



CAMBRIDGE
SYSTEMATICS

Think  Forward

Express Lanes Coding and PeMS Data Training

presented to

Caltrans District 4

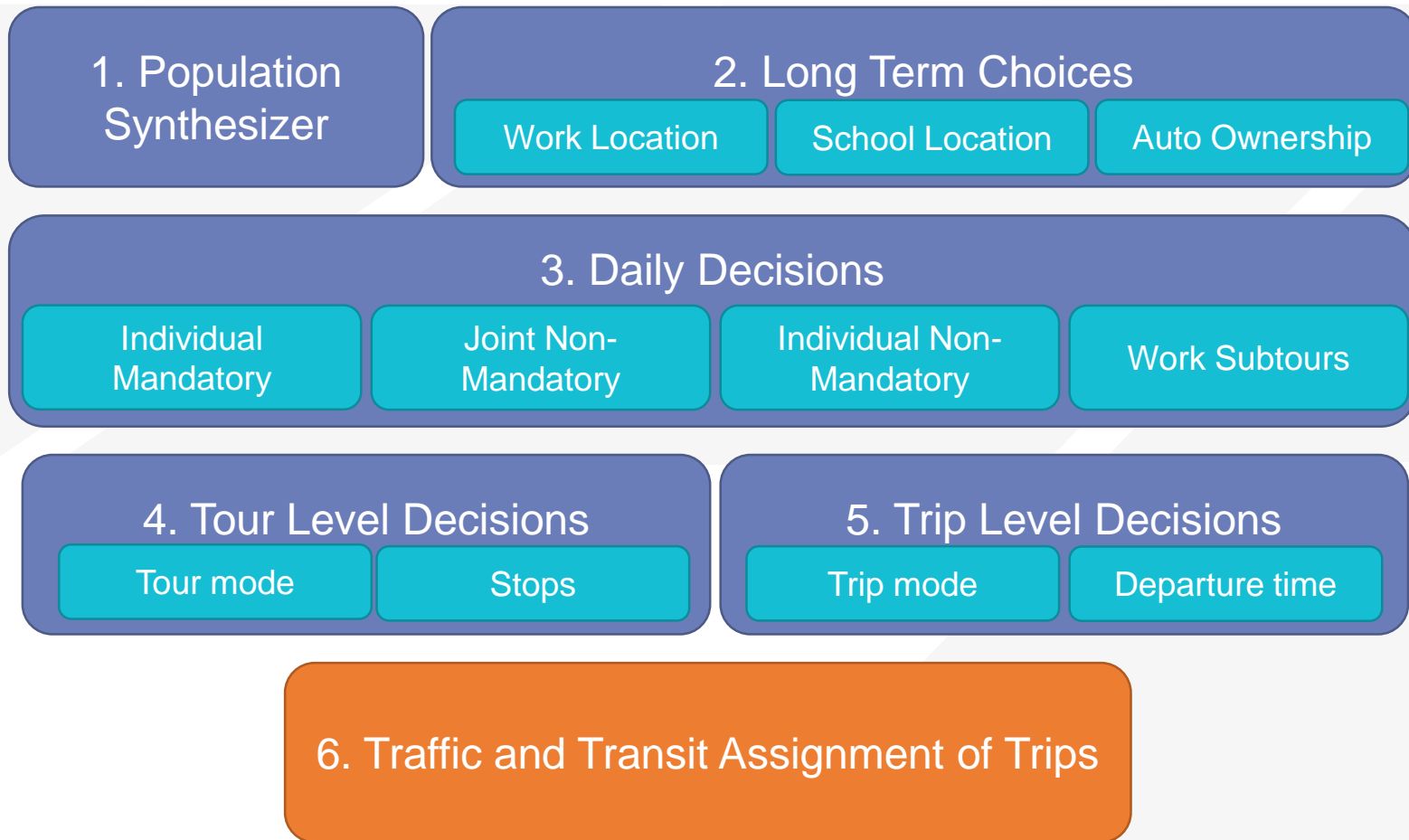
presented by

Cambridge Systematics, Inc.

