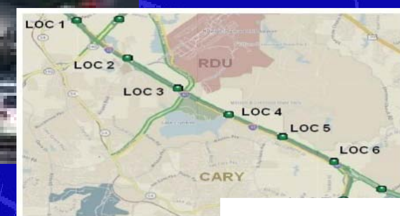
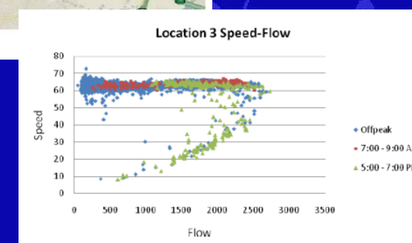
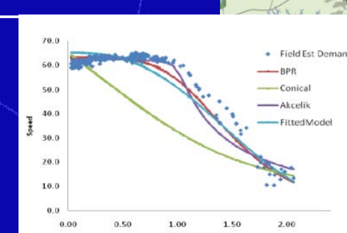




Calibrating Travel Demand Model Volume-Delay Functions Using Bottleneck and Queuing Analysis

Leta F Huntsinger, PE, PhD Candidate
Nagui M Rouphail, PhD



North Carolina Model Users Group Meeting – April 2011

Overview

- Literature Review
- Motivation
- Approach
- Results
- Conclusions and Future Research

Literature Review

- BPR, Conical, HCM, Akcelik
- Adjustments made during highway assignment
- Some agencies use locally collected data, most rely on defaults
- Need for more research on methods for using locally collected data

Motivation

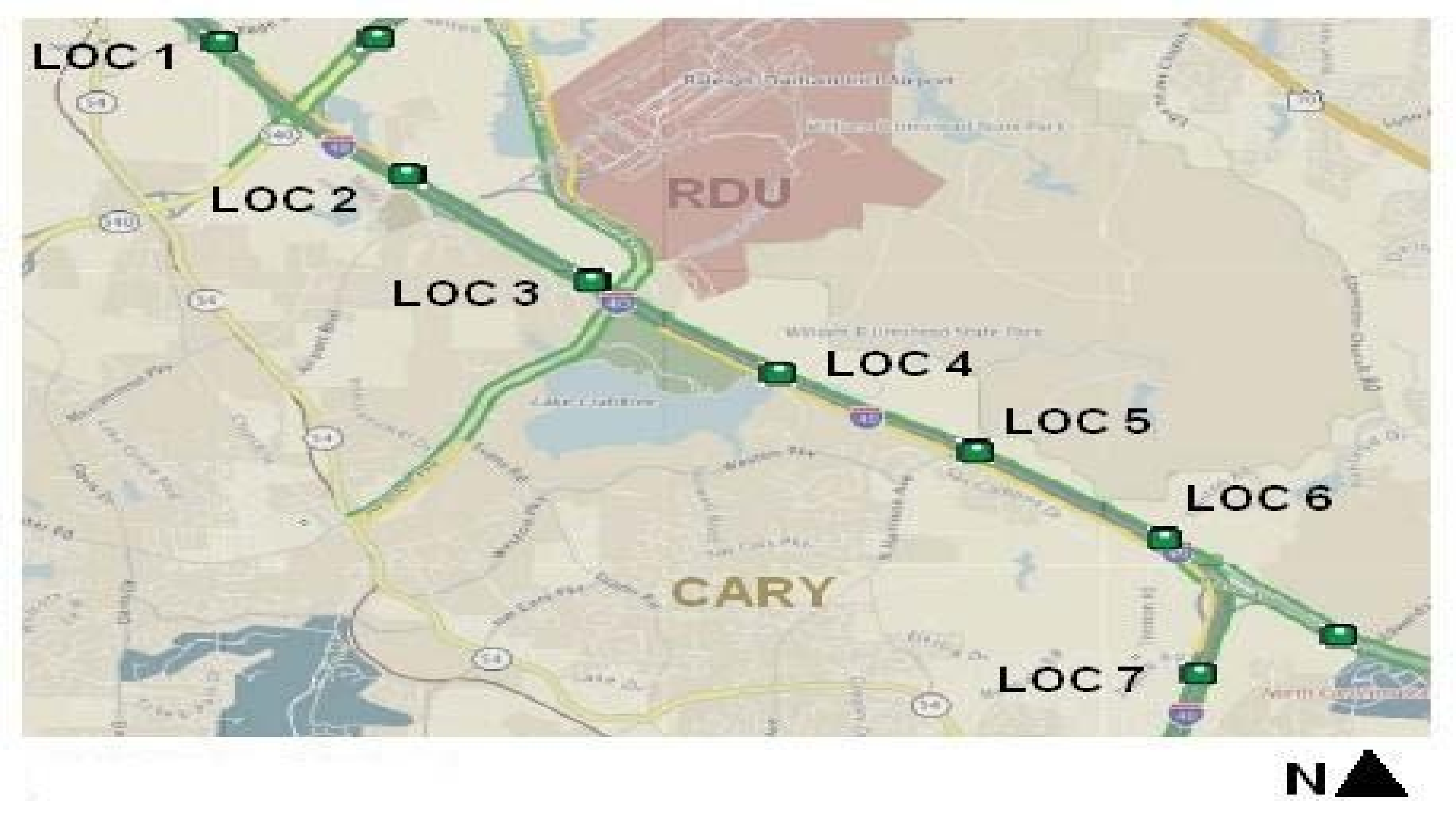
Challenge:

