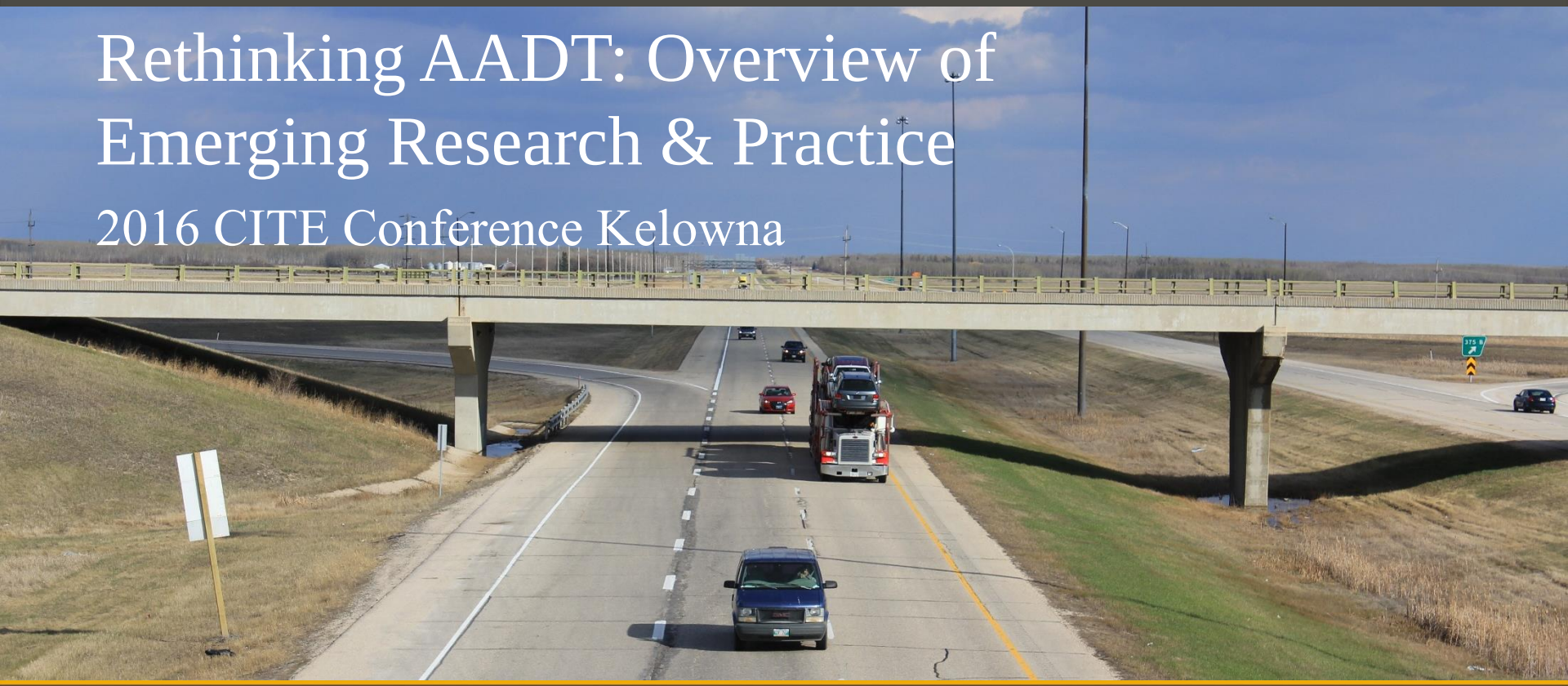
ADVENTURER EXPLORER TRAILBLAZER REBEL PIONEER CREATOR DEFENDER ADVENTURER EXPLORER TRAILBLAZ

REBEL PIONEER CREATOR DEFENDER ADVENTURER EXPLORER TRAILBLAZER REBEL PIONEER CREATOR DEFENDER ADVENTURER EXPLORER TRAILBLAZER REBEL PIONEER CREATOR DEFENDE

Rethinking AADT: Overview of Emerging Research & Practice

2016 CITE Conference Kelowna



Giuseppe Grande, B.Sc., EIT
Steven Wood, B.Sc., EIT
Auja Ominski, B.Sc., EIT
Jonathan Regehr, Ph.D., P.Eng

University of Manitoba

Outline

1. Introduction
2. Current Practice
3. New AADT Formulation
4. Illustrative Analysis
   a) Findings
   b) Practical implications
5. Concluding remarks
6. References

Introduction

This presentation reviews current and emerging practice for determining AADT from continuous count sites.