Mary Martchouk, Xuan Liu

May 2, 2017

Activity-based Model (MTC)



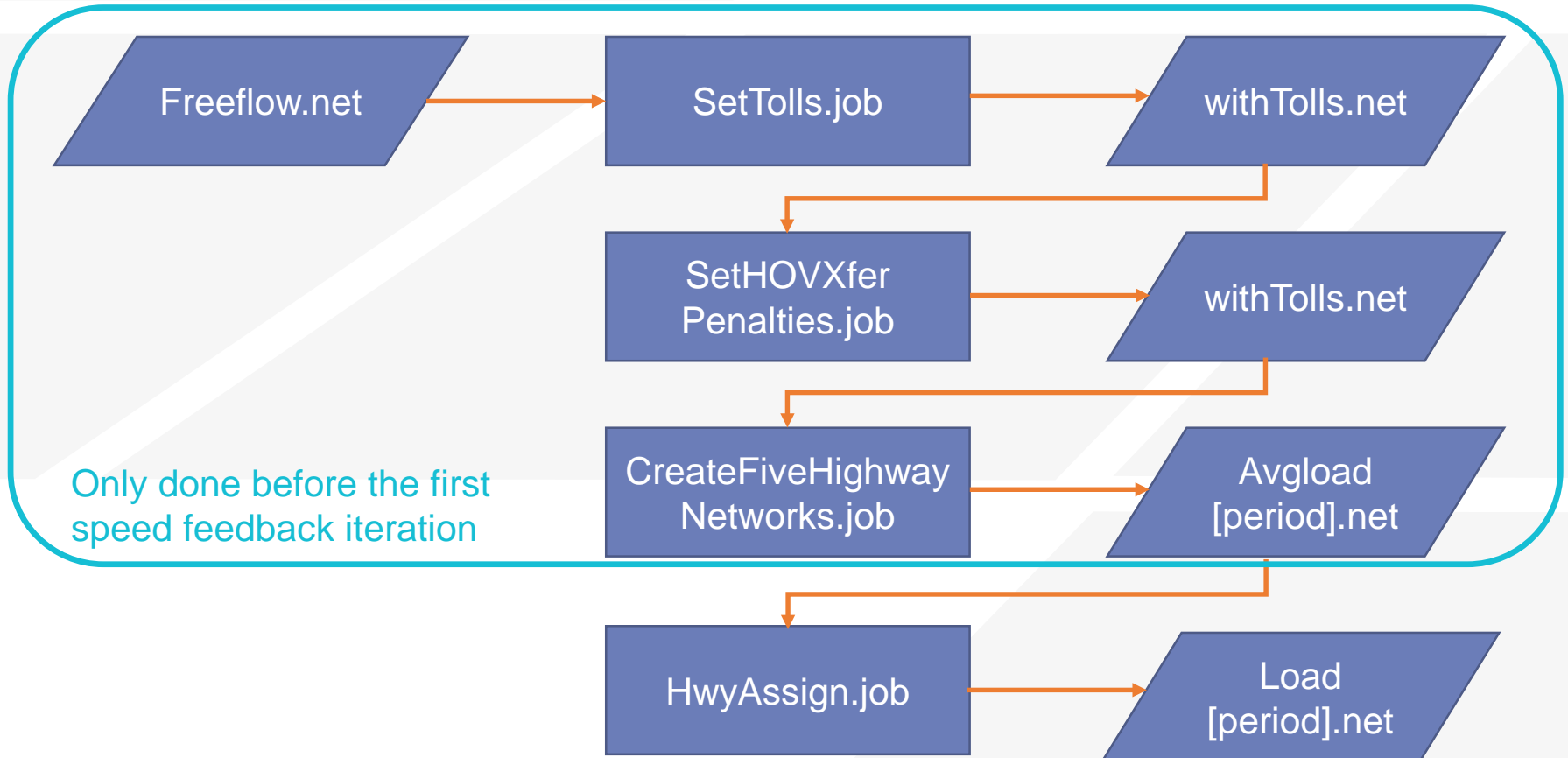
MTC Model

- Activity-based model with 9 Bay Area counties
- Current version is Travel Model One 0.6
 - » Very recently updated
- Uses Plan Bay Area land use through 2040
- Used to evaluate projects for the RTP
- Large part of the model is a “black box”: many of the components are written in Java and Python and pre-compiled
- Highway and transit assignment are implemented in Citilabs Cube

Highway Assignment Periods

- Early AM, 3 am to 6 am;
- AM peak period, 6 am to 10 am;
- Midday, 10 am to 3 pm;
- PM peak period, 3 pm to 7 pm;
- Evening, 7 pm to 3 am

Highway Assignment



Uses relative gap of 0.0005 for AM and PM peak periods

Coding Express Lanes

- Add link if necessary
- Assign a TOLLCLASS value that is not used elsewhere
- Update SetTolls.job script with new TOLLCLASS and toll value
- Run the preprocessing and assignment scripts

In- Class Exercise

- Copy MTCnoExpLane folder to ExpLane folder
- Open freeflow.net
- Add links 9878-6112 and 6116-9879
 - » Right-click on a neighboring link on Hwy 101 and select “Copy”
 - » Right click somewhere else and select “Paste”
 - » Drag link from A node to B node
- Make sure TOLLCLASS is set to 43
- Run SetTolls.job, SetHOVXferPenalties.job, CreateFiveHighwayNetworks.job