- Models heavily dependent on data
- Highway assignment relies primarily on traffic counts
- How to represent demand greater than capacity

Solution:

- Freeway detector data
- Bottleneck and Queue Analysis
- Approach for estimating demand beyond capacity

Data



Approach

Processing: Density

$$k = \left(\frac{52.8}{L_v + L_d} \right) * \%OCC$$

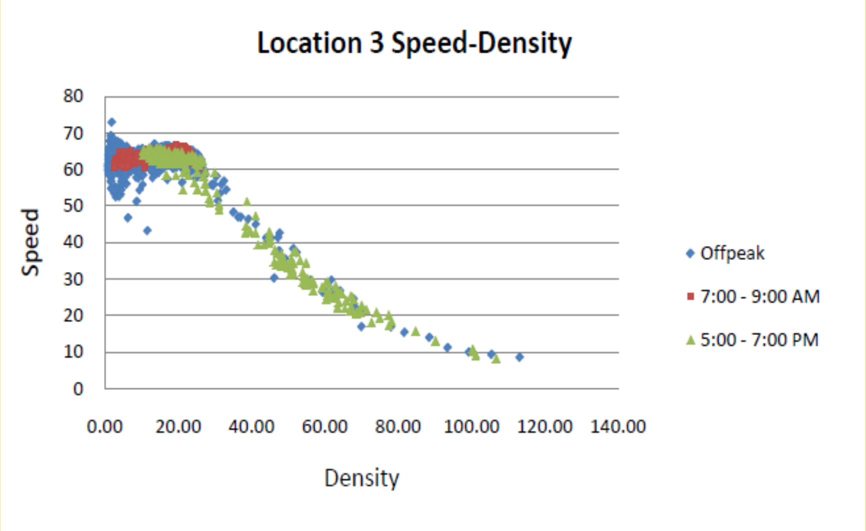
K=density (pc/mile)