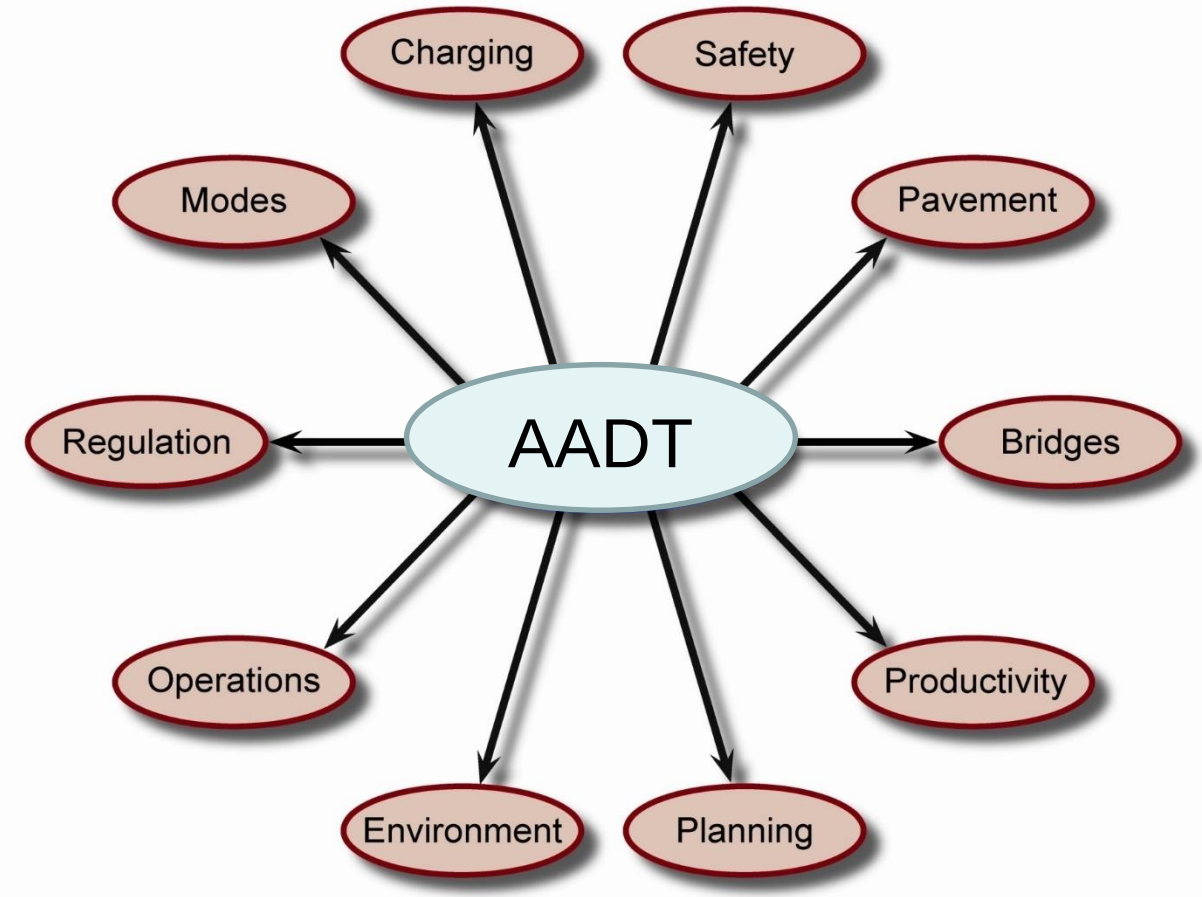
What is AADT?

- AADT is the number of vehicles passing a point on an average day of the year

Where do the data come from?

- Continuous count sites (focus of this presentation)
- Short-duration count sites (requires factoring)

Importance of AADT



Current Practice

So how do we currently calculate AADT?

- Simple average (if we have “good” data)
- AASHTO Method

Simple Average

Exactly what it sounds like:

$$AADT = \frac{1}{n}\sum_{i=1}^{n} VOL_i$$

Where:
VOL_i = total traffic on *i*th day of year
n = number of days in a particular year

Simple Average

Exactly what it sounds like:

$$AADT = \frac{1}{n}\sum_{i=1}^{n} VOL_i$$

- Works perfectly IF we have 365 full days of data (i.e., 24-hours each)
- If missing hours (or days) we introduce a bias because of the natural periodicities of traffic flow

AASHTO Method

Accounts for bias in missing data by grouping similar days by day of week and month:

$$AADT = \frac{1}{12}\sum_{m=1}^{12}\frac{1}{7}\sum_{j=1}^{7}\frac{1}{n_{jm}}\sum_{i=1}^{n_{jm}}VOL_{ijm}$$

Where:

VOL_{ijm} = total traffic on *i*th occurrence of *j*th day of week within *m*th month

i = occurrence of a particular day of week in a particular month

j = day of week (1 to 7)

m = month of year (1 to 12)

n_{jm} = amount of times day *j* occurs in month *m* for which traffic data is available

AASHTO Method

Accounts for bias in missing data by grouping similar days by day of week and month:

$$AADT = \frac{1}{12}\sum_{m=1}^{12}\frac{1}{7}\sum_{j=1}^{7}\frac{1}{n_{jm}}\sum_{i=1}^{n_{jm}}VOL_{ijm}$$

- Still requires 24 hours of data in a single day
- Requires at least one of every day-of-the-week per month
- Can calculate by class

AASHTO Method

JAN						
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEB						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

MAR						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

APR						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

MAY						
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

JUN						
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

JUL						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

AUG						
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

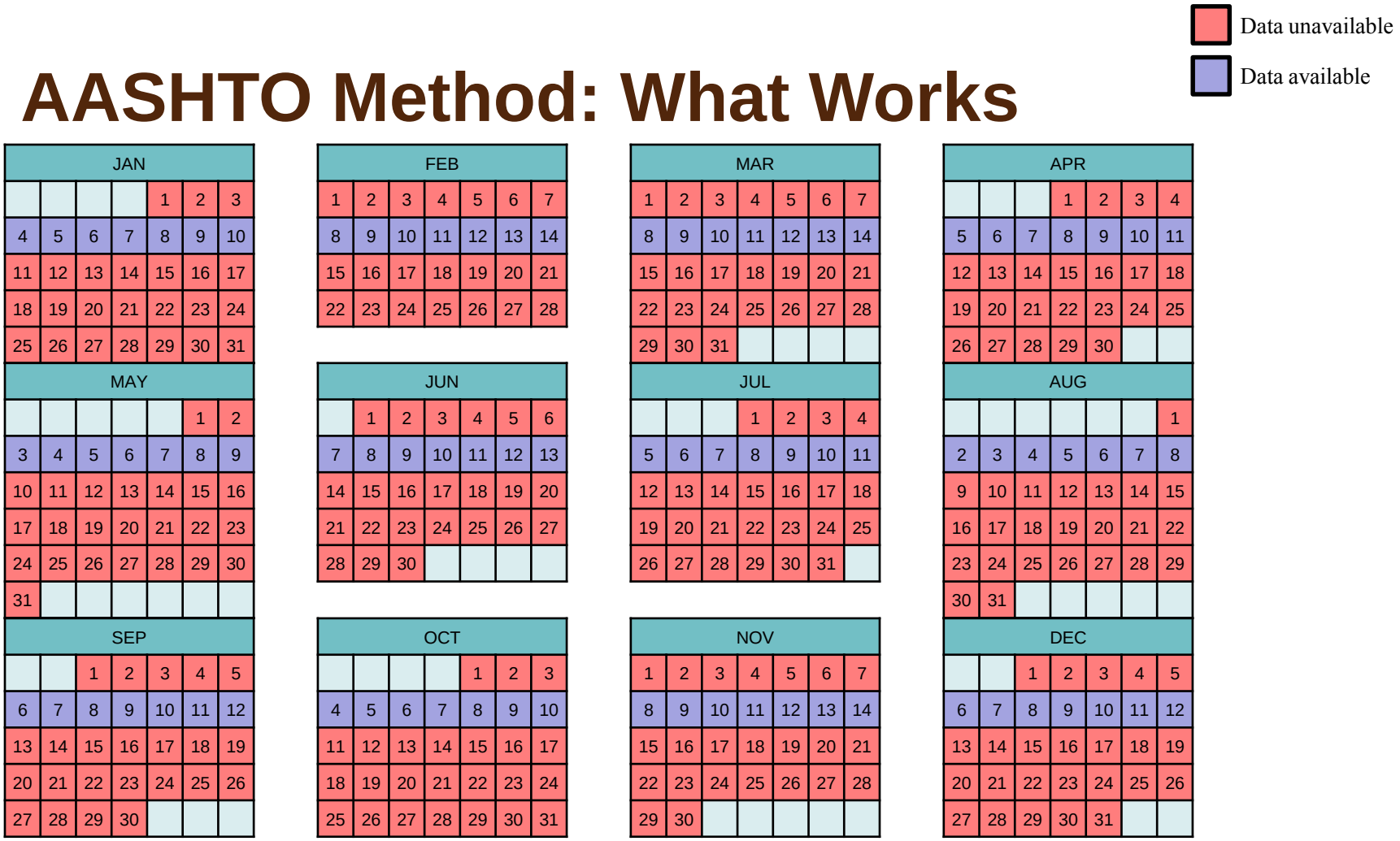
SEP						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