PeMS Data

Outline

- PeMS Single Detector Counts Extraction
- Peak Period to Peak Hour Calculation
- PeMS Multiple Detectors Counts Extraction
- Analyzing corridor-level data
- Data Quality Control
- PeMS vs Model Volume

Single Detector Counts Extraction

1. Click "Inventory" on the left side
2. Select District 4 on "Jump to District..."
3. Locate and zoom in to SR 37 detectors and pick detectors on Mare Island
4. Click "Aggregates"

PeMS 17.0 1

State of California

Current Location

PeMS 17.0 2

Real-Time Performance **Inventory** Search

Expand All | Collapse All | Expand Checked

Freeways - Mainline VDSs

Speeds: All Estimated Measured

Lanes: All 1 2 3 4+

Diagnostic Thresholds: All

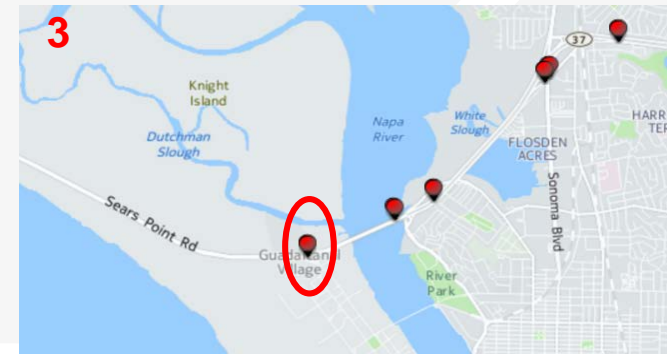
Owner: All

Sensor Technology: Any Sensor Technology

Date Added

Jump to District...
 Jump to District...
 D1 - Northwest
 D2 - Northeast
 D3 - North Central
D4 - Bay Area
 D5 - Central Coast
 D6 - South Coast
 D7 - LA/Ventura
 D8 - San Bernardino/Riverside
 D9 - Eastern Sierra
 D10 - Central
 D11 - San Diego/Imperial
 D12 - Orange County

Maps Real-Time Performance **Inventory**



Mainline VDS 402047
Walnut Ave off-e-diag

2 lanes @ SR37-E CA PM=R7.24 (16.74)
District 4, Solano County

LDS	403576
Owner	Caltrans
Aliases	None
Added	03/05/2008
Last Updated	01/28/2017
Sensor Technology	Dual Loop

