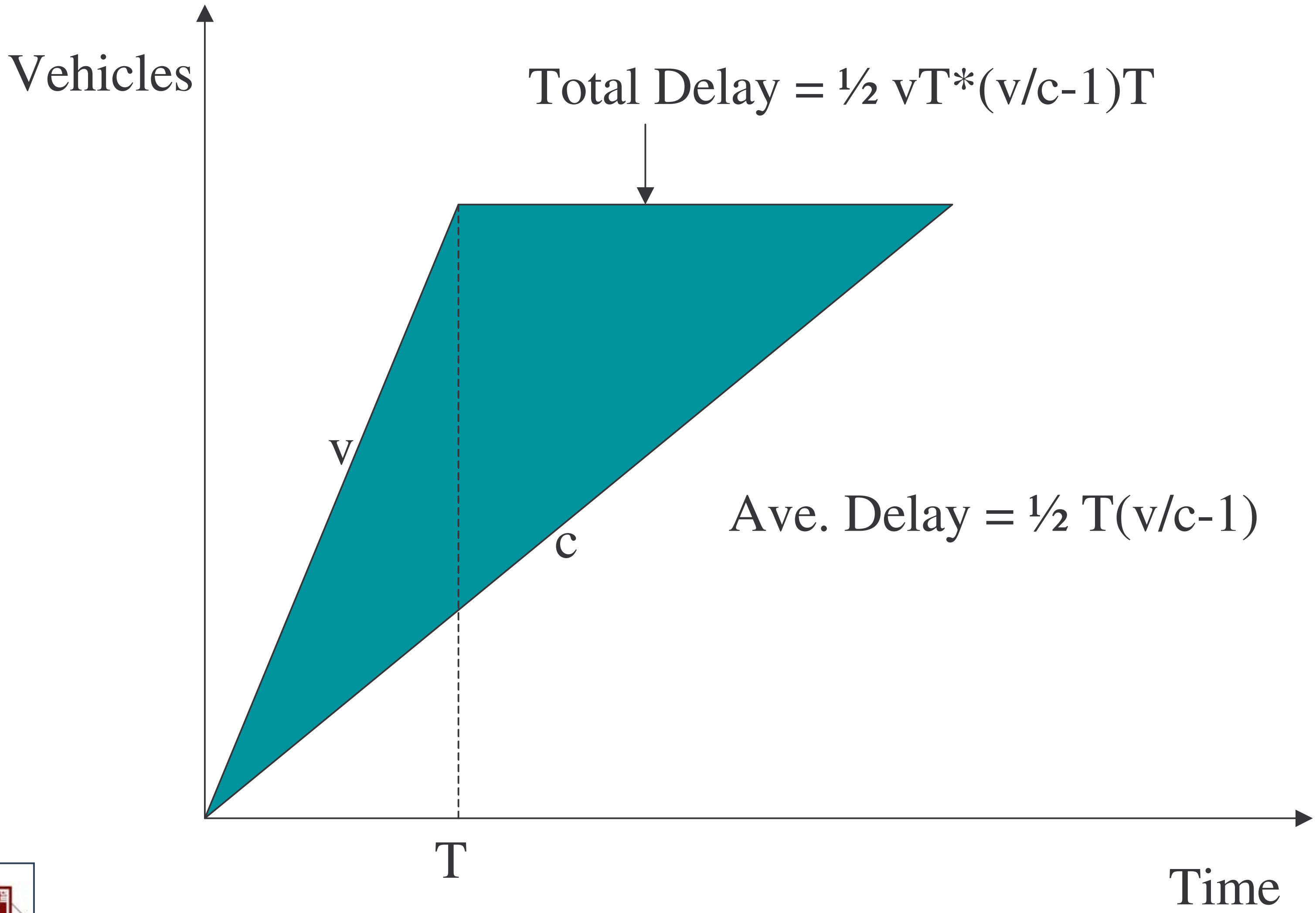
Fitted BPR vs. Exponential



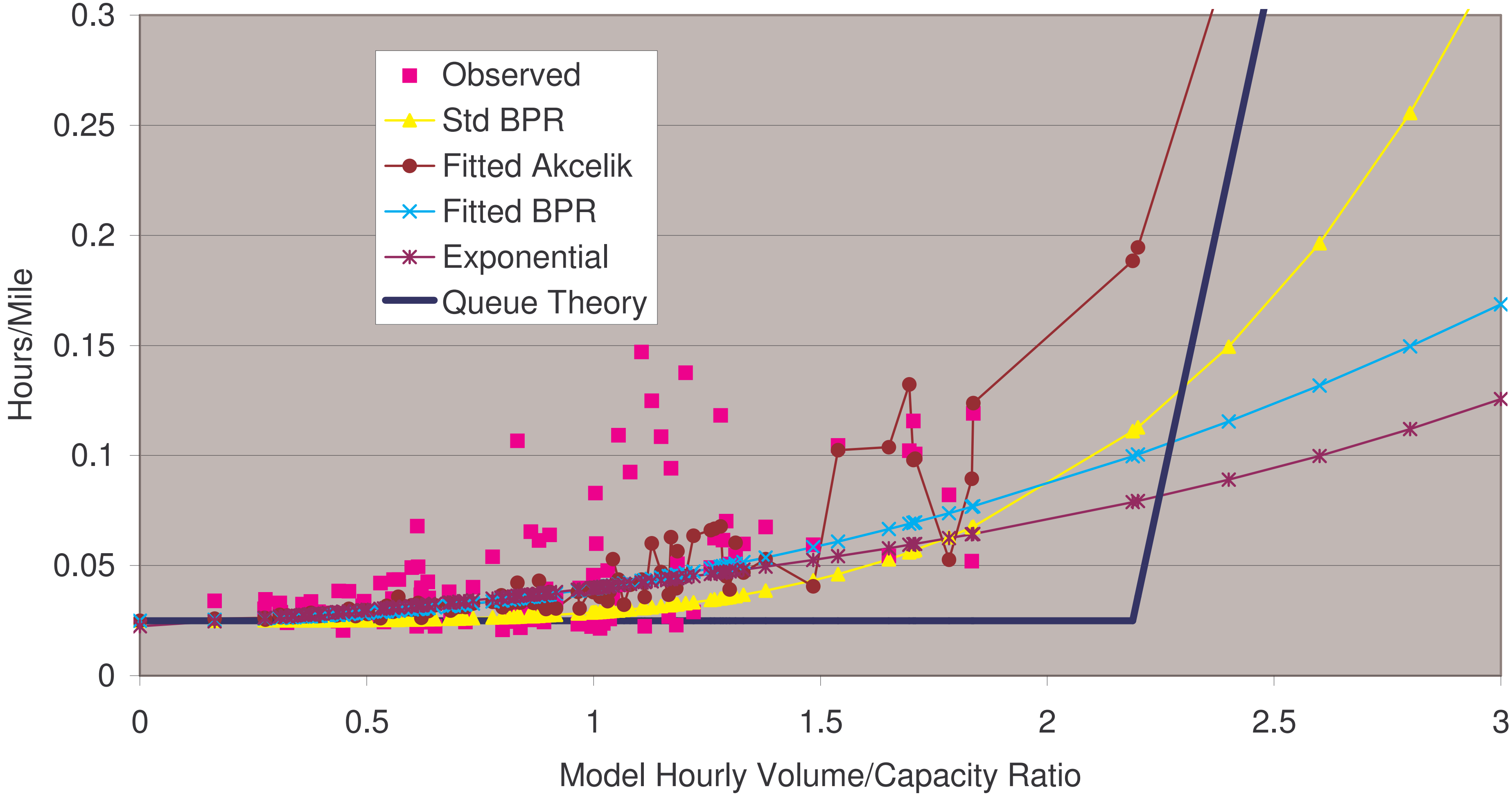
Akcelik vs Other Curves



How about for V/C >>1.00?



Speed-Flow Curves vs Queuing



Akcelik Equation

$$s = \frac{L}{L/s_0 + 0.25\left[(x-1) + \sqrt{(x-1)^2 + \frac{8ax}{cap}}\right]}$$

- L = link length (mi)
- S_0 = free-flow speed (mph)
- x = v/c ratio
- a = calibration parameter
- cap = approach capacity (vph)

Additive or Multiplicative Delay?

- BPR, Exponential
  - Delay is a multiple of the free-flow time
- Akcelik
  - Delay is independent of free-flow time
- Implications
  - Additive delay is more realistic, but
    - Splitting link into dummy links impacts total time. (can be compensated for)

Conclusions

- Investigate
  - Fitted BPR Curve (a=0.60, b=2.1)
  - Exponential Curve
  - Akcelik Curve
- Determine impacts on model validation results (and run times).
- Look into potential for link specific calibration of free-flow speeds.