OCT						
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

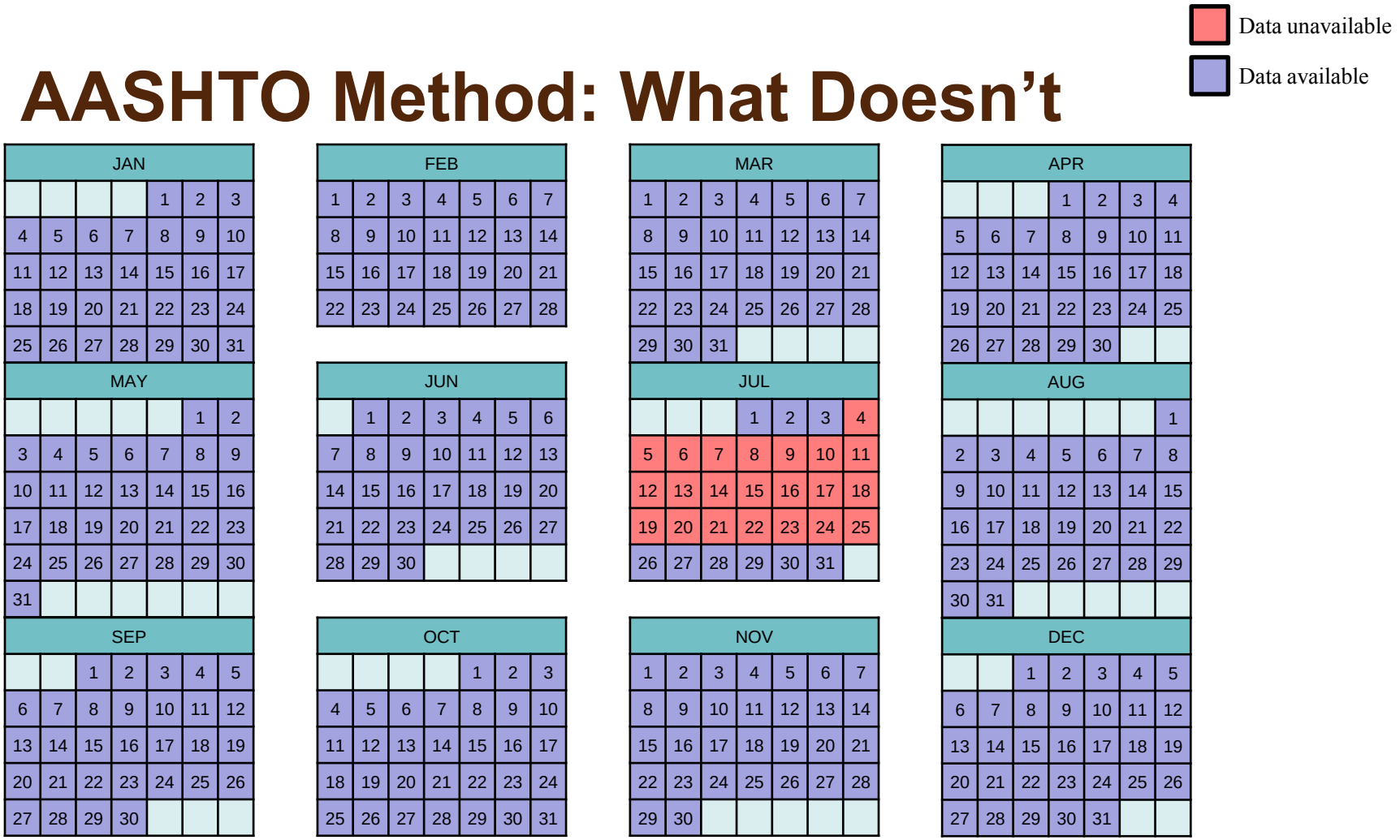
NOV						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

DEC						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

AASHTO Method: What Works



AASHTO Method: What Doesn't



New AADT Formulation: HPSJB

Concerns with accuracy and inability to use valuable data led to creation of the Highway Policy Steven Jessberger-FHWA and Battelle (HPSJB) Method

New AADT Formulation: HPSJB

$$AADT = \frac{\sum_{m=1}^{12} d_m * \frac{\sum_{j=1}^{7} w_{jm} * \sum_{h=1}^{24} \left[\frac{1}{n_{hjm}} \sum_{i=1}^{n_{hjm}} VOL_{ihjm} \right]}{\sum_{j=1}^{7} w_{jm}}}{\sum_{m=1}^{12} d_m}$$