Configuration Aggregates - Detector Health - AADT

Single Detector Counts Extraction

5. Select “Time of Day” as the type of aggregates

Performance > Aggregates > Time Series

From: 10/31/2016 00:00
Max Range: 3 months

To: 11/07/2016 14:59

ABOUT THIS REPORT 6

- Time Series
- Time of Day
- Day of Week
- Quantity Relationships

6. Input selection time periods “4/3/2016 – 4/28/2016”, “Tu”, “We”, “Th” and use “Median, 25%, 75%”, and then select to “Export to XLS”

Performance > Aggregates > Time of Day

ABOUT THIS REPORT

From: 04/03/2017
Min Range: 2 days Max Range: 1 year

To: 04/28/2017

Include Days
 Su Mo Tu We Th Fr Sa Holidays

Quantity
Flow

Statistics
 Mean, Min, Max
 Mean, Mean+ σ , Mean- σ
 Median, 25 %, 75 %
 Discrete Days

DRAW PLOT VIEW TABLE EXPORT TEXT EXPORT to .XLS EXPORT to .PDF

Single Detector Counts Extraction

7. Download and open .xls file

» Data table

The screenshot shows an Excel spreadsheet with the following data:

Time	25th	Median	75th	# Lane Points	% Observed
0:00	251	271	325	288	91.7
1:00	148	191	205	286	95.8
2:00	121	143	195	288	100
3:00	112	132	192	288	100
4:00	204	221	245	288	100
5:00	309	391	422	288	100
6:00	664	790	825	288	100

» Detector information

PeMS Report Description	
Report	Aggregates>Time of Day
Report link	http://pems.dot.ca.gov/?report_form=1&dnnode=VDS&content=
Report generated	5/1/2017 13:15
PeMS version	
Report Parameters	
Parameter	Value
Quantity	Flow
Data	6,910 Lane Points
Data Quality	97% Observed
Segment Type	VDS
Segment Name	Mainline VDS 402047 - Walnut Ave off-e-diag
start date	4/3/2017 0:00
end date	4/28/2017 23:59

PP2PH Factor from Single Detector

➤ Definition

- » Peak period to(2) peak hour factor
 - Peak period: travel demand modeling key word
 - Peak hour: traffic impact study key word

➤ Calculation

$$» PP2PH = \frac{\text{Peak Hour Count}}{\text{Peak Period Count}}$$

$$» PP2PH = \frac{1035}{729+1035+1058+1088} = 0.265$$

Time	25th	Median	75th	Data Quality	
				# Lane Points	% Observed
00:00	251.0	271.0	325.0	288	91.7
01:00	148.0	191.0	205.0	286	95.8
02:00	121.0	143.0	195.0	288	100.0
03:00	112.0	132.0	192.0	288	100.0
04:00	204.0	221.0	245.0	288	100.0
05:00	309.0	391.0	422.0	288	100.0
06:00	664.0	729.0	825.0	288	100.0
07:00	1,004.0	1,035.0	1,083.0	288	100.0
08:00	1,007.0	1,058.0	1,126.0	288	100.0
09:00	1,068.0	1,088.0	1,111.0	288	100.0
10:00	869.0	1,048.0	1,065.0	288	96.5
11:00	946.0	1,064.0	1,138.0	288	98.6
12:00	1,085.0	1,134.0	1,169.0	288	86.8
13:00	1,202.0	1,305.0	1,342.0	288	88.2
14:00	1,342.0	1,392.0	1,427.0	288	91.7
15:00	1,255.0	1,311.0	1,378.0	288	91.7
16:00	1,234.0	1,255.0	1,286.0	288	93.8
17:00	1,167.0	1,222.0	1,284.0	288	100.0
18:00	1,154.0	1,192.0	1,235.0	288	100.0
19:00	1,030.0	1,090.0	1,173.0	288	100.0
20:00	812.0	915.0	1,026.0	288	96.5
21:00	731.0	749.0	782.0	288	99.3
22:00	532.0	561.0	611.0	288	100.0
23:00	371.0	396.0	451.0	288	96.5
Total				6,910	97.0