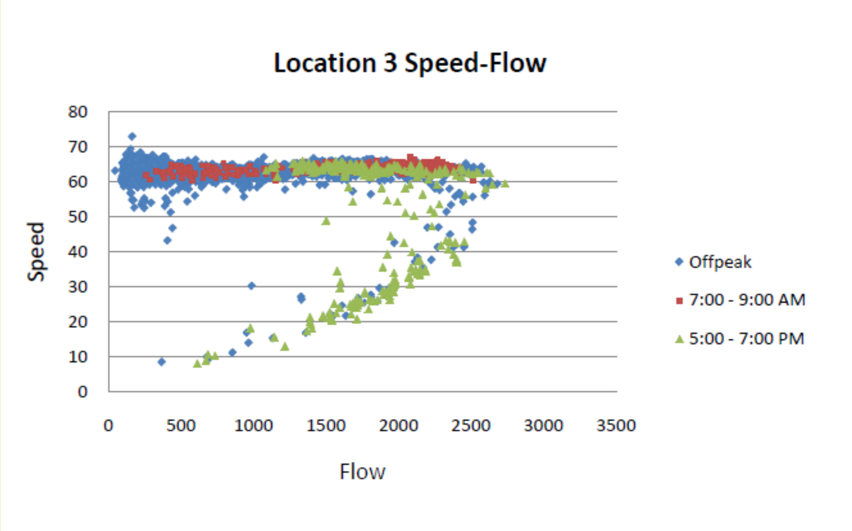
L_v = average vehicle length (feet)

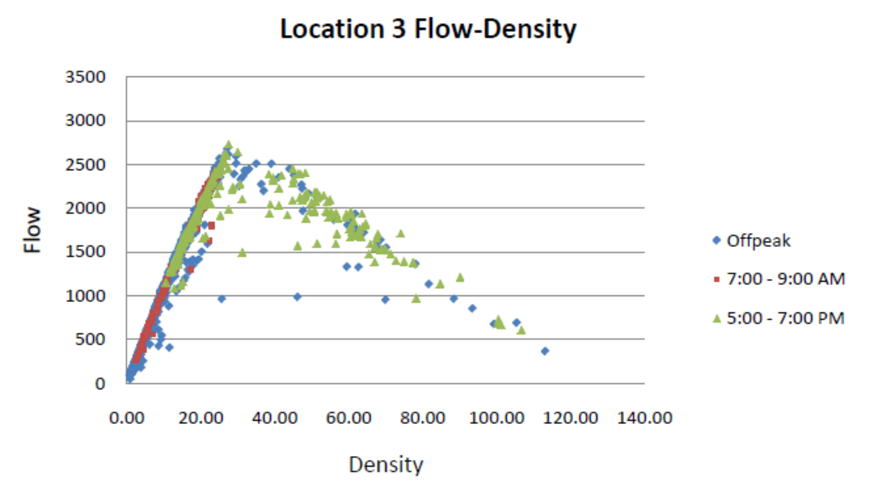
L_d = detection zone length (feet)