Where:

VOL_{ihjm} = total traffic on *i*th occurrence of the *h*th hour within *j*th day of week within *m*th month

i = occurrence of a particular day of week in a particular month

h = hour of day (1 to 24)

j = day of week (1 to 7)

m = month of year (1 to 12)

n_{hjm} = number of times hour *h* within day *j* of week occurs during month *m* for which traffic data is available

w_{jm} = number of times day *j* occurs during month *m*

d_m = number of days in month *m*

New AADT Formulation: HPSJB

Two major differences from AASHTO method:

- Group by hour of day – *Improve useful number of days*
- Weighted average – *Reduce bias from shorter months*

$$AADT = \frac{\sum_{m=1}^{12} d_m * \dfrac{\sum_{j=1}^{7} w_{jm} * \sum_{h=1}^{24} \left[\dfrac{1}{n_{hjm}} \sum_{i=1}^{n_{hjm}} VOL_{ihjm} \right]}{\sum_{j=1}^{7} w_{jm}}}{\sum_{m=1}^{12} d_m}$$

Data unavailable

Data available

HPSJB: Advantages

JAN						
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEB						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

MAR						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

APR						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

APRIL 17
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM

MAY						
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

JUN						
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

JUL						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

AUG						
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

SEP						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

OCT						
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

NOV						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

DEC						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Data unavailable

Data available

HPSJB: Advantages

JAN						
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEB						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

MAR						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

APR						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

MAY						
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

JUN						
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

JUL						
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

AUG						
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

SEP						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

OCT						
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

NOV						
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

DEC						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JULY 4
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM

JULY 25
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM

Illustrative Analysis Using Manitoba Data

Analysis Objective:

- Study the robustness of the simple average versus AASHTO versus other formulations

Illustrative Analysis Using Manitoba Data

Source Data:

- In Manitoba, 79 permanent count sites
- For 2014, 33 counters (with vehicle classifying capabilities) had 24 hours of data for a full year
- Two stations were analyzed: Station 1 and 90
- Both stations are automatic vehicle classifiers that counted for a full 24 hours every day in 2014

Illustrative Analysis Using Manitoba Data

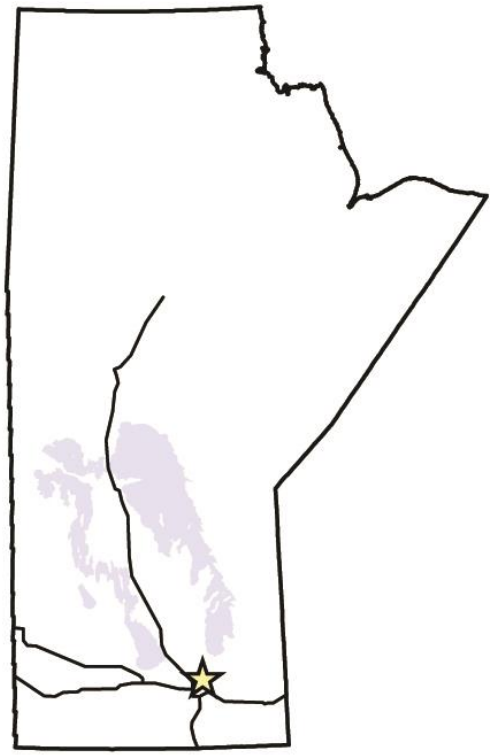
Analysis Method:

- Take counters with full year of 24-hour data
  - Treat them as if they are missing data
  - Compute AADTT using methods and compare to actual AADTT
- Data were removed following several different temporal patterns meant to represent real-life scenarios

Illustrative Analysis Using Manitoba Data

Station 1:

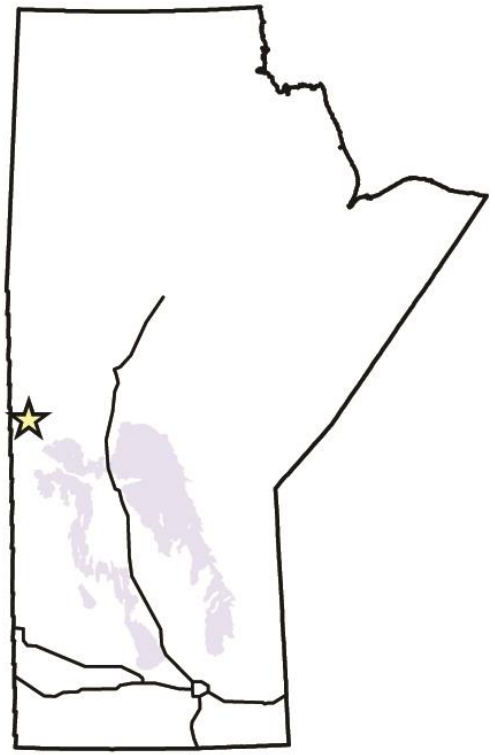
- Near Winnipeg perimeter highway
- Heavy urban influence
- True AADTT = 520