Multiple Detectors Count Extraction

To download multiple detector counts, click on Data Clearinghouse

The screenshot displays the PeMS 17.0 interface for the State of California. The main navigation bar includes 'Overview', 'Facilities & Devices', 'Performance', 'Data Quality', and 'Events'. The 'Current Location' section shows a map of California with major cities like San Francisco, San Jose, Los Angeles, Phoenix, and San Diego. Below the map is a 'Freeway Details' table:

Directional Distance	30,599.4 mi
Controllers	6,912
Stations	17,732
Detectors	43,923
Traffic Census Stations	16,527

The 'Quick Links' section provides dropdown menus for jumping to default pages for district, county, city, and freeway. The 'Featured Sections' include links for Mobility Performance Report, Detector Health, CHP Incidents, Lane Closure System, Corridors, and PhotoLog Viewer. The 'Tools' section lists links for Holidays, Data Clearinghouse, PeMS User Manual, Transit PeMS User Manual, Lane Closure Manual, District TCR Training Guide, and PeMS Forum (External Site).

The 'Status Check' section features three charts: 'Delay by Day of Week' (line chart showing delay in vehicle-hours), 'Travel Time Reliability' (two radial charts for 5-10 AM and 3-8 PM), and 'Detector Health' (line chart showing % Working vs. Statewide Goal of 90%).

The 'Report Finder' section includes dropdowns for 'Select a freeway', 'Restrict Location - Optional', and 'Select a report'. The 'Announcements' section lists 'Database Maintenance' (April 26, 2017), 'PeMS 17.0' (April 23, 2017), 'PeMS 16.X' (April 19, 2017), and 'PeMS 15.2' (February 15, 2017).

The 'Cool New Features' section highlights 'Featured Tool: Time of Week Radial Chart' and 'Featured Tool: Corridor Module'.

Multiple Detectors Count Extraction

1. Select data format

2. Select district

4. Click the grey bar of year(col) and month(row) to locate dataset

Dataset header

- Field1: timestamp
- Field2: station number
- Field4: route #
- Field5: route direction
- Field6: detector type
- Field9: observation%
- Field10: total flow

3. Click Submit

The screenshot shows the PeMS data extraction interface. At the top, there are dropdown menus for 'Type' (set to 'Station Hour') and 'District' (set to 'District 4'), along with a 'Submit' button. Below this is a calendar grid for 'D4 2016 Station Hour' with columns for months (M, A, M, J, J, A, S, O, N, D) and rows for months (16, 15, 13, 12, 11, 10). A grey bar highlights the month of April. To the right is a 'Data Summary' section with text explaining the dataset and a note about clicking grey bars to view available files. Below the calendar is a 'Field Specification' table, and to the right is an 'Available Files' table. A red box highlights the file 'd04_text_station_hour_2016_04.txt.gz' in the 'Available Files' table. A red box also highlights the 'Submit' button.

Type: Station Hour | **District**: District 4 | **Submit**

D4 2016 Station Hour

	M	A	M	J	J	A	S	O	N	D
16										
15										
13										
12										
11										
10										

Data Summary

This dataset contains the hourly totals for each active station on the given day. At the end of each hour, PeMS summarizes 5-minute values into hourly totals in order to facilitate reporting long term trends.

Months with data are indicated by a grey rectangle. Click a rectangle to view a listing of files available for download.