%OCC = percent occupancy

Processing: Reasonableness Checks



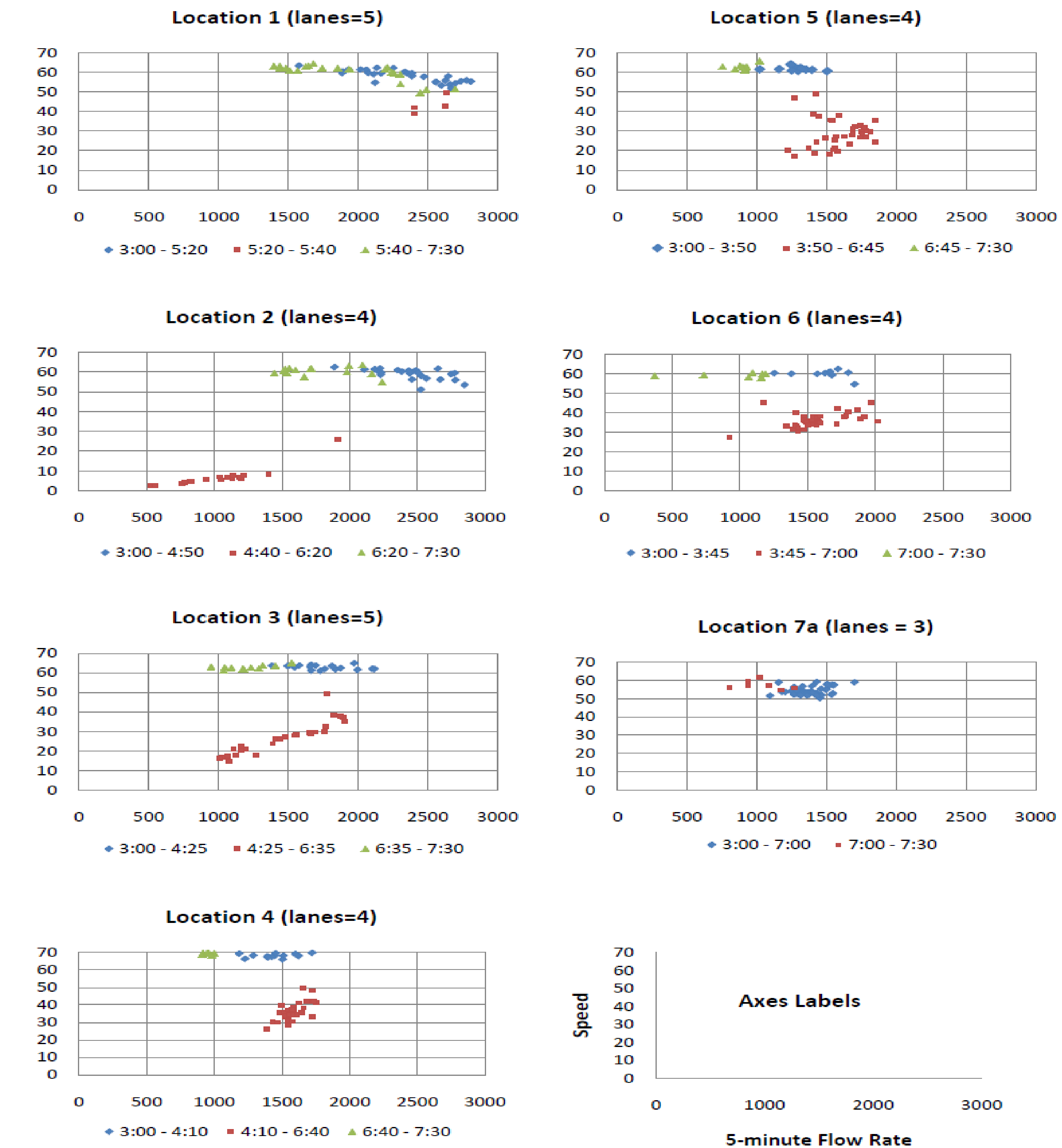




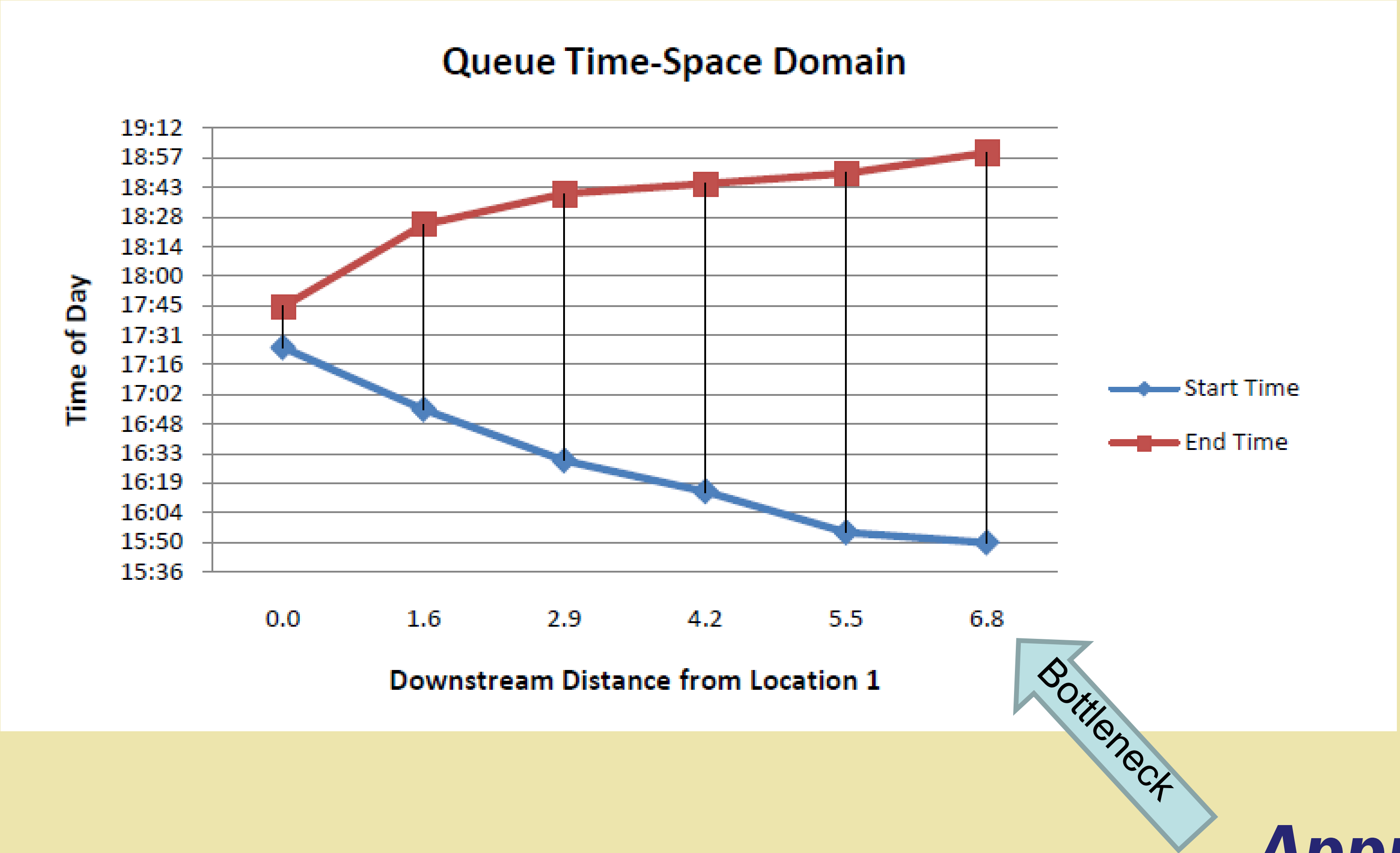
Approach

Identification of Bottleneck

Approach



Spatial Extent of Queue



Approach

Length of Queue

$$A = \left(.5d_{ud} * L\right) + \left(.5d_{dd} * L\right)$$

A = area of influence

d_{ud} = distance to upstream detector (mi)

d_{dd} = distance to downstream detector (mi)

L= number of lanes

Approach

Queue per Time Interval

$$Queue_T = \sum_{i=1}^{n} [(k_{Ti}) * (A_i)]$$

T = time interval of interest (min)

i = detector

n = maximum number of detectors

k_{Ti} = density at time interval T for detector i (pc/mi)