Illustrative Analysis Using Manitoba Data

Station 90:

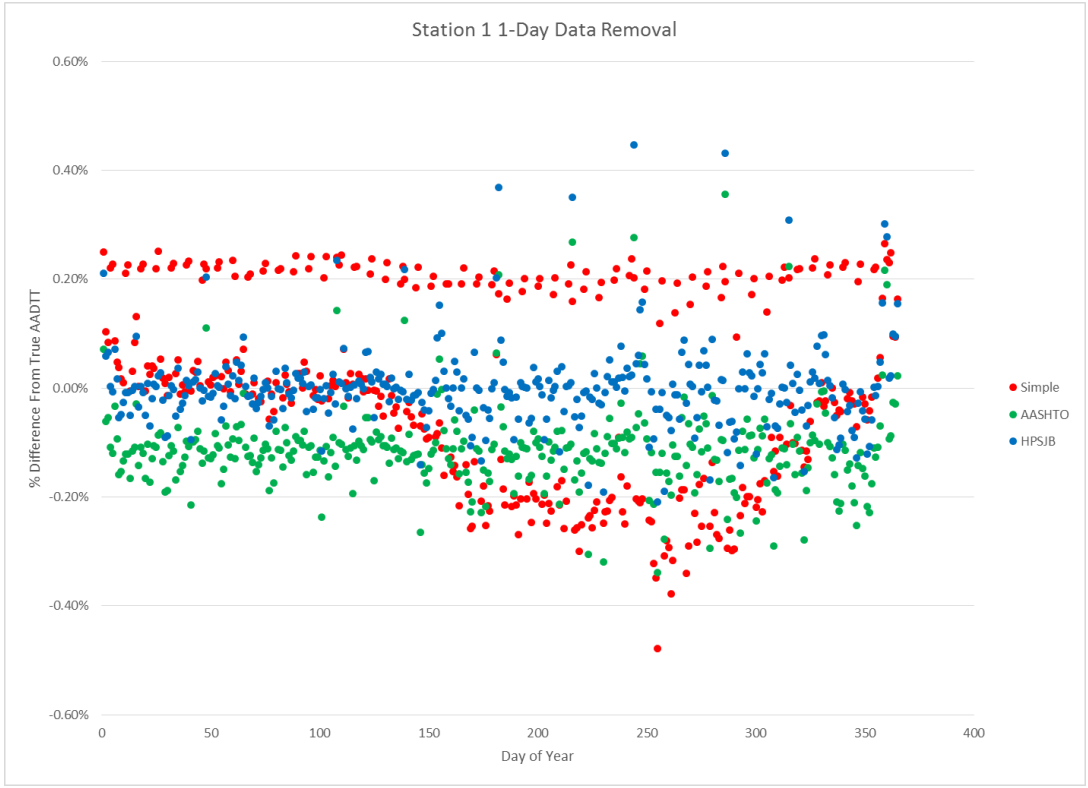
- Northwest Manitoba near The Pas
- Heavy forestry influence
- True AADTT = 150



Illustrative Analysis Using Manitoba Data

1-Day Removal (St. 1):