Field Specification

Name	Comment	Units
Timestamp	The date and time of the beginning of the summary interval. For example, a time of 08:00:00 indicates that the aggregate(s) contain measurements collected between 08:00:00 and 08:59:59. Note that minute and second values are always 0 for hourly aggregations. The format is MM/DD/YYYY HH24:MI:SS.	
Station	Unique station identifier. Use this value to cross-reference with <i>Metadata</i> files.	
District	District #	
Route	Route #	
Direction of Travel	N S E W	
Lane Type	A string indicating the type of lane. Possible values (and their meaning) are: <ul style="list-style-type: none">• CD (Coll/Dist)• CH (Conventional Highway)• FF (Fwy-Fwy connector)• FR (Off Ramp)• HV (HOV)• ML (Mainline)• OR (On Ramp)	
Station Length	Segment length covered by the station in miles/km.	
Samples	Total number of samples received for all lanes.	
%	Percentage of 5-minute lane points that	%

Available Files

File Name	Bytes
d04_text_station_hour_2016_01.txt.gz	70,405,016
d04_text_station_hour_2016_02.txt.gz	61,537,140
d04_text_station_hour_2016_03.txt.gz	70,823,415
d04_text_station_hour_2016_04.txt.gz	71,723,986
d04_text_station_hour_2016_05.txt.gz	76,888,364
d04_text_station_hour_2016_06.txt.gz	75,633,959
d04_text_station_hour_2016_07.txt.gz	78,067,593
d04_text_station_hour_2016_08.txt.gz	78,984,332
d04_text_station_hour_2016_09.txt.gz	77,877,077
d04_text_station_hour_2016_10.txt.gz	80,816,118
d04_text_station_hour_2016_11.txt.gz	8,798,582
d04_text_station_hour_2016_12.txt.gz	86,859

5. Click the dataset to download; [DistrictNumber]_text_[dataformat]_year_month.txt

Analyzing Downloaded Data in MS Access

- Downloaded data contains
 - » All days in the specific month
 - » All detectors in the district
 - » All corridors in the district
 - » All detector types in the direct
- Import into MS Access, which is a database tool
- Create a query to filter data as necessary
 - » Facility name, direction, etc.
- Reference video
 - » PeMS Data Query By Using ACCESS.mp4

Calculate Peak Period to Peak Hour Factor

- Open the file created by Access in Excel
- Add columns and calculate weekday and hour for each record
- Use a pivot table to summarize the data by hour
 - » Row: detectors
 - » Column: hours
 - » Filter: weekday and data quality
- Reference video
 - » Summarize PeMS Data By Using Excel PivotTable.mp4

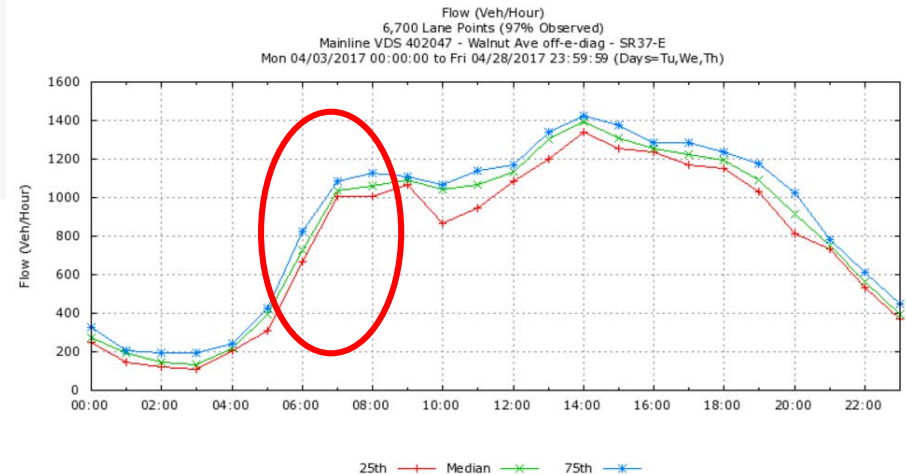
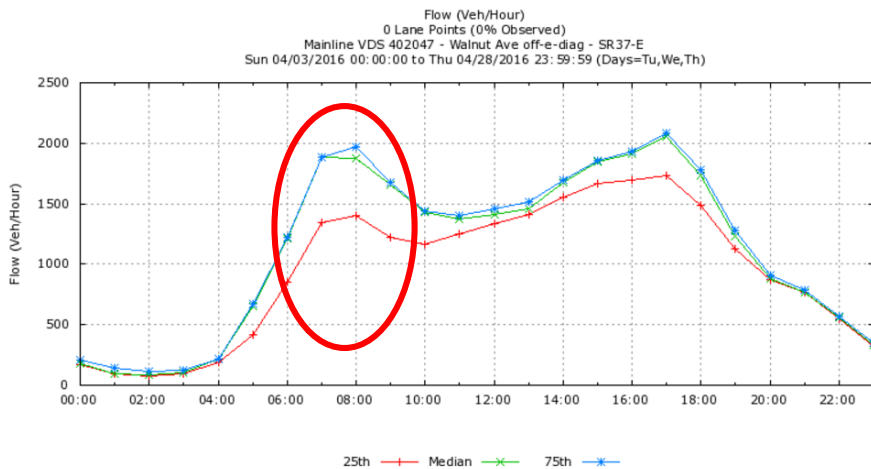
Data Quality Control