A_i = number of lanes

Approach

Demand

$$Demand_B = (DemandAtCapacity) + (Queue_T)$$

D_B = demand at the bottleneck

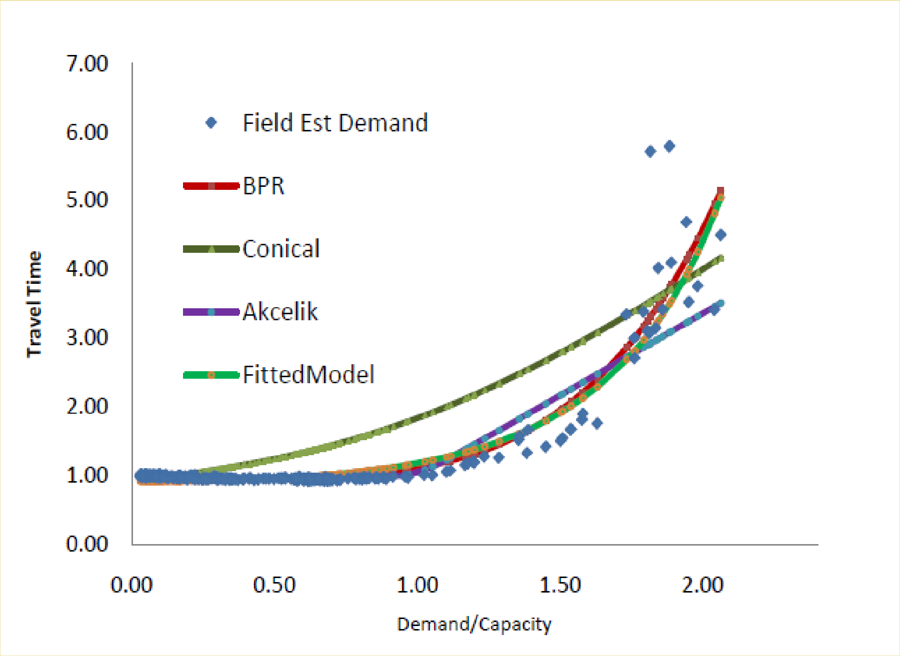
DemandAtCapacity = calculated as the average of the top 1% measured flow rate

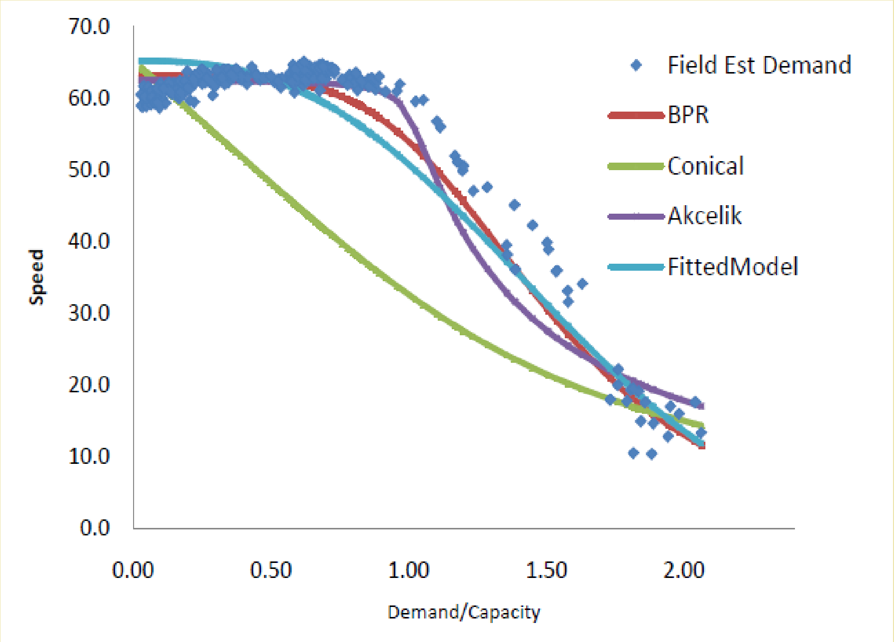
$Queue_T$ = queue per time interval

Finally:

$$D/C = (Demand_B)/(Capacity)$$

Model Fitting





Results

Model Fitting

Function	t_0 (hrs)	FFS (mph)	Alpha	Beta	J	R^2	MSE $(mph)^2$	T-test	F-test
BPR	0.95	63.4	0.17	4.50		0.88	.06	1.0	0.29
Conical	0.92	65.2	1.68			0.72	.23	0	0.73
Akcelik	0.96	61.4			0.10	0.85	.09	1.0	0.0
Exponential	0.92	65.2	0.25	2.65		0.86	.07	0.97	0.19

Results

Findings

- Models perform well
- Parameters are within expected range
- Akcelik, BPR, and exponential acceptable models
- Bottleneck and queuing analysis effective approach

Conclusions / Future Research

Conclusions:

- Analysis tools needed
- Visualize demand > capacity
- Straightforward approach

Future Research:

- Transferability
  - Other freeways in Raleigh-Durham
  - Other freeways in other areas
  - Multi-lane highways

Thank You!