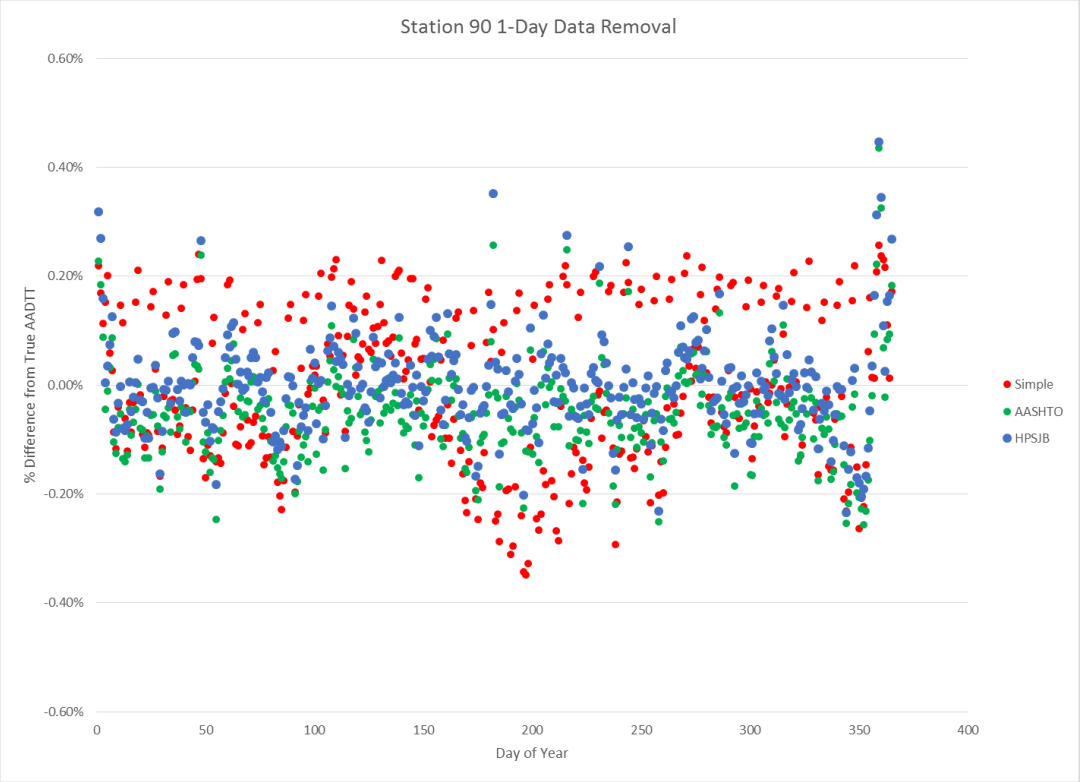
- Data removed for full 24 hours each day of the year
- HPSJB is poorest when holidays are removed



Illustrative Analysis Using Manitoba Data

1-Day Removal (St. 90):

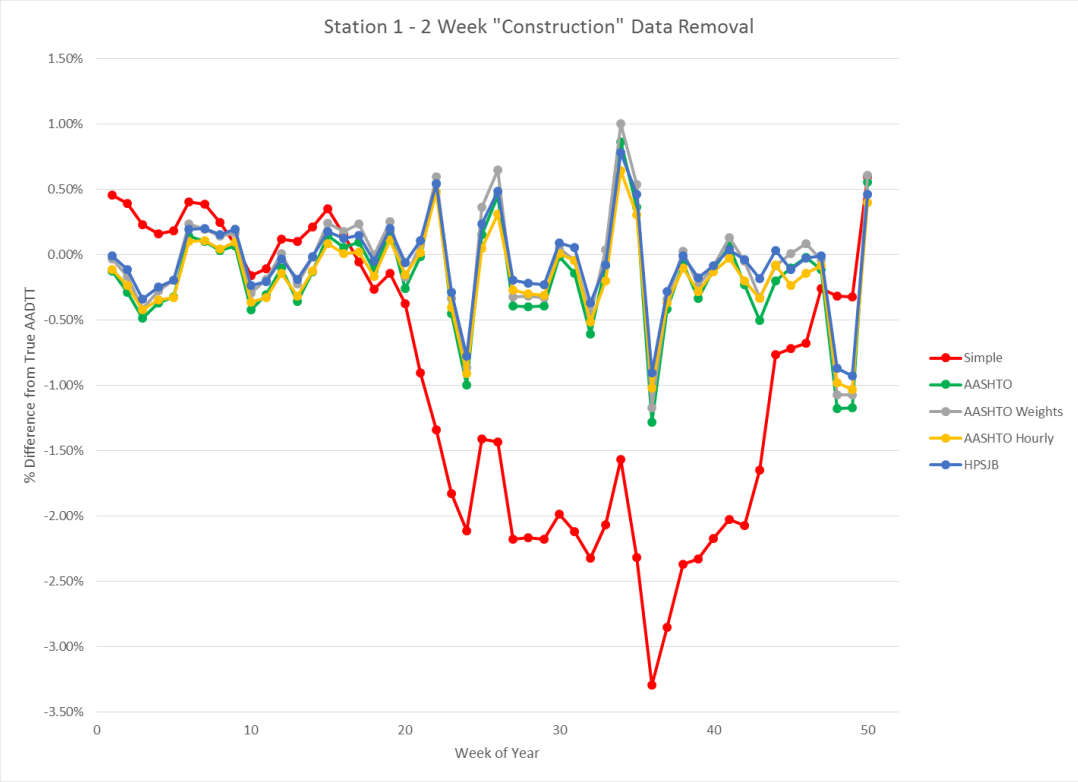
- Data removed for full 24 hours each day of the year
- Low volume obscures the apparent patterns



Illustrative Analysis Using Manitoba Data

Construction Scenario (St. 1):