- Data Quality Measures
 - » Statistics – 25%, Median, 75%
 - » % Observed
- Bad Data vs Good Data

Bad Data vs Good Data

➤ Data Plot

- » Bad data: 4/4/2016 – 4/28/2016
- » Good data: 4/4/2017 – 4/28/2017



Bad Data vs Good Data

➤ Data Table

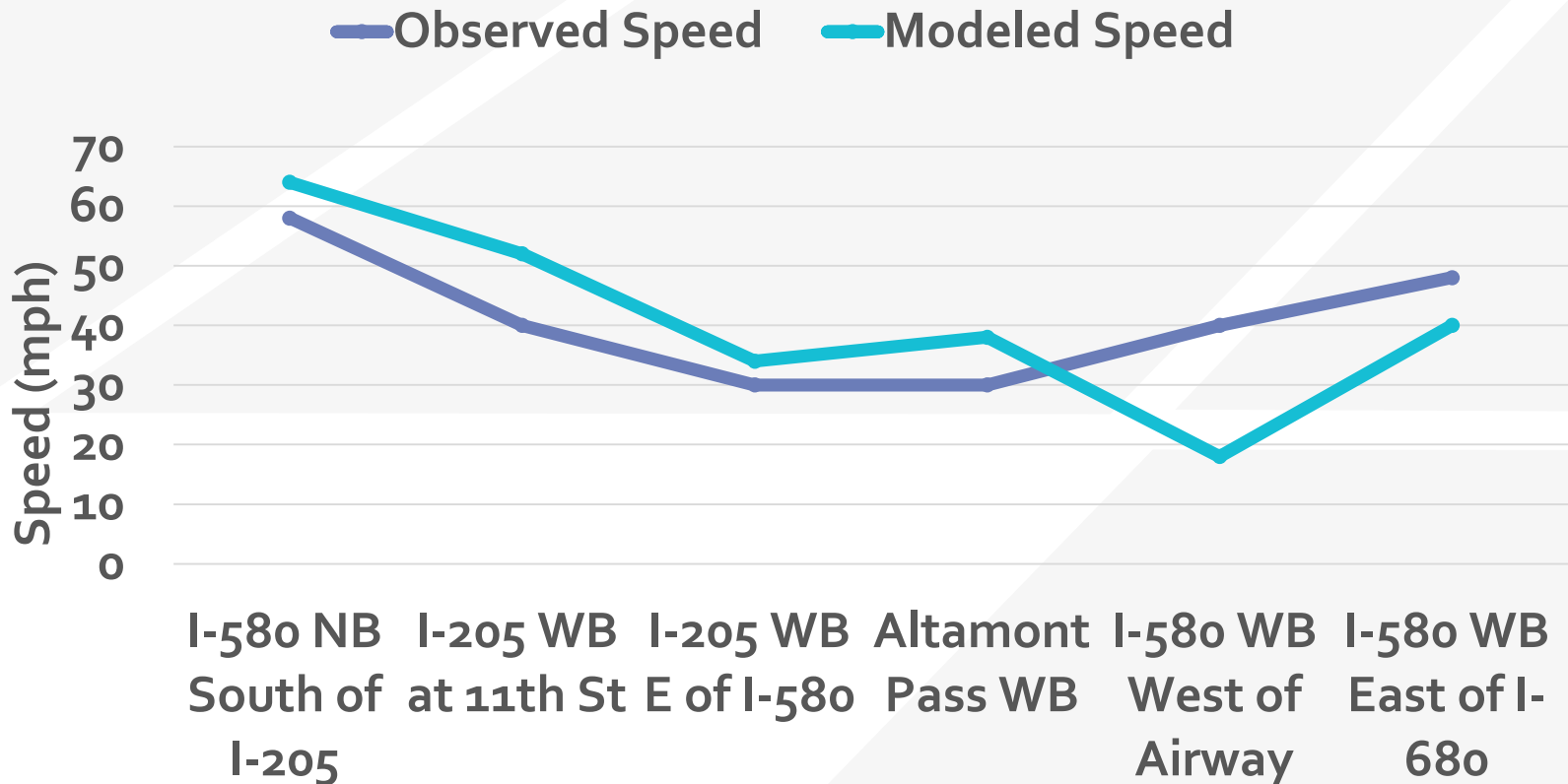
- » Bad data: 0% Observation
- » Good data: > 80% Observation