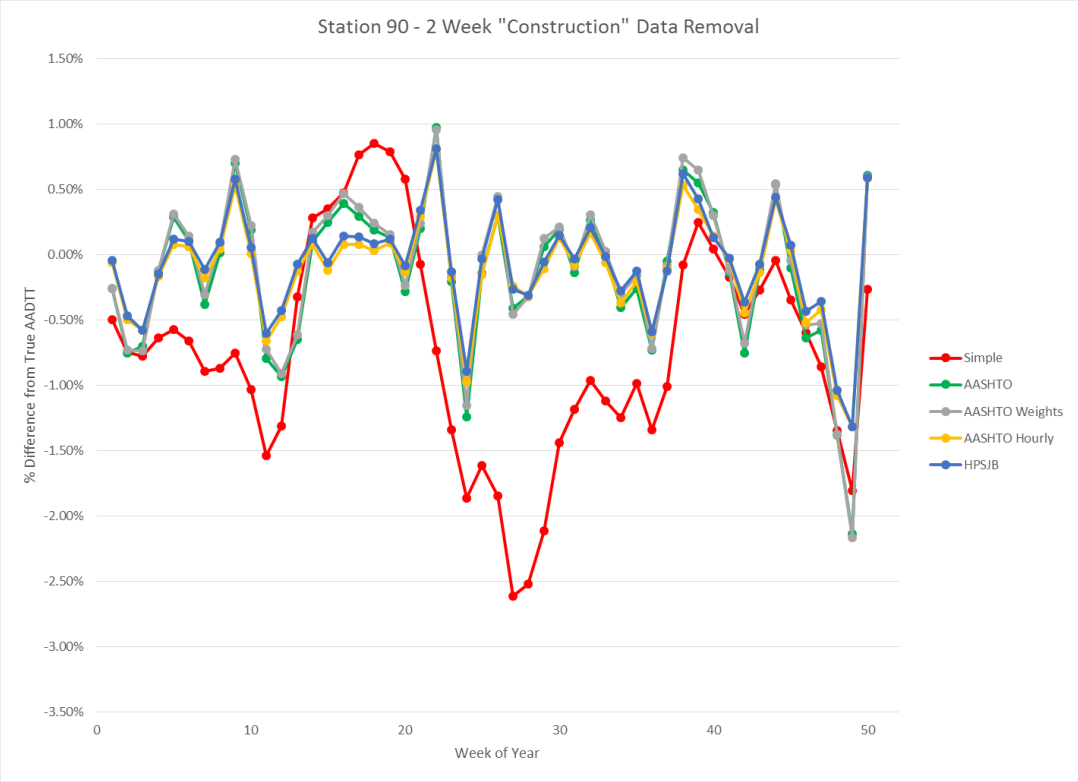
- Mon-Fri data removed from 7:00 AM- 5:00 PM for two weeks
- Generally, HPSJB performs best (but with exceptions)



Illustrative Analysis Using Manitoba Data

Construction Scenario (St. 90):

- Mon-Fri data removed from 7:00 AM- 5:00 PM for two weeks
- Generally, HPSJB performs best (but with exceptions)



Findings

- Research shows that HPSJB method improves accuracy of AADT when days are missing
  - Reduced bias
  - Improved confidence
  - Accuracy improvements are evident but in the order of 0-2% of true AADTT
- Expected addendum to FHWA Traffic Monitoring Guide
- Possible consideration in new Canadian guide for traffic monitoring (in progress)

Practical Implications

- Better utilization of continuous counters
  - Less data rejection
  - Inclusion of data from alternative sources (e.g., loops at traffic signals)
- Although accuracy improvements are small, they may be important in certain applications
  - Determining and applying traffic growth rates
  - Evaluating conditions of a warrant

Concluding Remarks

- AADT is the fundamental measure of traffic volume
- A new AADT formula has been proposed that provides a small improvement in accuracy and better reliability when missing days of data
- Changes in AADT calculations influence transportation engineering applications

References

- Federal Highway Administration (FHWA). *Assessing Roadway Traffic Count Duration and Frequency Impacts on Annual Average Daily Traffic (AADT) Estimation.* November 2014.
- American Association of State Highway and Transportation Officials (AASHTO). *AASHTO Guidelines for Traffic Data Programs*, page 5-7. 2009.
- FHWA.*Traffic Monitoring Guide.* September 2013.
- Vogt, Mark. *Analysis of the Impact of Count Duration and Missing Data on AADT Estimates in Manitoba.* 2015.
- Manitoba Highway Traffic Information System (MHTIS). *2014 Traffic Report*. 2015.

EST. 1877

UNIVERSITY OF MANITOBA