Time	25th	Median	75th	Data Quality	
				# Lane Points	% Observed
00:00	169.0	176.0	213.0	288	0.0
01:00	96.0	97.0	139.0	288	0.0
02:00	80.0	82.0	112.0	288	0.0
03:00	96.0	101.0	121.0	288	0.0
04:00	193.0	220.0	222.0	288	0.0
05:00	419.0	650.0	672.0	288	0.0
06:00	852.0	1,209.0	1,221.0	288	0.0
07:00	1,349.0	1,885.0	1,887.0	288	0.0
08:00	1,404.0	1,878.0	1,971.0	288	0.0
09:00	1,220.0	1,656.0	1,680.0	288	0.0
10:00	1,169.0	1,434.0	1,444.0	288	0.0
11:00	1,250.0	1,370.0	1,397.0	288	0.0
12:00	1,332.0	1,413.0	1,454.0	288	0.0
13:00	1,413.0	1,460.0	1,519.0	288	0.0
14:00	1,555.0	1,676.0	1,695.0	288	0.0
15:00	1,667.0	1,844.0	1,858.0	288	0.0
16:00	1,691.0	1,911.0	1,934.0	288	0.0
17:00	1,735.0	2,056.0	2,079.0	288	0.0
18:00	1,489.0	1,735.0	1,785.0	288	0.0
19:00	1,124.0	1,235.0	1,275.0	288	0.0
20:00	875.0	878.0	905.0	288	0.0
21:00	766.0	767.0	790.0	288	0.0
22:00	549.0	560.0	567.0	288	0.0
23:00	320.0	333.0	355.0	288	0.0
Total				6,912	0.0

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11:00	946.0	1,064.0	1,138.0	288	98.6
12:00	1,085.0	1,134.0	1,169.0	288	86.8
13:00	1,202.0	1,305.0	1,342.0	288	88.2
14:00	1,342.0	1,392.0	1,427.0	288	91.7
15:00	1,255.0	1,311.0	1,378.0	288	91.7
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PeMS vs ACTC Model Volume

2013 AM Peak Hour Speeds Westbound



PeMS vs INRIX vs ACTTC Model

